ANNUAL REPORT
वार्षिक प्रतिवेदन
2020

भाकृअनुप
ICAR

ICAR-NATIONAL RESEARCH CENTRE ON PIG

Rani, Guwahati-781 131, Assam

भा.कृ.अनु.प.-राष्ट्रीय शूकर अनुसंधान केन्द्र

राणी, गुवाहाटी-781 131, असम

राष्ट्रीय सूकर अनुसन्धान केन्द्र
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The Director
ICAR-NRC on Pig

Cover Page Theme:

The graphic depicts the Institute's research endeavour in understanding and promoting the research activities in the areas of scientific pig production, reproduction, nutrition, health management, clean pork production, value addition of pork and capacity building activities in the country. It also reflects the importance of piggery in providing sustainable livelihood and nutritional security to the rural poor in the country.

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Table of Contents

Contents	Page number
Message from The Director	v
Executive Summary	vii-xiv
Salient achievements during 2020	xv-xvi
Introduction	1-2
Priority Setting and Management	3
Expenditure Statement and Revenue generation	4
Organizational Setup	5
Physical progress	6-7
Research Projects	8-83
Out-Reach Programmes	84-87
AICRP & Mega Seed Project on Pig	88-94
Krishi Vigyan Kendra	95-118
NAIF Scheme : ITMU & ABI	119-126
Swachh Bharat Mission	127-132
Linkage and Collaboration of ICAR-NRC on Pig	133
Meetings and other activities	134-135
Celebrations	136-138
Hindi Cell	139-142
Training Programmes Organized	143-145
Awards and Recognitions	146-151
Human Resource Development	152-161
Research Programmes & Projects	162-164
Personnel	165-166
Publications	167-176

Message from The Director

In India, pigs are widely distributed in all the agro-climatic regions of the country and are an important occupation of the rural society especially the tribal masses and ethnic groups. Pig rearing fits in very well with mixed farming and can also be complimentary to intensive crop production operations. In India pig farming has a special significance as it can play an important role in improving the socio-economic status of a sizeable section of the weaker rural community. With the adoption of improved pig rearing practices under rural conditions, there will be significant increase in the income of some of the poorest people in the country who traditionally rear pigs. Pigs could provide direct and indirect employment to the people, the direct cash returns by sale of live pigs and pork, and the indirect returns in terms of manure and fuel. Scientific piggery could not only contribute towards piling-up of quality animal protein at affordable prices in India but also could help in achieving multiplying the income of farmers in short periods. In entrepreneurship point of view pig farming requires smaller investment and gives quick as well as high return.

Major issues concerned with slow pace of growth in the Indian piggery sector are reduced availability of quality breeding germplasm, poor growth rate of the indigenous breeds, lack of sound breeding programs, increase incidence of diseases, lack of post harvest infrastructure, lack of structured marketing channel etc. Thus, it is very much essential to undertake coordinated piggery development programs along with stakeholders to ensure nutrition and livelihood security to millions of people in the country.

During the last 18 years, ICAR-National research Centre on Pig is relentlessly working with the vision to bring in excellence in pig production, health and product processing through innovative research in order to provide technology backstopping for quality germplasm, enhanced pork production, employment generation and poverty reduction among socially and economically weaker sections through medium of pig husbandry. The Institute is coordinating 15 All India Coordinated Research Project on Pig and seven Megaseed centres on pig, located in different parts of the country. Krishi Vigyan Kendra (KVK) of the institute is actively been engaged in conducting several programmes for extension personnel of line departments, entrepreneurs and farmers

in different aspect of animal science, crop science, farm mechanization, fishery, home science, horticulture, plant protection, and soil and water conservation through training, OFTs and FLDs.

On human resource development front, the scientists and administrative staffs of the Institute were awarded/ honoured in various platforms.

I wish to express my sincere thanks and gratitude for the constant support and encouragement received from Dr. Trilochan Mohapatra, Hon'ble Secretary, DARE & Director General, ICAR and Dr. B.N. Tripathi, Deputy Director General (Animal Sciences). I am thankful to Dr. V. K. Saxena, ADG (AP&B), Dr. A.K. Tyagi, ADG (ANP), Dr. Ashok Kumar, Assistant Director General (Animal Health) and other staff of Animal Science Division, ICAR, Krishi Bhawan, New Delhi for their continuous support in facilitating the activities at Head Quarter.

It will be unfair not to put on record the untiring effort of the scientists and other staff of the Institute. Their hard work and dedication have been duly reflected in this report. I congratulate the entire team of the Editorial board for bringing out this report as per the schedule.

It is my privilege to present you the salient achievements of the Institute in the form of annual report 2020 for your perusal and critical comments. The report will serve as a reference to those in the field of scientific pig production and pork processing.

(Vivek Kumar Gupta)
Director

कार्यकारी सारांश

राष्ट्रीय शूकर अनुसंधान केंद्र, राणी, गुवाहाटी ने स्थापना के 18 साल सफलतापूर्वक पूरे किए हैं इस दौरान अनुसंधान केंद्र ने नॉर्थ ईस्ट किसानों, प्रसार कर्मियों, नीति निर्माताओं, शूकर पालन और पोर्क प्रसंस्करण से जुड़े उद्योगों में अपनी उत्कृष्टता कायम रखी है। वर्ष 2020 के दौरान, संस्थान ने 20 वैज्ञानिकों, 06 तकनीकी कर्मचारियों, 06 प्रशासनिक और लेखा कर्मियों के साथ काम किया। वित्तीय वर्ष के दौरान कुल योजना और गैर-योजना बजट का आवंटन 2324.18 लाख रूपए था। इस अवधि में संस्थान ने राजस्व के रूप में 124.00 लाख रुपये की आय अर्जित की। संस्थान के वैज्ञानिकों ने अधिदेश के अनुसार छह प्रमुख कार्यक्रमों के तहत परिभाषित अनुसंधान और विस्तार से संबंधित विभिन्न लक्ष्यों को प्राप्त करने के लिए अथक प्रयास किया।

पशु आनुवंशिकी और प्रजनन

रानी क्रॉस का जेनरेशन-वाइज जेनेटिक इवैलुएशन का अध्ययन 8 पीढ़ियों के लिए किया गया और पाया गया कि रानी क्रॉसब्रेड की नस्ल के पात्रों को कई पीढ़ियों के लगातार क्रॉस वंशवृद्धि के लिए स्थिर किया गया। नॉर्थ ईस्ट इंडिया के देशी शूकरों के शूकर माइटोकॉन्ड्रियल जीनोम अनुक्रमों के वंशावली विश्लेषण से पता चला है कि पूर्वोत्तर के देशी शूकर केवल हाल ही में एक-दूसरे से विचलित हुए और विदेशी यूरोपीय शूकरों से अलग थे। परिणाम से यह भी पता चला कि भारतीय जंगली शूकर का अन्य सभी घरेलू शूकरों के साथ दूर का आनुवांशिक संबंध था। शूकर की एमएसवाई जीन (Y गुणसूत्र के नर -विशिष्ट क्षेत्र) के लक्षण वर्णन और जीन अभिव्यक्ति पर काम किया गया। शूकर में नर-विशिष्ट जीन को फिर से खोजकर और इन प्रजननों के अभिव्यक्ति पैटर्न को नर प्रजनन ऊतकों में और साथ ही शरीर के अन्य ऊतक पैनल को शूकर की प्रजनन क्षमता के साथ जोड़ने के लिए चिह्नित किया गया। यह भी देखा गया कि इन्फ्रारेड थर्मोग्राफी का उपयोग मद में शूकरों के वुल्वार त्वचा के तापमान की निगरानी और विकास के लिए किया जा सकता है। स्वदेशी शूकर की नस्लों के आणविक लक्षण वर्णन को माइक्रोसैटेलाइट प्राइमरों और एकल न्यूक्लियोटाइड बहुरूपताओं का उपयोग करके किया गया है। एफएसएचव, लेप्टिन, ईएसआर 1, ईएसआर 2, लेप्टिन रिसेप्टर (एलईपीआर) जीन के बाहरी क्षेत्रों में देशी शूकरों में प्रजनन लक्षणों के साथ इन साइटों पर बहुरूपता का पता लगाने के लिए प्रवर्धित किया गया ।

पशु पोषण

शूकर के भोजन में मक्का का अमरूद के साथ प्रतिस्थापन ने संकेत दिया कि आहार में अमरूद के फलों के अपशिष्ट के स्तर में वृद्धि के साथ औसत शुष्क पदार्थ का सेवन और पोषक तत्वों की पाचन क्षमता बढ़ गई । उपचार समूहों में नाइट्रोजन संतुलन (जी / डी) सकारात्मक पाया गया। इस अध्ययन से, यह निष्कर्ष निकाला गया है कि बेहतर पोषक तत्वों के उपयोग के लिए उत्पादकों में क्रॉस ब्रेड शूकरों में अमरूद के अपशिष्ट को 10% के स्तर पर पूरक किया जा सकता है और फ़ीड लागत को कम की जा सकती है। केले के तने और मक्का के चारे का उपयोग करके अपशिष्ट आधारित सिलेज तैयार किया गया और इसकी स्वीकार्यता शूकरों में शरीर के विकास और प्रभाव का अध्ययन किया गया।

पशुधन उत्पादन और प्रबंधन

शूकरों के एथोग्राम विकास और कल्याण मूल्यांकन शुरू किए गए । भोजन के तुरंत बाद लेटने की स्थिति से अधिक समय व्यतीत होता है। विदेशी नस्ल ने क्रॉसब्रेड (रानी) वीन पिगलेट की तुलना में लेटने की स्थिति में अधिक समय बिताया। पिगलेट्स के शुरुआती जीवन में, सूक्ष्मजीव शरीर के तापमान को सूक्ष्म पर्यावरणीय तापमान के साथ सकारात्मक रूप से सहसंबद्ध किया जाता है। उम्र के साथ नवजात पिगलेट्स का मलाशय तापमान बढ़ गया। इसके अलावा, यह देखा गया कि पिगलेट्स के लिंग का खड़े और लेटने की व्यवहार पर कोई महत्वपूर्ण प्रभाव नहीं पड़ता है।

पशु प्रजनन

अनुसंधान कार्यों ने संकेत दिया कि एंड्रोहेप और जीईपीएस एक्सटेंडर में विस्तारित शूकर वीर्य को संरक्षण के 48 घंटे तक प्रसार के लिए इस्तेमाल किया जा सकता है और केवल एंड्रोहीप एक्सटेंडर में 17^0C के संरक्षण के लिए 96 घंटे तक ए.आई. के लिए उपयोग करने की क्षमता है। शूकरों में कृत्रिम गर्भाधान हेतु कुल 06 विशिष्ट प्रशिक्षण कार्यक्रम और कृत्रिम गर्भाधान में

6 जागरूकता कार्यक्रम आयोजित किए गए। रिपोर्ट की गई अवधि के दौरान 111 नए किसानों को स्व-रोजगार सृजन के लिए और लगभग 400 किसानों ने राष्ट्रीय शूकर अनुसंधान केंद्र द्वारा आपूर्ति किए गए तरल वीर्य के साथ कृत्रिम गर्भाधान द्वारा अपने शूकरो में प्रजनन करवाया। शूकर जेल के जैव रासायनिक लक्षण वर्णन और शूकरों में जैव-उत्तेजना के लिए अध्ययनों से संकेत मिलता है कि शूकर का जेल मादा में एस्ट्रस और सिंक्रनाइज़ेशन को प्रेरित करने और नर में कृत्रिम गर्भाधान उद्देश्य के लिए नर के प्रशिक्षण के लिए इस्तेमाल किया जा सकता है। इसके अलावा, यह देखा गया कि सेमिनल जेल और लार के संयोजन से नर के प्रशिक्षण के लिए अकेले जेल की तुलना में अधिक तीव्र बायोस्टिम्यूलेशन प्रभाव पड़ता है और साथ ही मादा में एस्ट्रस का समावेश होता है।

पशु शरीर क्रिया विज्ञान

विभिन्न मौसमों के दौरान गर्मी के तनाव में फिजियो-जीनोमिक प्रतिक्रियाओं और एमसीटी प्रोफाइलिंग को समझने के लिए त्रिपुरा के स्वदेशी शूकर अर्थात माली नस्ल में शोध कार्य किया गया है। ऊष्मा-सहिष्णु शूकर के विकास पर अनुसंधान कार्य के तहत बायोमाकर सहायता प्राप्त चयन के माध्यम से हीट शॉक ट्रीटेड और कंट्रोल सेल्स से पृथक आरएनए को पूरे ट्रांसक्रिप् टम विश्लेषण के अधीन किया गया। जैव सूचना विज्ञान विश्लेषण ने संकेत दिया कि गर्मी के झटकों के दौरान विशेष रूप से प्रोटीन कोडिंग RNAs की संख्या में महत्वपूर्ण अंतर होता है। इसके अलावा, इम्यूनोफ्लोरेसेंस प्रयोगों को हीट शॉक प्रतिक्रिया के दौरान हिस्टोन एच 3 प्रोटीन के 4 वें लाइसिन अवशेष में त्रि-मेथिलेशन की भूमिका को समझने के लिए भी किया गया। गर्मी के झटके की प्रतिक्रिया संकेतन के दौरान जीन की अभिव्यक्ति प्रोफ़ाइल और इन विट्रो ट्रांसक्रिप्टोमिक परिवर्तनों के लिए जानवरों की स्क्रीनिंग के आधार पर, उच्च गर्मी सहिष्णुता वाले जानवरों को आगे प्रयोग के लिए उपयोग किया जाएगा। इसके अलावा, शूकरों में गर्मी के तनाव के दौरान शारीरिक प्रतिक्रियाओं के माइक्रोएएनए ने मध्यस्थता विनियमन का अध्ययन किया। अध्ययन के दौरान 336, 84 और 10 miRNA को छोटे आरएनए अनुक्रमण, आरआईपी के साथ अरगोनाट प्रोटीन 2 (एजीओ 2) एंटीबॉडी और डिग्रेडोम अनुक्रमण का उपयोग करके पहचाना गया। अध्ययन के दौरान कुल मिलाकर 396 miRNAs ज्ञात और उपन्यास miRNAs की पहचान की गई। इसके अलावा, कुल 27881 और 27997 लिपियों में क्रमश: कम और उच्च प्रजनन क्षमता वाले शूकर जीन पाए गए। उच्च प्रजनन क्षमता वाले जानवरों के लिए अद्वितीय 979 जीनों के साथ 27018 आम जीन थे। मादा शूकर में एस्ट्रस चक्र के दौरान कॉर्पस ल्यूटियम के विभिन्न विकास चरणों के ट्रांसक्रिपटोम प्रोफाइलिंग ने हब जीनों का पता लगाया जो कि विभिन्न कोशिकीय कार्यों से जुड़े पाए गए। उम्मीदवार जीन की पहचान की गई, जिसमें ल्यूटियल एंजियोजेनेसिस, स्टेरॉइडोजेनेसिस, ल्यूटोलिटिक संवेदनशीलता और प्रतिगमन के साथ शामिल सिग्नलिंग मार्ग को नियंत्रित करके ल्यूटल फ़ंक्शन को नियंत्रित करने में निश्चित भूमिका हो सकती है।

पशु स्वास्थ्य

असम के संगठित और असंगठित शूकर पालकों के यहाँ से मल, नाक की सूजन और ऊतक के कुल 232 नमूनों एकत्र किए गए ताकि शूकरों की नवजात मृत्यु दर से जुड़े जीवों को अलग किया जा सके जैसे स्ट्रेप्टोकोकस सूइस, पास्तिला मल्टीकोसिडा, ई.कोलाई और मेथिसिलिन प्रतिरोधी स्टैफिलोकोकस ऑरियस (MRSA)। असम के शूकरों से अलग MRSA ने 2020 में संयुक्त राज्य अमेरिका से मानव द्वारा MRSA के साथ 100% समानता का खुलासा किया, 2020 में चीन से मानव का MRSA, 2015 में चीन से शूकर का MRSA और 2020 और MRSA ने 2010 में रिपोर्ट किया। पोर्सिन सर्कोवायरस टाइप -II (पीसीवी -2)) का पता लगाने के लिए LAMP परख, पोर्सिन परवोवायरस (पीपीवी) का पता लगाने के लिए LAMP परख, पोर्सिन सर्कोवायरस -2 (पीसीवी -2), पोर्सिन परवोवायरस (पीपीवी) और क्लासिकल स्वाइन फीवर वायरस (सीएसएफवी) का पता लगाने हेतु कीट विकसित की गई। टायफोनियम ट्रिलोबाटम स्कूट ट्युबेर एक्सट्रैक्ट ने विकास और महत्वपूर्ण बैक्टीरियल रोगजनकों के निषेध के क्षेत्र में यह देखा गया कि 300 और 500 मिलीग्राम / एमएल पर अर्क ज्यादातर बैक्टीरिया की प्रजातियों से जुड़े श्वसन संक्रमण के उपचार का विकल्प हो सकता है। परियोजना की अवधि के दौरान JEV एंटीबॉडी का पता लगाने के लिए असम के नौ JEV स्थानिक जिलों से कुल 3236 फ़ील्ड सीरा नमूनों की जांच की गई। जून-जुलाई के दौरान एकत्र नमूनों में मई-जून के दौरान जेईवी एंटीबॉडी का उच्चतम प्रसार दर्ज किया गया था। पोर्सन प्रजनन और श्वसन सिंड्रोम वायरस के इम्युनोजेनिक प्रोटीन की नैदानिक क्षमता की अभिव्यक्ति और मूल्यांकन के अनुसंधान कार्य के तहत, PRRSV के लक्षित न्यूक्लियोकैप्सिड (N), मैट्रिक्स (रू) और ग्लाइकोप्रोटीन -5 (GP-5 या ORF-5) जीन पीसीआर नैदानिक नमूनों से प्रवर्धित किया गया। तीनों (N, रू और ORF-5) जीनों को pJET1.2 में क्लोन किया गया है। क्लोन वेक्टर और पॉजिटिव क्लोन की पुष्टि कॉलोनी / पीसीआर या टच-अप पीसीआर और सिक्वेंसिंग द्वारा की गई थी। वर्तमान अध्ययन समूहों में भारतीय, उत्तरी अमेरिकी वंश या जीनोटाइप- II

में यूरोपीय एक या जीनोटाइप- I से अलग है। OfPRRS के शुरुआती पता लगाने के लिए CD163 होस्ट रिसेप्टर आधारित सीरो-डायग्नोस्टिक के विकास पर अध्ययन, PRRSV डॉकड साइट पोरसीन 163 होस्ट रिसेप्टर की पहचान की। यह भी देखा गया कि पोर्सिन सीडी 163 होस्ट रिसेप्टर के एक्सॉन 7, PRRSV के ग्लाइकोप्रोटीन 4 (GPy) (जो ग्लाइकोप्रोटीन 2a / GPwa के साथ जटिल है) के साथ संचार कर सकता है। इसके अलावा, डॉक न्यूक्लियोटाइड अनुक्रम को विभिन्न भारतीय शूकर नस्लों से प्रवर्धित किया गया था जैसे घुंघरू, माली, न्यांग मेघा और लार्ज व्हाइट यॉर्कशायर। पोर्सिन परवोवायरस (पीपीवी) के आणविक और सीरोलॉजिकल डिटेक्शन पर शोध परियोजना के तहत, पोलिस परवोवायरस के खिलाफ एंटीबॉडी का पता लगाने के लिए 88 सीरम की जांच की गई। एलिसा में कार्यरत पीपीवी की सीरो-प्रचलन दर (20/59) और असंगठित झुंड (23/23) 29) क्रमश: 33.89% और 79.31% थी। शूकरों के आंतों के प्रोटोजोअन परजीवी रोगों की महामारी विज्ञान के लिए मल के नमूनों के विश्लेषण से पता चला है कि आंतों के प्रोटोजोआ संक्रमण की घटनाओं को खत्म करने वालों की तुलना में वयस्कों में अधिक था। इसके अलावा, सर्दियों में संक्रमण की दर गर्मियों के महीनों की तुलना में अधिक थी, जो इस क्षेत्र में सर्दियों के दौरान नमी की उपस्थिति और सर्दियों के दौरान जानवरों की बाधा के कारण अधिक हो सकती है, संक्रमण के अधिग्रहण और प्रसार की संभावना भी अधिक होती है।

पशुधन उत्पाद प्रौद्योगिकी

कार्यात्मक पोर्क उत्पादों को खाने के लिए तैयार पोर्क को स्वास्थ्य के प्रति जागरूक उपभोक्ताओं की जरूरतों को पूरा करने के लिए महत्वपूर्ण अवयवों के साथ विकसित किया गया। विभिन्न स्थानीय रूप से उपलब्ध खाद्य सामग्री अर्थात, बांस शूट, किण्वित बांस शूट, स्टार फल आदि को बढ़ाया एंटीऑक्सिडेंट और एंटी-माइक्रोबियल गुणों को प्राप्त करने के लिए उत्पाद तैयार करने में शामिल किया गया। विभिन्न प्रसंस्करण मापदंडों का अनुकूलन करने के लिए अनुसंधान कार्य किया गया है। जैसे नमक, एकाग्रता, जल गतिविधि, पीएच (अम्लता)। तापमान और पैकेजिंग की स्थिति चयनित खाद्य जनित रोगजनकों (साल्मोनेला एसपीपी, लिस्टेरिया एसपीपी और यर्सिनिया एसपीपी) को निष्क्रिय करने के लिए पारंपरिक पोर्क उत्पादों सहित पोर्क उत्पादों को विकसित किया गया। पोर्क और प्रसंस्कृत पोर्क उत्पादों में उनकी घटना को रोकने के लिए जोखिम शमन रणनीति फार्म-टू-फोर्क पोर्क आपूर्ति श्रृंखला से जुड़े खतरों की जोखिम रूपरेखा तैयार की गई है और सुरक्षा हस्तक्षेप विकसित करने की दिशा में खतरों और प्रसंस्करण प्रथाओं पर एक डेटाबेस विकसित किया। एफसीएआई सूचीबद्ध रोगजनक बैक्टीरिया का पता लगाने के लिए डीसीआर आधारित तरीके विकसित किए गए और मान्य किए गए जैसे साल्मोनेला एंटरिटिडिस; साल्मोनेला टाइफिमुरियम; साल्मोनेला कोलेरेरस; ई। कोलाई 0157: H 7, कॉम्पाइलोबैक्टीरियजुनी, लिस्टेरिया मोनोसाइटोजेन्स और येरसिनिया एंटरोकोलिटिका। कीटनाशक अवशेषों का पता लगाने के लिए विकसित और मान्य मल्टी-अवशेष तरीके को एलसी एमएस / एमएस का उपयोग करते हुए मांस के नमूनों में कार्बोफ्यूरान, मैलाथियोन, डाइमेथोएट, क्लोरपाइरीफोस, डायज़िनोन और डाइक्लोरोवोस पता लगाया गया। खाद्य गुणवत्ता प्रबंधन डेटाबेस को ट्रैसबिलिटी के साथ विश्लेषणात्मक नमूनों को संभालने के लिए डिज़ाइन और विकसित किया गया है।

प्रसार शिक्षा

दो शैक्षिक तकनीकी बुलेटिन (असमिया) और एक वीडियो (अंग्रेजी, हिंदी और असमिया) हितधारकों के लिए वैज्ञानिक शूकर उत्पादन प्रक्रियाओं पर तैयार किया गया। प्रश्नावली में तैयार 30 वस्तुओं के लिए आइटम विश्लेषण किया गया। आइटम कठिनाई सूचकांक और भेदभाव सूचकांक के आधार पर, ज्ञान परीक्षण के लिए 15 वस्तुओं का चयन किया गया । आदिवासी महिलाओं की स्थायी आजीविका के लिए उत्तर पूर्व भारत में पोर्क विपणन श्रृंखला पर परियोजना कार्य के तहत असम में पोर्क उत्पादन की प्रवृत्ति को समझने के लिए डेटा का विश्लेषण किया गया । 10 वर्षों (2007-08 से 2016-17) के उपलब्ध आंकड़ों के आधार पर, असम में पोर्क उत्पादन के लिए मिश्रित वार्षिक विकास दर (CAGR) 5.3% के रूप में अनुमानित की गई थी। हर साल असम में कुल पोर्क उत्पादन में 5.3% की वृद्धि हुई है।

अखिल भारतीय शूकर समन्वित अनुसंधान और मेगा बीज परियोजना

संस्थान ने शूकर परियोजना (15 केंद्र) पर एआईसीआरपी की प्रगति और शूकर पालन पर मेगा बीज परियोजना (07 केंद्र) की नियमित निगरानी जारी रखी। अंतिम समीक्षा बैठक भा.कृ.अनु.प.-आर.सी.एन.ई.एस., उमियाम, बारापानी में 27-28 सितंबर, 2019 को आयोजित की गई । क्षेत्र विकसित करने के लिए, अलग-अलग जलवायु परिस्थितियों में शूकरों के प्रदर्शन का अध्ययन करने के लिए देश भर के विभिन्न केंद्रों में परियोजना जारी है। गुणवत्ता जर्मप्लाज्म सहित प्रक्रियाओं का विशिष्ट पैकेज और स्वदेशी जर्मप्लाज्म का संरक्षण करना उद्देश्य है। शूकर पर मेगा बीज परियोजना के तहत, बारहवीं योजना अवधि के दौरान

वितरण के लिए उन्नत किस्म के कुल 18027 पिगलेट का उत्पादन किया गया। 2018–19 में वितरण के लिए 4103 क्रमश: विभिन्न प्रकार के पिगलेट का उत्पादन किया गया।

कृषि विज्ञान केंद्र (KVK)

वर्ष के दौरान प्रतिभागियों के 2858 संख्या को कवर करते हुए कुल 99 प्रशिक्षण कार्यक्रम आयोजित किए गए। कृषि विज्ञान केंद्र गोलपारा ने नव सृजित कृषि प्रौद्योगिकियों पर 13 कृषि परीक्षणों का आयोजन किया है। सूचित अवधि के दौरान एफएलडी और तीन सीएफएलडी की दस संख्याएँ आयोजित की गईं। के.वी.के सक्रिय रूप से NARI (पोषण संवेदनशील कृषि संसाधन और नवाचार) कार्यक्रम, ग्रामीण कृषि सेवा सेवा / DAMU कार्यक्रम और फार्मर प्रोड्यूसर्स ऑर्गनाइजेशन (FPO) के गठन के तहत गतिविधियों को कार्यान्वित करता है। शूकर पर कृषक समृद्धि परियोजना और एआईसीआरपी पर काम किया गया। अंतराष्ट्रीय महिला दिवस, विश्व पर्यावरण दिवस और राष्ट्रीय पाहन माँ का उत्सव आयोजित किया गया।

अन्य

संस्थान ने नियमित रूप से अनुसंधान सलाहकार और संस्थान अनुसंधान समिति की बैठकें आयोजित की हैं। संस्थान ने गणतंत्र दिवस, स्वतंत्रता दिवस, हिंदी पखवाड़ा, संस्थान स्थापना दिवस और विश्व पर्यावरण दिवस जैसे विभिन्न आधिकारिक कार्यों का भी अवलोकन किया। मनोरंजन क्लब द्वारा कर्मचारियों के लिए विभिन्न सामाजिक कार्यक्रम भी आयोजित किए गए। महात्मा गांधी के 'स्वच्छ भारत' के सपने को साकार करने की दिशा में काम करने के संकल्प के साथ संस्थान नियमित रूप से 'स्वच्छ भारत अभियान' के तहत गतिविधियों का संचालन कर रहा है। कार्यालय और परिसर के क्षेत्र को स्वच्छ और पर्यावरण के अनुकूल बनाए रखने के लिए कई पहल की गईं। इसके अतिरिक्त, किसानों के लाभ के लिए वैज्ञानिक विशेषज्ञता का विस्तार करने के लिए, संस्थान ने भारत सरकार के आदिवासी उप योजना और अनुसूचित जाति उप योजना योजनाओं को लागू किया।

Executive Summary

The ICAR-National Research Centre on Pig has successfully completed 18 years since inception and continued its excellence in catering the farmers, extension workers, policy makers and industries associated with pig farming and pork processing. During the year 2020, the Institute functioned with 20 scientists, 06 technical staff and 06 administrative and accounts personnel. The total plan and non-plan budget allocations were 2324.18 lakh during the financial year. The institute has generated Rs 124.00 lakh as revenue during the period. The scientists of the Institute relentlessly worked for achieving various targets related to research and extension, defined under the six major programmes as per the mandate.

Animal Genetics and Breeding

Generation-Wise Genetic Evaluation of Rani Crosses was studied for 8 generations and was found that breed characters of Rani Crossbred was stabilized for consistent crossbreeding of several generations. Phylogenetic analysis of Pig mitochondrial genome sequences of native pigs of North East India, revealed that native pig of Northeast was only recently diverged from each other and distinctly different from exotic European pigs. The result also revealed that Indian wild boar had a distant genetic relationship with all other domestic pigs. Research work on 'characterization and expression profiling of Pig MSY (male-specific region of the Y chromosome) genes for boar fertility' identified twelve MSY genes thereby rediscovering the male-specific genes in Pig and partially characterise the expression pattern of these genes in male reproductive tissues as well as other body tissue panel to link them with boar fertility. It was also observed that infrared thermography can be used a diagnostic tool to monitor and evolution of the vulvar skin temperature of pigs in oestrus and not in oestrus. The molecular characterisation of indigenous pig breeds has been carried out using microsatellite primers and the Single nucleotide polymorphisms in exonic regions of FSHβ, Leptin, ESR1, ESR2, Leptin Receptor (LEPR) genes were amplified to detect polymorphism at these sites for association with reproduction traits in indigenous pigs.

Animal Nutrition

Replacement of maize in the pig feed with guava (*Psidium guajava*) fruit waste indicated that the average dry matter intake and digestibility coefficients of nutrients were increased with increased level of guava fruit waste in the diet. Nitrogen balance (g/d) was found positive across the treatment groups. From this study, it is concluded that guava fruit waste can be supplemented at 10 % level in grower crossbred pigs for better nutrient utilization and also to reduce the feed cost. Vegetable waste based silage was prepared using banana stem and maize fodder and its acceptability by pigs and effect on body growth in pigs was studied.

Livestock Production and Management

Ethogram development and welfare assessment of growing pigs were initiated. Immediately-weaned piglets spent more time in standing position than lying condition in the post-feeding period. The exotic breed spent more time in lying conditions than as compared to crossbreed (Rani) weaned piglets. In the early life of piglets, the diurnal core body temperature is positively correlated with micro-environmental temperature. The rectal temperature of neonatal piglets increased with the age. Also it was observed that the days of weaning and sex of piglets have no significant effect on the standing and lying behaviour.

Animal Reproduction

The research works indicated that boar semen extended in Androhep and GEPS extender can be used for insemination up to 48h of preservation and only Androhep extender has the

potential to use for AI up to 96h of preservation at 17^0C. A total of 06 specific training programmes and 6 awareness programmes on AI in pigs were conducted. During the reported period 111 new farmers were trained as inseminators for selfemployment generation and about 400 farmers have bred their sows by artificial insemination with liquid semen supplied by ICAR- NRC on Pig, Rani. The studies on biochemical characterization of boar seminal gel and its application for bio-stimulation in pigs indicated that seminal gel can be used to induce estrus and synchronization in females and training of males for artificial insemination purpose in swine. Also, it was observed that combination of seminal gel and saliva has more intense biostimulation effect than gel alone for training of males as well as induction of estrus in gilts and sows.

Animal Physiology

Research work has been carried out in indigenous pig breed of Tripura i.e. Mali to understand the physio-genomic responses and MCT profiling in heat stress during different seasons. The RNA isolated from heat shock treated and control cells, under the research work on development of thermo-tolerant pig through biomarker assisted selection, were subjected to whole transcriptome analysis. The bioinformatics analysis indicated that significant difference in the number of transcripts, especially protein coding RNAs during heat shock. Further, immunofluorescence experiments were also conducted to understand role of tri-methylation at the 4th lysine residue of the histone H3 protein during heat shock response. Based on the screening of animals for expression profile of genes and in vitro transcriptomic changes during heat shock response signaling, the animals with higher heat tolerance will be used for further experimentation. Further, MicroRNA mediated regulation of physiological responses during heat stress in pigs was studied. During the study 336, 84 and 10 miRNA were identified using small RNA sequencing, RIP with Argonaute protein 2 (AGO2) antibody and degradome sequencing. Overall, 396 miRNAs known and novel miRNAs were identified during the study. In addition, a total of 27881 and 27997 transcripts were detected in boars with low and high fertility, respectively. There were 27018 common genes with 979 genes unique to animals with high fertility. The transcriptome profiling of different developmental stages of corpus luteum during estrous cycle in porcine revealed hub genes which were found to be associated with diverse cellular functions. Novel candidate genes were identified, which may have definite role in controlling luteal function by modulating signalling pathway involved with luteal angiogenesis, growth, steroidogenesis, luteolytic sensitivity and regression.

Animal Health

A total number of 232 samples *viz.* faecal, Nasal swab and tissue samples were collected from from organised and unorganised pig farms of Assam to isolate the organisms associated with neonatal mortality of pigs and could isolate *Streptococcus suis*, *Pasteurella multocida*, *E. coli* and methicillin resistant *Staphylococcus aureus* (MRSA) from pre-weaned/stillborn pig samples. MRSA isolated from pigs of Assam revealed 100% similarity with MRSA from Human reported from USA in 2020, MRSA from Human reported from China in 2020, MRSA from Pig reported from China in 2015 and 2020 and MRSA reported in 2010. A number of diagnostic kits were developed which include LAMP assay for detection of Porcine Circovirus Type –II (PCV-2), LAMP assay for detection of Porcine Parvovirus (PPV), MULTIPLEX PCR assay for simultaneous detection of Porcine Circovirus -2 (PCV-2), Porcine Parvovirus (PPV) and Classical Swine Fever Virus (CSFV).

The *Typhonium trilobatum schott* tuber extract showed inhibition of growth and zone of inhibition of important bacterial pathogens and it was observed that at 300 and 500mg/ml the extract could be the choice of treatment of respiratory infections of pigs mostly associated with the bacterial species. A total of 3236 field sera samples from nine JEV endemic districts of Assam were screened for detection of JEV antibodies during the project period. Highest prevalence of JEV antibodies were recorded in samples collected during June-July followed by May-June.

Under the research work on expression and evaluation of diagnostic potential of immunogenic proteins of porcine reproductive and respiratory syndrome virus, the targeted Nucleocapsid (N), Matrix (M) and Glycoprotein-5 (GP-5/ORF-5) genes of the PRRSV were PCR amplified from the clinical samples. All the three (N, M and ORF-5) genes have been cloned in the pJET1.2 cloning vector and positive clones were confirmed by colony/PCR or touch-up PCR and sequencing. The isolate in the present study clusters with other Indian isolates in the North American lineage or Genotype-II distinct from the European one or Genotype-I. The studies on development of CD163 host receptor based sero-diagnostic for early detection of PRRS, identified the PRRSV docked site at porcine CD163 host receptor. It was also observed that exon 7 of porcine CD163 host receptor can interact with glycoprotein 4 (GP4) (which complexed with glycoprotein 2a/GP2a) of PRRSV. Further, the docked nucleotide sequence was amplified from different Indian Pig breeds viz. Ghungroo, Mali, Nyang Megha and Large White Yorkshire.

Under the research project on molecular and Serological detection of Porcine Parvovirus (PPV), 88 Serum was screened for detection of antibodies against Porcine Parvovirus employing ELISA.The sero-prevalence rate of PPV in organized (20/59) and unorganized herd (23/29) were 33.89 % and 79.31% respectively. Analysis of faecal samples for epidemiology of Intestinal protozoan parasitic diseases of pigs revealed that the incidence of intestinal protozoan infection was higher in adults than in the finishers. Also, infection rate in winter was higher than that of summer months, which may be due to the presence of humidity during winters in the region and moreover due to hurdling of animals during winter the chances of acquiring and propagation of infection is also much higher.

Livestock Products Technology

Pork based ready to eat functional pork products was developed through the addition of critical ingredients to cater the needs of the health-conscious consumers. Different locally available food ingredients viz. bamboo shoot, fermented bamboo shoot, star fruit etc. were incorporated in the product formulation to achieve enhanced antioxidant and anti-microbial properties. Research work has been carried out to optimize the different processing parameters viz. NaCl concentration, water activity (aw), pH (acidity), temperature and packaging conditions to inactivate the selected food borne pathogens (Salmonella spp., Listeria spp. and Yersinia spp.) in value added pork products including traditional pork products and to develop risk mitigation strategy (ies) to prevent their occurrence in pork and processed pork products. Farm-to-Fork Risk profiling of hazards associated with pork supply chain has been carried out and developed a database on hazards and processing practices towards developing food safety interventions to reduce these hazards. PCR based methods were developed and validated for detection of FSSAI listed pathogenic bacteria viz. *Salmonella* Enteritidis; *Salmonella* Typhimurium; *Salmonella* Cholerasuis; *E. coli* O157:H7, *Compylobacter jejuni*, *Listeria monocytogenes*, and *Yersinia enterocolitica*. Developed and validated multi-residue methods for detection of pesticide residues viz. Carbofuran, Malathion, Dimethoate, Chlorpyrifos, Diazinon and Dichlorvos in meat samples using LC MS/MS. Food Quality Management Database has been designed and developed for handling the analytical samples with traceability.

Extension

Two educational tools viz. technical bulletin (Assamese) and a video (English, Hindi and Assamese) was prepared on scientific pig production practices for the stakeholders. Item analysis was carried out for the prepared 30 items in the questionnaire. Based on the item difficulty index and discrimination index, 15 items were selected for the knowledge test. Under the project work on Pork marketing chains in North East India for sustainable livelihood of tribal women, the data was analyzed for understanding the trend of pork production in Assam. Based on the available data for 10 years (2007-08 to 2016-17), the Compound Annual Growth Rate (CAGR) for pork production

in Assam was estimated as 5.3 %. That is every year there is an increase of 5.3 % in total pork production in Assam.

AICRP and Mega Seed on Pig

The Institute continued regular monitoring of the progress of AICRP on Pig project (15 centers) and Mega seed project on pig (07 centers) through technical and financial monitoring in consultation with the council and conduction of review meet. The last AICRP review meet was conducted at ICAR-RCNEH, Umiam, Barapani on 27-28th September, 2019. The AICRP project is continuing in different centers across the country to study the performance of pigs in different agro-climatic condition, to develop region-specific package of practices including quality germplasm and to conserve the indigenous germplasm. Under mega seed project on pig, total 18027 piglet of improved variety were produced for distribution during XIIth Plan Period. A total of 4403 nos. of improved variety of piglets were produced for distribution in 2018-19, respectively.

Krishi Vigyan Kendra (KVK)

A total of 99 training programmes were conducted covering 2858 number of participants during the year. The Krishi Vigyan Kendra Goalpara has conducted 13 On farm Trial on newly generated agricultural technologies. Ten numbers of FLDs and three CFLDs were conducted during the reported period. KVK is actively implemented the activities under NARI (Nutrition Sensitive Agriculture Resources and innovations) programme, Gramin Krishi Mausam Sewa/ DAMU Programme and Formation of Farmer Producers Organization (FPO). Work on Krishak Samridhi Project and AICRP on Pig was carried out. Celebration of International Women's Day, World Environment Day and Rashtriya Poshan Maah was organized.

Others

The Institute has conducted meetings of Research Advisory and Institute Research committee regularly. The Institute also observed various official functions such as Republic Day, Independence Day, Hindi Pakhwada, Institute Foundation Day and World Environment Day. Various social events were also organized by the Recreation Club for the staff. The Institute is regularly conducting activities under "Swachh Bharat Abhiyan" with the resolution to work towards realizing the Mahatma Gandhi's dream of "Swachh Bharat". Various initiatives were taken to maintain the office and campus premises clean and environment friendly. Additionally, to extend the scientific expertise for the benefit of farmers, the Institute has implemented Mera Gaon Mera Gaurav, Tribal Sub Plan and SC Sub Plan Schemes of Govt . of India.

Salient Achievements During 2020

1. Generation-Wise Genetic Evaluation of Rani Crosses was studied for 8 generations and was found that breed characters of Rani Crossbred was stabilized for consistent crossbreeding of several generations.
2. Phylogenetic analysis of Pig mitochondrial genome sequences of native pigs of North East India, revealed that native pig of Northeast was only recently diverged from each other and distinctly different from exotic European pigs.
3. Guava fruit waste can be used to replace of maize at 10 % level in in grower crossbred pig's ration for better nutrient utilization and to reduce the feed cost.
4. Ethogram development and welfare assessment of growing pigs indicated that in the early life of piglets, the diurnal core body temperature is positively correlated with micro-environmental temperature.
5. Biochemical characterization of boar seminal gel and its application for bio-stimulation in pigs indicated that seminal gel can be used to induce estrus and synchronization in females and training of males for artificial insemination purpose in swine.
6. The bioinformatics analysis of the RNA isolated from heat shock treated and control cells indicated that significant difference in the number of transcripts, especially protein coding RNAs during heat shock.
7. The transcriptome profiling of different developmental stages of corpus luteum during estrous cycle in pig revealed hub genes which were found to be associated with diverse cellular functions.
8. Investigation on neonatal mortality in piglet revealed that the important bacterial pathogens associated with neonatal piglet mortality are Streptococcus suis, Pasteurella multocida and enterotoxigenic E coli.
9. Studies on MRSA isolated from pigs revealed 100% similarity with human isolates.
10. Diagnstic kits (LAMP assay) specially developed for PCV2 and PPV and multiplex assay for detection of PCV2, PPV and CSFV has been used for detection from clinical samples of pigs.
11. Antibacterial property of Typhonium trilobatum extract has been accessed including evaluation of its efficacy in the form of capsule in invivo studies in clinically affected pigs.
12. PRRS recombinant protein expression has been standardised.
13. Pork based ready to eat functional pork products was developed through the addition of critical ingredients to cater the needs of the health-conscious consumers.
14. Farm-to-Fork Risk profiling of hazards associated with pork supply chain has been carried out and developed a database on hazards and processing practices towards developing food safety interventions to reduce these hazards.
15. Food Quality Management Database has been designed and developed for handling the analytical samples with traceability.
16. Two educational tools viz. technical bulletin (Assamese) and a video (English, Hindi and Assamese) was prepared on scientific pig production practices for the stakeholders.

17. The AICRP on pig project is strengthened in different centers across the country to study the performance of pigs in different agro-climatic condition, to develop region-specific package of practices including quality germplasm and to conserve the indigenous germplasm. Under mega seed project on pig, improved variety of piglets were produced and distributed to the farmers.
18. A total of 11 numbers of copyrights were granted during the year 2020. Also, the institute has filled 02 numbers of patents and 02 numbers of copyright applications during the reported period.
19. Institute has established a state of the art ABI Centre and inducted 07 number of incubates during the year 2020.
20. Institute has regularly conducted activities under "Swachh Bharat Abhiyan" with the resolution to work towards realizing the Mahatma Gandhi's dream of "Swachh Bharat". In order to extend the scientific expertise for the benefit of farmers, the Institute has implemented MeraGaon-Mera Gaurav programme.
21. The Krishi Vigyan Kendra of ICAR-NRC on Pig has conducted On Farm Trials (OFT) and Front Line Demonstrations (FLD) under various disciplines to promote the technology transfer. For capacity building of farmers, rural youth and extension functionaries, a total of 99 training programmes were conducted covering 2858 number of participants during the year 2020.

INTRODUCTION

The ICAR-National Research Centre on Pig (ICAR-NRCP) was established in 2002 under the aegis of the Indian Council of Agricultural Research (ICAR) to bring in excellence in pig production, health and product processing through innovative research in order to provide technology backstopping for enhanced pork production, employment generation and poverty reduction among socially and economically weaker sections through the medium of pig husbandry. The institute has been trying its level best for popularizing the scientific pig production and post harvest management in the country since its inception as well as all round development of the piggery sector along with its affiliation units, namely Krishi Vigyan Kendra (KVK), fifteen centres of All India Coordinated Research Project on Pig, and eight centres of Mega seed Project on Pig, spread over different parts of the country. All India Coordinated Research Project on Pig and Mega seed Project on Pig are the flagship programmes for which the Institute acts as a nodal agency. Development of region-specific pig production technologies and filling the critical gap of demand for superior pig genetics are the focus of the two programmes respectively.

Location

The institute is located at Rani, Guwahati in the state of Assam. The institute is approximately 35 kms away from the Guwahati City Railway Station and 12 kms from the Lokpriya Gopinath Bordoloi International Airport.

Faculty and Staff

The Institute is headed by the Director and currently 18 scientists, 06 adiministrative/supporting and 06 technical staffs are in position.

Staff Position

SCIENTISTS

Particulars	Sanctioned Strength	In-position	Vacant
Scientist	18	15	03
Senior Scientist	04	04	0
Principal Scientist	02	01	01
Director	01	01	0
TOTAL	**25**	**21**	**4**

ADMINISTRATION

Particulars	Sanctioned Strength	In-position	Vacant
A.O	01	00	01
AAO	01	01	0
AF & AO	01	01	0
Assistant	04	0	4
P.A to Director	01	0	1
Jr. Stenographer	01	01	0
UDC	01	01	0
LDC	01	01	0
TOTAL	**11**	**05**	**06**

SKILLED SUPPORTING STAFF

Particulars	Sanctioned Strength	In-position	Vacant
SSS	04	01	03
TOTAL	04	01	03

TECHNCIAL

Particulars	Sanctioned Strength	In-position	Vacant
T3/T4	04	03	01
T1	03	03	0
TOTAL	**07**	**06**	**01**

KVK CADRE STRENGTH

Particulars	Sanctioned Strength	In-position	Vacant
Senior Scientist & Head	01	01	00
SMS	06	05	01
T3/T4	03	03	00
Assistant	01	00	01
Jr Steno	01	01	00
SSS	02	02	00
T1/T-2 Drivers	02	02	00
Total	**16**	**14**	**02**

PRIORITY SETTING AND MANAGEMENT

The Institute has a high powered Research Advisory Committee (RAC) comprising of eminent scientists and professor, who guide the research agenda of the institute and set research priorities. Dr N. Balraman, Former Vice-Chancellor, Tamil Nadu Veterinary and Animal Sciences University, Chennai is the chairman of the committee. The other members include scientists and professors from the field of Animal Genetics and Breeding, Animal Nutrition, Biotechnology, Microbiology, Animal Reproduction and Livestock Products Technology. The functioning of the institute is supervised by Institute Managemental Committee (IMC) headed by the Director of the institute as Chairman and members drawn from state government, university and public personnel. A number of internal committees such as Purchase, Library, Works, Official Language Implementation, ISO 9001- 2015 Implementation, Grievance, Publication, Priority Setting Monitoring and Evaluation Cell, Staff Welfare Club, IPR Cell, Institute Technology Management Unit, Agri-Business Incubation and ICC (women committee) have been constituted to decentralize the management with developed responsibilities for smooth functioning of the institute. The Institute Joint Staff Council has been constituted for promoting healthy and congenial work environment. The Institute Research Council (IRC) provides a platform for effective professional interactions in respect of review and implementation of various research projects.

Vision

To bring in excellence in pig production, health and product processing through innovative research in order to provide technology backstopping for enhanced pork production, employment generation and poverty reduction among socially and economically weaker sections through the medium of pig husbandry.

Mission

Performance appraisal and genetic cataloguing of indigenous pigs, development of improved pig variety together with production, health, product processing and pig based integrated farming system technologies to facilitate the pig rearers of the country for achieving household food, nutritional and economic security.

Mandate

The mandate of the institute is:

- To undertake basic and applied research for enhancing pig production
- To act as a repository of information on pig production
- Capacity building

Research Programmes

Flagship Programme : Artificial Insemination in Pigs

Programme-1 : Conservation and genetic improvement of indigenous pigs

Programme-2 : Optimization of physiological and reproductive efficiency including identifying markers for early detection of fertility

Programme-3 : Characterization of production system, feeding practices and their optimization for enhancing pig production, especially under field conditions.

Programme-4 : Continuous monitoring, recording of pig diseases and development of disease management protocol

Programme–5 : Technology development for improved postharvest handling, processing and value addition of pig products

Programme-6 : Institute-stakeholder linkages and skill development

EXPENDITURE STATEMENT

BUDGET VISA-A-VIS EXPENDITURE 2020

Rs. in lakh

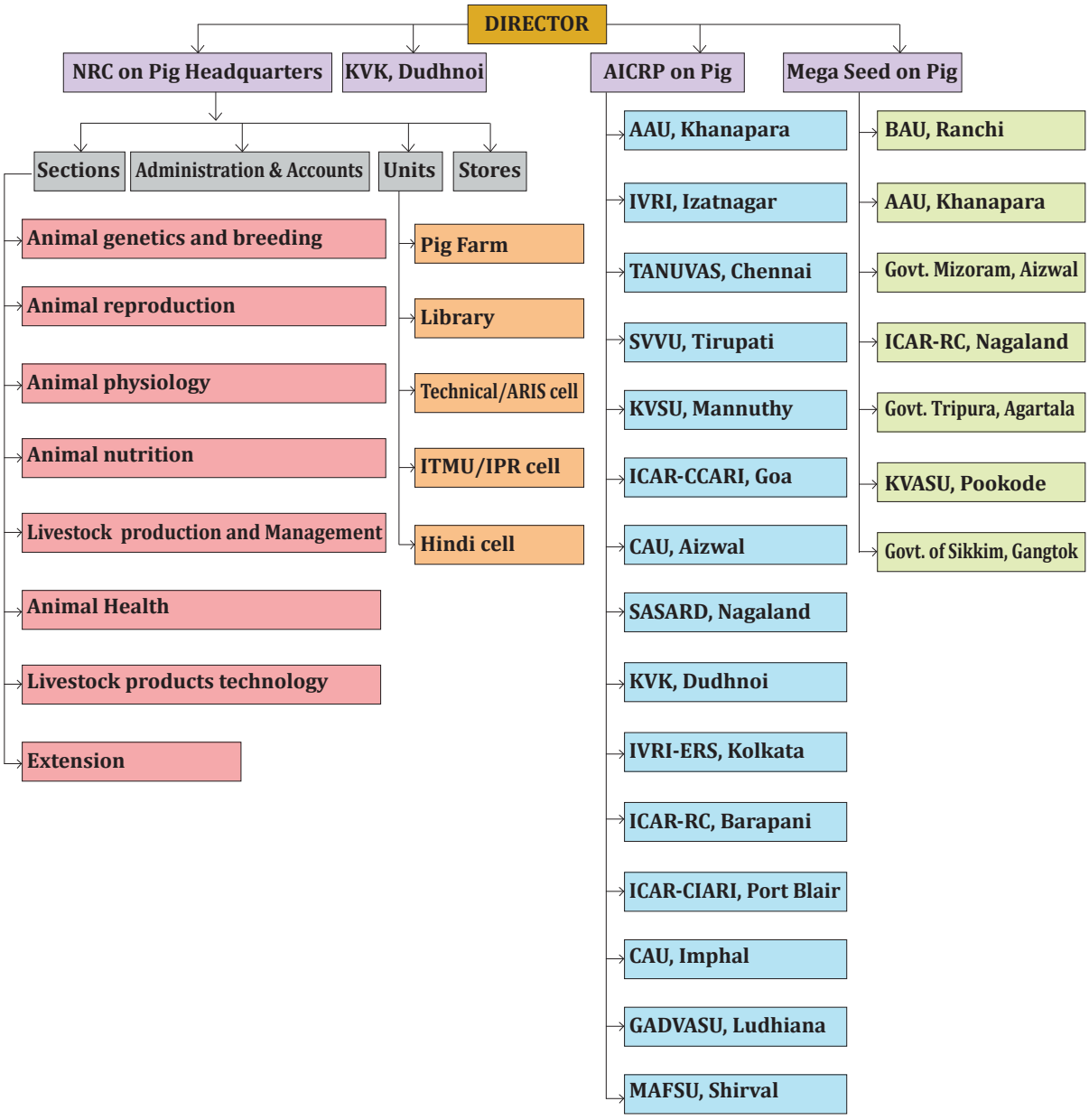
NAME OF THE SCHEME/ PROJECT	DETAILED	PAY & ALLOWANCES	GENERAL	CAPITAL	TOTAL
ICAR-NRC ON PIG, MAIN SCHEME	R.E.	585.53	564.15	142.00	1291.68
	EXP.	583.36	563.63	141.25	1288.24
AICRP ON PIG PROJECT	R.E.	120.75	477.00	63.00	660.75
	EXP.	120.75	477.00	63.00	660.75
MEGA SEED ON PIG PROJECT	R.E.	0.00	340.00	32.00	372.00
	EXP.	0.00	340.00	32.00	372.00

REVENUE GENERATION

Rs. in lakh

REVENUE TARGET DURING 2020	Not assigned
REVENUE GENERATION DURING 2020	134.00

ORGANIZATIONAL SETUP



The matrix mode of management is adopted in the research activities which provide devolved responsibilities for effective implementation of multidisciplinary/interdisciplinary programmes. Director is the Head of the Institute, supported by administrative and financial wings. To strengthen the local decision-making and research monitoring, Research Advisory Committee, Institute Management Committee, Institute Research Council and PME Cell play a vital role through periodical meetings.

PHYSICAL PROGRESS

Recreation Hall

Recreation Hall has been constructed with ample facilities for indoor games viz. table tennis, carom, chess etc. The unit also has provisions for maintaining physical fitness of the staffs.

Recreation Hall

Modern boar semen production centre

Institute has established a Modern boar semen production centre with the financial assistance from North Eastern Council, Ministry of DoNER, Govt. of India. The centre has facilities for processing boar semen from 50 Boars a day. The unit is equipped with modern semen processing equipments viz. CASA, automatic sperm concentration counter, automatic straw filling and sealing machine etc. The centre also has a lecture hall for training and awareness of stakeholders.

Modern boar semen production centre

Training cum Demonstration Unit

Institute has established a 20 pen demonstration pig sty in the newly acquired plot. This unit has provision for automatic drinking water facilities, among others. Further, this unit will be used for the on farm training of stakeholders.

Training cum demonstration unit

Construction of water treatment cum storage facility

Institute has constructed a drinking water treatment cum storage facility in the campus. The unit has the capacity of storing 50000L water in the underground tank and 25000L in the overhead tank. This unit, along with the borewell, will ensure quality water supply to the research pig farm as well as R&D pork processing unit.

RESEARCH PROJECTS

Animal Genetics and Breeding

Institute project: Generation-Wise Genetic Evaluation of Rani Crosses

S. Banik, P.J. Das, K. Barman, R. Thomas, S.R. Pegu and Sunil Kumar

An improved crossbred pig variety namely Rani suitable for northeastern region of the country for breeder farmers was released by ICAR after performance evaluation at the institute as well as by conducting multi-location trials including field testing. Pure parental lines of Hampshire and Duroc (male), and Ghungroo (female) pigs, maintained through selective breeding at pig breeding farm of ICAR-National Research Centre on Pig, Guwahati, was used as exotic and indigenous germplasm, respectively for development of the crossbred variety.

To maintain the developed crossbred variety, rigorous selection both in sire and dam line is done followed by *inter-se*-mating. The breed characters of the developed variety was stabilized for consistent crossbreeding of several generations. Till now the variety has completed eight generations of *inter-se* mating. The generation-wise genetic performance of different productive, reproductive, adaptive and carcass characteristics of developed cross was carefully recorded and evaluated for the study. Ten sire lines of Hampshire and 19 dam line of Ghungroo was initially used to develop the Rani animals. Mating ratio of 1:2.5 (M: F) was followed. Top 3 and 8 percent of male and female were selected for producing subsequent generation based on performance traits. Generation interval was estimate as 1.5 years. Presently the ninth generation of Rani Crosses are maintained at the farm.

Large scale propagation of these developed varieties coupled with use of scientific package of practices was done by distribution of animals through different mandated institute activities and through artificial insemination which ensured sustainable livelihood among the tribal masses.

The generation-wise genetic gain and performance of Rani cross are given below.

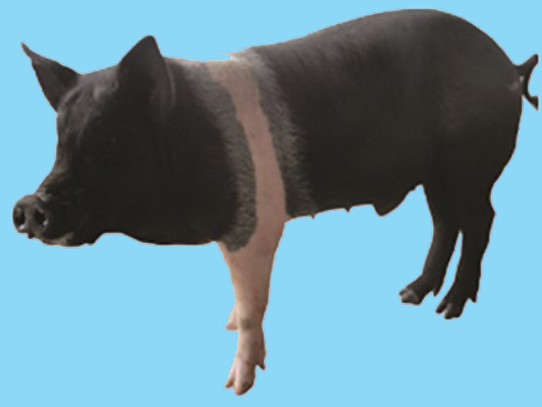


Fig. A Rani crossbred grower

Table : Performance of Rani cross

	Parental Generation			Filial Generation							
	P_2 (H)	P_1 (G)	Mean (P_1+P_2)	G_1	G_2	G_3	G_4	G_5	G_6	G_7	G_8
(Re)productive traits											
Litter size at birth	7.91±0.23	8.91±0.15	8.41	9.50±0.22	9.65±0.35	9.69±0.39	9.50±0.68	9.80±0.42	9.86±0.32	9.87±0.40	9.90±0.34
Litter weight at birth	8.01±0.34	7.95±0.22	7.98	10.20±0.26	10.62±0.22	10.66±0.35	10.45±0.75	10.70±0.52	10.89±0.42	10.95±0.50	11.12±0.37
Litter size at weaning	7.00±0.22	7.5±0.15	7.25	8.25±0.15	8.65±0.32	8.60±0.57	8.50±0.55	8.75±0.35	8.81±0.23	8.83±0.31	8.90±0.42
Litter weight at weaning	50.28±3.52	42.93±3.29	46.605	54.67±3.55	55.32±2.87	56.21±3.84	55.39±3.99	57.52±3.11	59.88±2.56	62.23±3.55	65.44±3.62
Weaning weight	7.23±0.42	5.95±0.52	6.59	6.63±0.35	6.40±0.62	6.49±0.52	6.55±0.75	6.60±0.43	6.93±0.39	7.01±0.32	7.11±0.31
Pre-weaning growth rate (g/d)	148.43±12.36	126.44±10.53	137.435	138.91±12.55	132.49±11.1	134.75±9.83	136.25±13.45	137.70±10.53	145.64±9.32	147.51±12.35	149.67±10.83
Post-weaning growth rate (g/d)	308.6±16.75	280.8±20.43	294.7	325.75±21.53	328.65±24.52	313.95±29.35	328.00±25.63	333.25±23.53	341.5026.35±	345.50±23.85	346.20±26.55
Weight at 8 month	68.95±3.89	62.11±4.28	65.53	71.78±3.29	72.13±3.52	69.28±4.29	72.15±4.56	73.25±3.88	75.23±3.72	76.11±4.22	76.35±4.07
FCR	4.01±0.25	4.21±0.23	4.11	3.80±0.28	3.79±0.31	3.81±0.19	3.88±0.17	3.80±0.33	3.75±0.23	3.70±0.20	3.68±0.19
Adaptive traits											
Pre-weaning mortality rate	6.0±0.52	6.2±.65	6.1	5.30±0.45	5.00±0.67	5.10±0.32	5.80±0.44	5.20±0.52	5.20±0.51	5.20±0.50	5.05±0.32
Carcass trait											
Dressing percentage	74.00±2.33	72.00±3.12	73	74.26±2.11	74.25±2.22	74.58±2.58	75.00±3.21	75.00±2.99	75.10±3.01	75.00±2.81	75.12±2.55
Carcass length	90.10±4.58	78.55±5.89	84.325	87.00±4.92	87.83±5.22	87.55±4.32	88.66±5.98	90.34±5.62	92.88±4.87	92.90±4.02	92.91±4.31
Back fat thickness	2.78±0.15	3.20±0.12	2.99	2.81±0.11	2.61±0.15	2.62±0.12	2.35±0.11	2.22±0.12	1.98±0.08	1.97±0.10	1.96±0.11
Loin eye area	4.59±0.13	4.39±0.23	4.49	4.59±0.12	4.62±0.14	4.63±0.13	4.59±0.11	4.62±0.22	4.63±0.09	4.65±0.11	4.66±0.12

Table : Generation-wise genetic gain of Rani cross

	Generation Wise Genetic Gain							
	GG_{1GEN}	GG_{2GEN}	GG_{3GEN}	GG_{4GEN}	GG_{5GEN}	GG_{6GEN}	GG_{7GEN}	GG_{8GEN}
(Re)productive traits								
Litter size at birth	12.96	1.58	0.41	-1.96	3.16	0.61	0.10	0.30
Litter weight at birth	27.82	4.12	0.38	-1.97	2.39	1.78	0.55	1.55
Litter size at weaning	13.79	4.85	-0.58	-1.16	2.94	0.69	0.23	0.79
Litter weight at weaning	17.31	1.19	1.61	-1.46	3.85	4.10	3.92	5.16
Individual weaning weight	0.61	-3.47	1.41	0.92	0.76	5.00	1.15	1.43
Pre-weaning growth rate (g/d)	-1.50	-4.62	1.71	1.12	1.07	5.76	1.29	1.46
Post-weaning growth rate (g/d)	10.54	0.89	-4.47	4.48	1.60	2.48	1.17	0.20
Weight at 8 month	9.54	0.49	-3.95	4.14	1.52	2.70	1.17	0.32
FCR	-7.54	-0.26	0.53	1.84	-2.06	-1.32	-1.33	-0.54
Adaptive traits								
Pre-weaning mortality rate	-13.11	-5.66	2.00	13.73	-10.34	0.00	0.00	-2.88
Carcass trait								
Dressing percentage	1.73	-0.01	0.44	0.56	0.00	0.13	-0.13	0.16
Carcass length	3.17	0.95	-0.32	1.27	1.89	2.81	0.02	0.01
Back fat thickness	-6.02	-7.12	0.38	-10.31	-5.53	-10.81	-0.51	-0.51
Loin eye area	2.23	0.65	0.22	-0.86	0.65	0.22	0.43	0.22

The developed Rani crossbred variety showed stable performances over the generations. The animals also showed stability in performance traits in field evaluation.

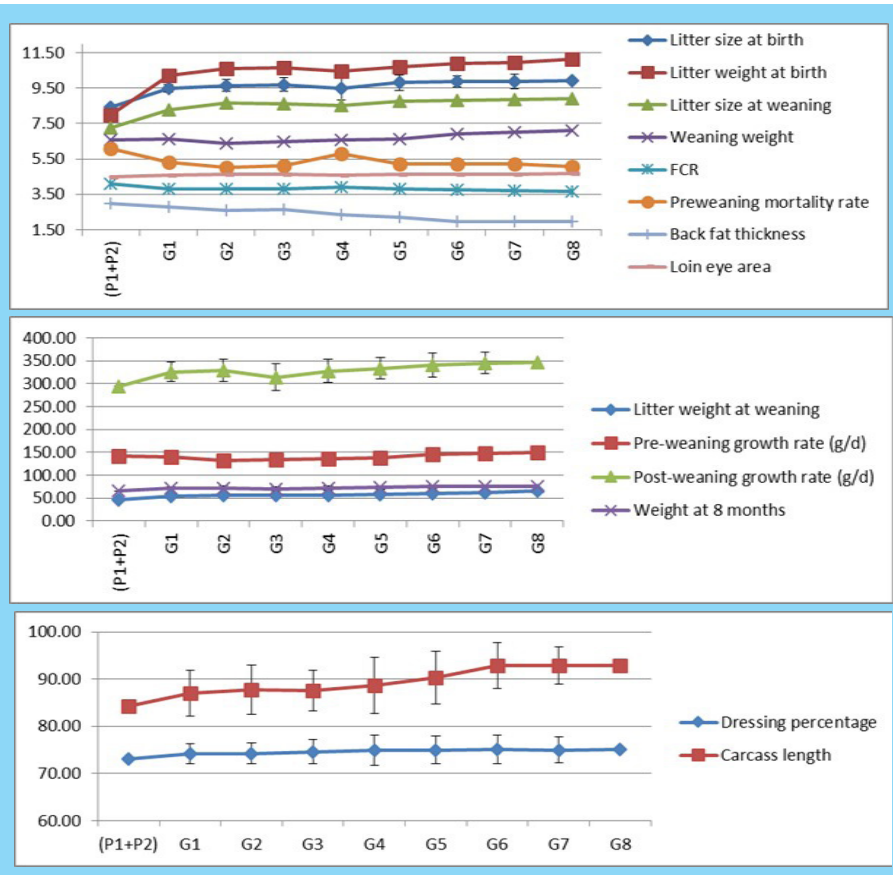


Fig. Generation-wise performance of different (re)productive traits

ICAR funded: All India Coordinated Research Project on Pig, KVK-Goalpara centre

S. Banik, P.J. Das, K. Barman, S. Rajkhowa and Satish Kumar

The All India Coordinated Project (AICRP) on Pig center of KVK-Goalpara is mandated to act as conservation unit of Doom pig of Assam. The center is maintaining 30 sow unit of Doom pig for conservation and subsequent genetic improvement purpose. Necessary steps were undertaken to conserve this unique pig germplasm. For this purpose, identification of original breed rearers of the breeding tract, regular training of farmers' regarding importance of these germplasm and dissemination of scientific management practice to conserve the breed was done. Presently the genetic improvement programme is being done by selective breeding among Doom pig. New replacement stock of animal was purchased for subsequent breeding. Further, the center is also propagating quality crossbred pig germplasm (Rani cross) developed by ICAR-NRC on Pig through artificial insemination.

Table : Performance of Doom Pig

Traits/Characters	Performance
Litter size at birth (no.)	4.5±0.5
Litter weight at birth (kg)	1.51±0.11
Litter size at weaning (no.)	4.50±0.50
Litter weight at weaning (kg)	5.06±0.85
Avg. Individual weight at birth (kg)	0.68±0.09
Avg. Individual weight at weaning (kg)	3.08±0.46
Avg. Individual weight at 8 months (kg)	43.12±3.81
Pre weaning growth rate (gm/d)	50.96±3.61
Post weaning growth rate (gm/d)	211.99±21.21
Overall growth rate (up to 9 m) (gm/d)	191.57±21.12

AICRP on Pig Shed

Doom pig at its conservation unit

Institute project: Characterization and expression profiling of Pig MSY (male-specific region of the Y chromosome) genes for boar fertility

P.J.Das, S. Banik, Sunil Kumar and S. Rajkhowa

Over the past few years, comprehensive work has been done on genome sequence analysis of many mammals that dealt with Y chromosome gene sequencing and understanding of diverse phenotype due to genetic variation. However, very limited information is available regarding the male-specific region of the Y chromosome (MSY) genes and their functional profiling. Although the whole-genome draft sequence of Pig is completed recently, the complete sequence annotation is still not available for Pig Y chromosome. It is well established now across the eutherian mammals that the non-recombination area of the Y chromosome genes are male-specific (MSY) and directed related to male fertility. Despite the importance of this chromosome in male fertility, particularly development testis and spermatozoa, this chromosome has not been studied well in Pig. Since Pigs are an economically important domestic species. Recalling that several Y chromosomal loci contribute to infertility in male, expectations are that important regulators of male biology are present also in the Pig Y chromosome. The pig Y-chromosome remains, however, poorly characterized to understand male reproductive performance. In this study, we are generating comprehensive functional profiling of the male-specific region of the pig Y chromosome to elucidate the functional profiling of the pig Y chromosome. The amplification of testis-expressed genes and the identification of a novel sequence class provide novel insights into the evolution and function of this unique chromosome. Fresh blood and tissue samples from slaughtered pigs have been collected aseptically and both DNA & RNA have been isolated following standard protocol. For amplification of MSY genes primers have been designed for twelve MSY genes, 6 control genes from Pig. Targeted genes were amplified in male and female genomic DNA and confirm the male-derived specificity. The tissue panel from the pig, as well as sperm, have been collected to understand novel complexity of these MSY genes in expression profiling. Moreover, testis-specific expression of MSY genes was distinct among the different tested tissues *viz*. liver, lung, kidney, pancreas, heart, spleen, skeletal muscle, ovary and testis. The identified MSY genes can be used to establish male-specific characteristics of pig and to differentiate male and female pig genotypically.

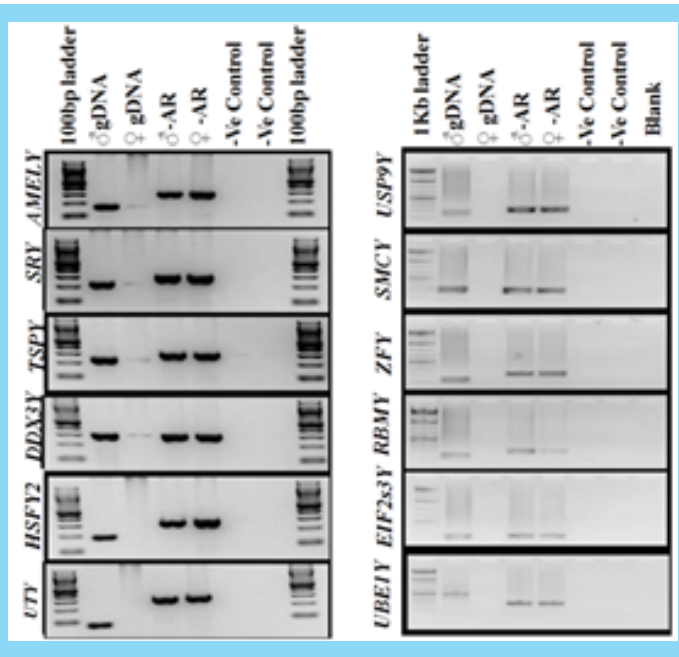


Fig. Amplification of 12 MSY genes in the pig genome

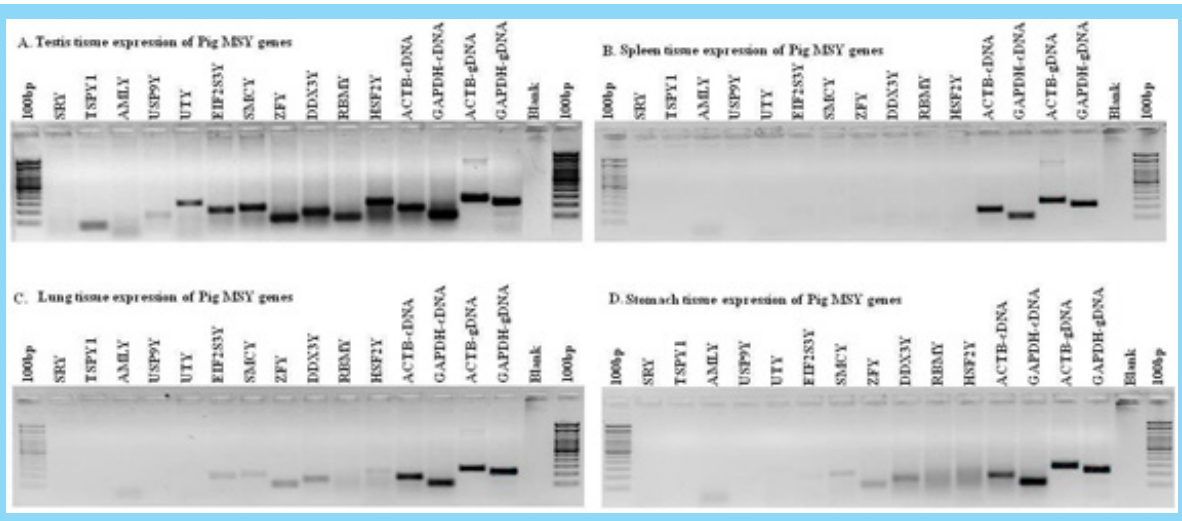


Fig. Expression analysis of 12MSY genes in four different tissues of Pig. A. Testis; B. Spleen, C. Lung, D. Stomach.

Institute project: Phylogenetic analysis of pig mitochondrial genome sequences of native pigs of North-East India

P.J.Das, S. Banik, S.R.Pegu and S. Rajkhowa

Multiple origins have been revealed to be a common phenomenon in domestic animals such as cattle, goats, chicken, and horses. Recent studies in pig domestication have highlighted the origin of pig domestication with many contrasting views. Among current views, China is one of the earliest countries originally feed pigs several studies also have shown that pigs were independently domesticated in various parts of the world. However, the most popular researches support the independent origin of domestic pigs in Europe and Asia. It is to mention that the time of divergence between European and Asian pig mitochondrial mtDNAs was long before the time of possible pig domestication. Recent studies have revealed a schematic profile concerning the origin of wild boars and their dispersal and domestication across Eurasia, as well as the Neolithic expansion in Island South East Asia and Oceania by analyzing the mtDNA D-loop sequences of worldwide wild boars, domestic pigs, and ancient specimens. But pigs found in Northeast India have limited representation in those studies to understand the origin and domestication of the pig world over. A recent finding also contrasts with the report of independent domestication of Asian and European pigs from their respective wild counterpart. So, to understand domestication root and variability among pigs population of the northeastern region of India, a complete phylogenomic analysis needs to be conducted by screening mtDNA complete coding region sequences as well as d-loop sequences to investigate migration and evolution of pig populations of this region.

The purpose of this study was to investigate the origin and evolution of pigs of Northeast India and using mitochondrial genomic sequences (mtDNA) from exotic pigs and wild pigs. The minimum blood five samples collected aseptically from indigenous pig breeds of NE region *viz*. Ghungroo, Niang Megha, Tenyi-Vo, Doom, Non-descript, Mali, Zovawk, Rani, Asha, Lumsiang, HDK75 and wild pig. A total of 30 pairs of primers were designed to amplify complete mtDNA genome from each breed as well as a pair of primer was designed to amplify the complete d-loop region of from minimum five individual from each breed. The mtDNA enriched DNA was isolated from the different samples and amplification was done using mtDNA specific primers. The complete mtDNA genomes of each breed as well as five each of whole mtDNA d-loop of Ghungroo, Niang Megha, Tenyi-Vo, Doom, Non-descript, Mali, Zovawk, Rani, Asha, Lumsiang, HDK75 and wild pig of NE were sequenced using ABI

Sanger Sequencing. The DNA sequences were assembled using Clustal X and exported to the FASTA file. The complete sequence was annotated using MITOS and DOGMA. A total of 30 overlapping fragments of the complete mitochondrial genome of 10 native and one wild pig breeds of North Eastern region of India have been amplified and sequenced using Sanger's sequencing platform (outsourcing). The resultant sequences were trimmed and edited and subsequently, all the fragments for each breed were aligned together to have a complete mitochondrial genome sequence of these breeds. The following table shows the gene annotation of complete mtDNA genome of Ghungroo Pig. The evolutionary history of the indigenous pig breeds of NE was inferred using the neighbour-joining (NJ) method as well as construct Cladogram to represents a hypothetical relationship between different breeds of the pig. The phylogenetic statuses of indigenous pigs were investigated by comparing the whole mtDNA sequences of complete and D-loop regions respectively amongst Asian breeds, European breeds, and wild boars. Neighbour-Joining trees constructed based on mtDNA D-loop sequences and the whole mtDNA analysis clearly showed that the indigenous pigs of NE region were located in a separate branch. These data suggest that the indigenous breeds of pigs are different from other breeds. It revealed that native pig of Northeast was only recently diverged from each other and distinctly different from exotic European pigs. The Indian wild boar had a distant genetic relationship with all other domestic pigs as well as excludes the potential effects of hybridization between local indigenous breed and exotic breeds of pig. In this mtDNA data analysis, it also suggests a high level of a subpopulation in the indigenous pigs of NE India. The haplogroup analysis of these domesticated pig breeds of this region inferred that pigs belonging to haplogroup I {Niang Megha, Tany Vo, Ghungroo, Rani, Asha (cluster-I)} are the most recently developed breeds, while pigs of haplogroup B (Doom and HDK75) are evidenced to be of most primitive origin. Phylogenetic analysis also reveals that Ghungroo pig has two independent domestication origins *viz.* haplogroup E and I. The complete sequence lengths of the BARCODE gene for all the domestic as well as wild pigs have been established in this study. The Cladogram analysis revealed independent BARCODE of doom pig because of its uniqueness and ancient origin. Therefore, this approach could be fine-tuned as a powerful tool to trace the origin of pig domestication, to conserve their indigenous germplasm and develop a breed signature to identify true breeds as well as to elucidate the lineage of other unknown pigs' origin.

For the first time, the whole mtDNA genome of native pig breeds of North East India is sequenced and compared with exotic and wild pig mitochondrial genome sequences to understand roots of domestication of these breeds. The unique database generated in this study sourced to understand the lineage of this animal as well as conservation of the germplasm of the indigenous pigs of NE region.

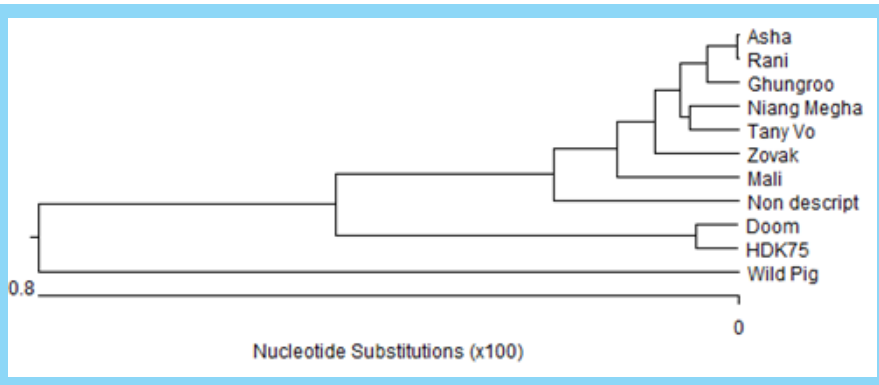


Fig. Constructed Phylogenetic tree of wild and domestic pigs of North Eastern region of India using eleven complete mitochondrial DNA (mtDNA) sequences. The tree was constructed by the neighbour-joining method with a wild pig as the out-group.

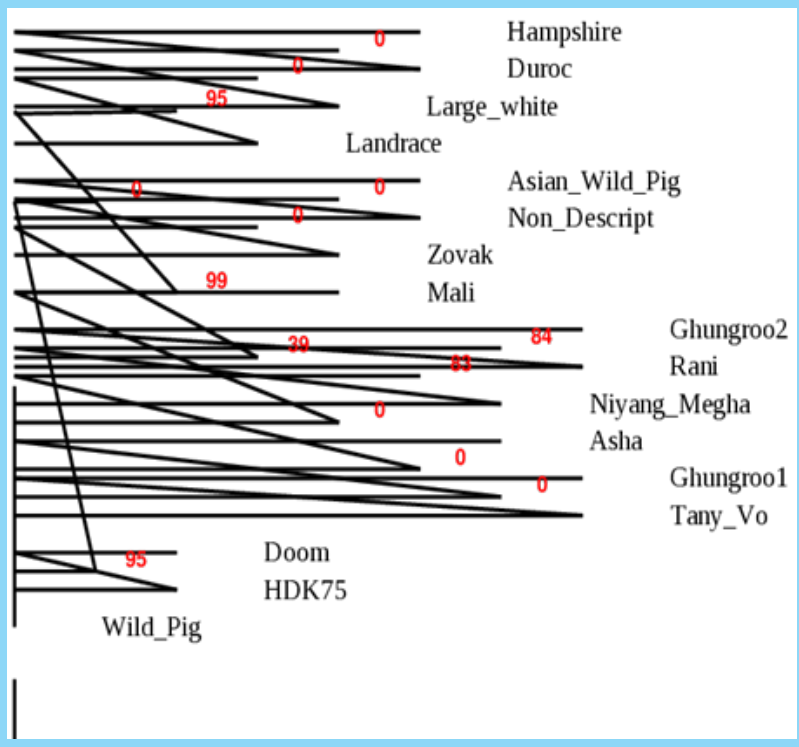


Fig. Cladogram showing origin and domestication of the wild of India and domestic pig of North Eastern Region of India with other exotic pigs.

Table : Gene annotation of complete mtDNA genome of Ghungroo Pig

Gene Name	Start	End	Bases
d-loop	1	1254	**1254**
Repeat _Region	203	264	**62**
Repeat _Region	706	921	**216**
tRNA-Phe	1255	1324	**70**
12S Ribosomal RNA	1325	2284	**960**
tRNA-Val	2285	2352	**68**
16S Ribosomal RNA	2353	3922	**1570**
tRNA-Leu	3923	3997	**75**
ND1	4000	4956	**957**
tRNA-Ile	4955	5023	**69**
tRNA-Gln	5028	5092	**65**
tRNA-Met	5094	5163	**70**
ND2	5165	6208	**1044**
tRNA-Trp	6207	6364	**158**

tRNA-Ala	6281	6348	**68**
tRNA-Asn	6349	6424	**76**
tRNA-Cys	6457	6522	**66**
tRNA-Try	6522	6587	**66**
COXI	6589	8133	**1545**
tRNA-Ser	8038	8207	**170**
tRNA-Asp	8213	8280	**68**
COXII	8281	8968	**688**
tRNA-Lys	8969	9035	**67**
ATP8	9037	9240	**204**
ATP6	9198	9878	**681**
COXIII	9878	10661	**784**
tRNA-Gly	10662	10730	**69**
ND3	10731	11076	**346**
tRNA-Arg	11078	11146	**69**
ND4L	11147	11443	**297**
ND4	11437	12814	**1378**
tRNA-His	12815	12883	**69**
tRNA-Ser	12884	12942	**59**
tRNA-Leu	12943	13012	**70**
ND5	13013	14833	**1821**
ND6-Complement	14817	15344	**528**
tRNA-GLU	15345	15413	**69**
CytoB	15418	16557	**1140**
tRNA-Thr	16558	16625	**68**
tRNA-Pro	16626	16690	**65**

Institute project: Development of IRT image-based systems for examining the health status of pigs

P. J. Das, S. Banik, Sunil Kumar, S.R.Pegu and S. Rajkhowa

The total radiation energy emitted or absorbed by an animal's body depends upon the emissivity of the skin; the larger part of such radiation energy is emitted in the wavelength of 7-14µm (such emission is referred as infrared-IR radiation) and in animals such heat loss accounts to about 40-60%. The IR radiation is captured by InfraRed Thermography (IRT) camera which can be connected to a computer and based on thermography data; diagnosis of diseases is possible

in animals. Infrared thermography is a very modern, non-invasive, and safe technique that is used in many applications in biology and veterinary science. The uniqueness and popularity of the infrared imaging in the identification and early detection of animal diseases have increased in recent time because of its automation, sensitivity and non-invasiveness. The IRT imaging reduces the risk of spreading infections owing to its non-contact nature, and reduced animal stress due to non-invasiveness nature. The Infrared thermography has been successfully practised in numerous practical applications such as human and veterinary medicine, animal husbandry, biology, ecology, industry, rescue operation, *etc*. In veterinary medicine, thermal imaging cameras have been used to map the surface body temperature, which detects the internal temperature of the tissues and the outer surface temperature of the body of the animal for any abnormality. Infrared thermography has been successfully used to detect and identification of the injuries, inflammations, and lameness; to diagnose infectious diseases, oestrus, and pregnancy; ectoparasite infestation in animals; to study animal welfare and environmental and physiological stress levels in. The advantage of using the thermal camera in disease diagnostics is its non-invasive nature *i.e.* it perceives heat emissions and does not require direct physical contact with the surface examined, thus allowing the monitoring of temperature distribution non-invasively. Because of its fast, non-invasive, reliable and non-contact requirement nature, it is considered as a safety device for the animals and the veterinarian. It considerably lowers the risk of spreading infections, since touching the subject is needless and also in animals, this is advantageous as handling and restraint increase stress, causing an effect on the surface temperature. The study was undertaken to identify a sow /gilt who are in an oestrous stage or are pregnant thus addressing the thermal profile of female reproductive parameters. The infrared thermal images taken during the entire study were recorded using Forward-looking infrared (FLIR) camera, model no. T62101. The emissivity and focal distance of the camera for the pigs were kept fixed throughout the investigation- at 0.95 and 1 m respectively. The temperature range at the time of investigation was 25-36°C and relative humidity recorded was 65-85%. No parts of the animals were in contact with any hot and cold sources during the study. In the present study, thermal imaging is used to monitor of health condition in pigs using Infrared Thermal Imaging. The IR thermography was performed by taking into anticipated temperature differences *viz*., diurnal changes, pig breed-specific variations and differences between healthy and diseased pigs (suffering some health conditions). Healthy farm pigs (n=300) of ICAR NRC on Pig were used for recording IR thermography between September to October 2019. Variation in pig's body temperature during different times of the day was recorded; IRT images were captured at three different locations *viz*., head, chest and back on three different occasions in a day *viz*., morning, afternoon and evening. The recorded IR thermography in pigs shows that the lowest and highest temperatures were observed during morning and afternoon hours. Temperatures recorded from different body parts differed significantly with the highest temperature at the back and lowest at the head. To determine the ovulation period, it has been shown earlier that oestrogen administration can induce an increase in vaginal blood flow measured through a rise in vaginal thermal conduction. The increased local blood flow linked to rising plasma estrogens is reflected by vulvar reddening and swelling that has been widely reported as typical signs of oestrus in the sow, infrared thermography has the potential to evaluate these physiological changes by monitoring the evolution of the vulvar skin temperature of pigs in oestrus and not in oestrus. This distinguishes variations of vulvar skin temperature (VST), gluteal skin temperature (GST) and the difference between vulvar and gluteal skin temperature (VGT) in the oestrous and non-oestrous stages of the cycle. The results of the study indicated significant differences among oestrus and non-oestrus animals for different temperature (°C) parameter estimated such as VST (36.78± 0.29 Vs 35.94±0.19), GST (33.44± 0.24 Vs 35.51±0.14) and VGT (3.34± 0.26 Vs 0.43±0.11). In conclusion, infrared thermography can be used to identify gilts and sows in oestrus effectively.

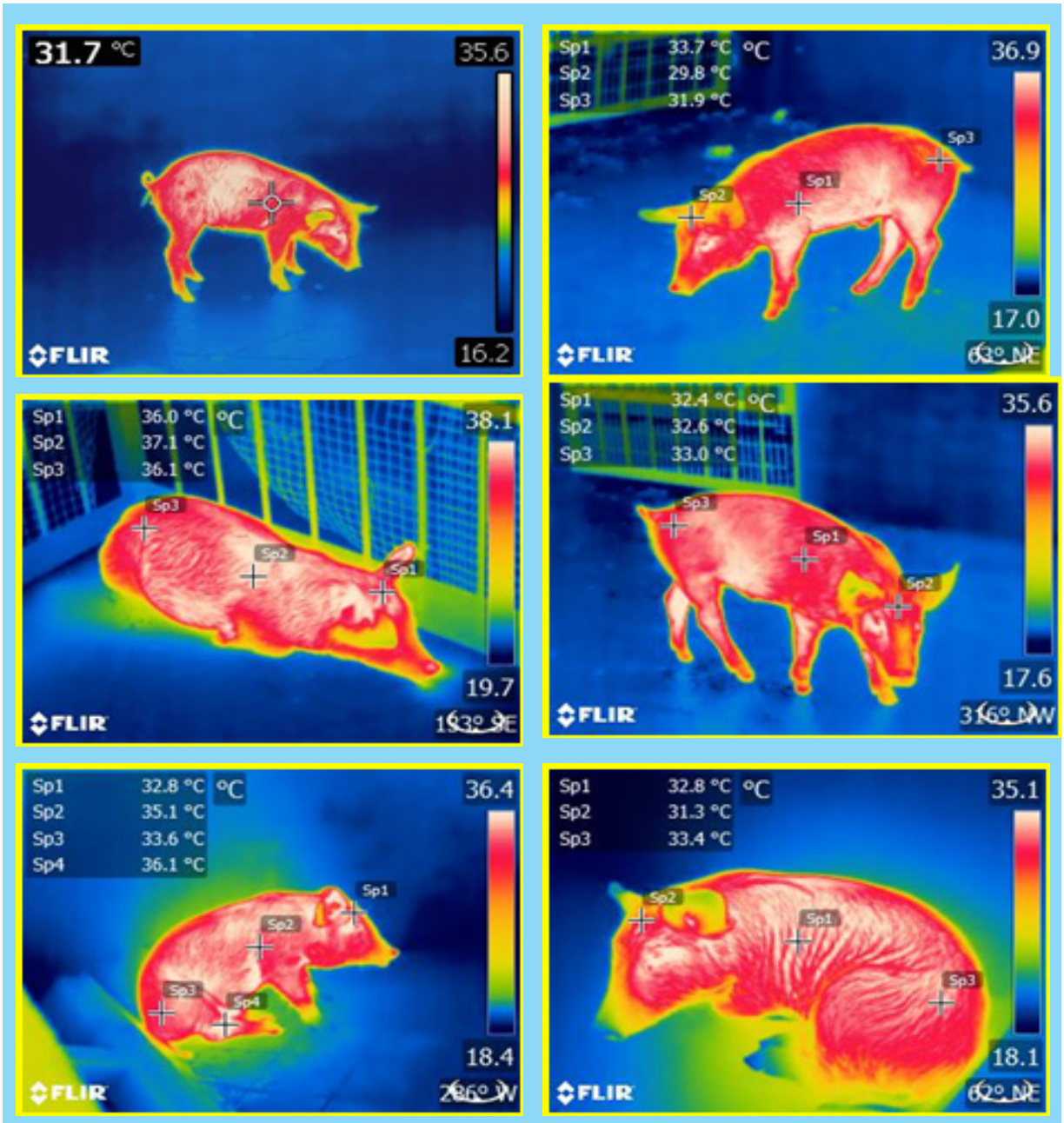


Fig. Temperatures recorded from different body parts differed viz. Head, chest & back showing the highest temperature at the back and lowest at the head

Institute project: Exploring genetic variability in different candidate genes and their association with re(production) traits in pigs

Satish Kumar, Santanu Banik, P J Das, Sunil Kumar and Jaya

To explore the genetic variability in the FSHβ, Leptin, ESR1, ESR2, Leptin Receptor (LEPR) Gene, all the SNPs in exonic region of these genes were targeted. The SNPs which could be genotyped by PCR-RFLP method was selected and suitable primers were designed by Primer3 online available software. The primers were standardized by gradient PCR for appropriate annealing temperature. The primers were amplified by PCR using Thermocycler such that it comprises the desired SNPs. After amplification the genotyping of SNPs were done by PCR-RFLP technique. The amplified PCR

product was digested using specific Restriction enzyme. The RE was selected using online available software NEBcutter V2.0. The SNP ID, primer sequence, product length, RE used for genotyping of SNP and fragments after digestion are given below.

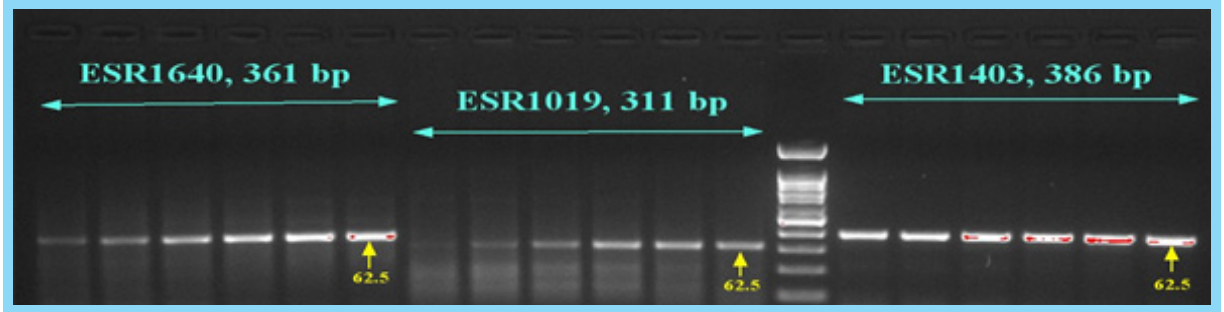


Fig. Agarose Gel (2%) electrophoresis of gradient PCR for suitable annealing temperature of primers ESR1640, ESR1010 and ESR1403 of ESR1 gene in pig. M represent 100bp DNA marker. Arrow indicate suitable annealing temperature for respective primers

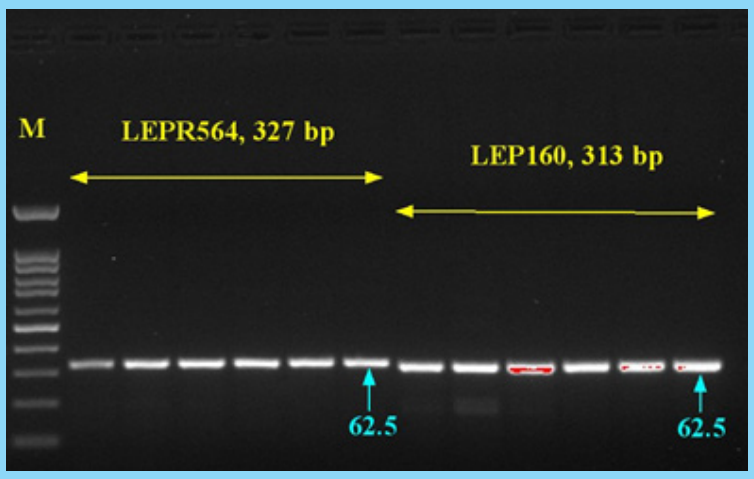


Fig. Agarose Gel (2%) electrophoresis of gradient PCR for suitable annealing temperature of primers LEPR564 and LEP160. M represent 100bp DNA marker. Arrow indicate suitable annealing temperature for respective primers

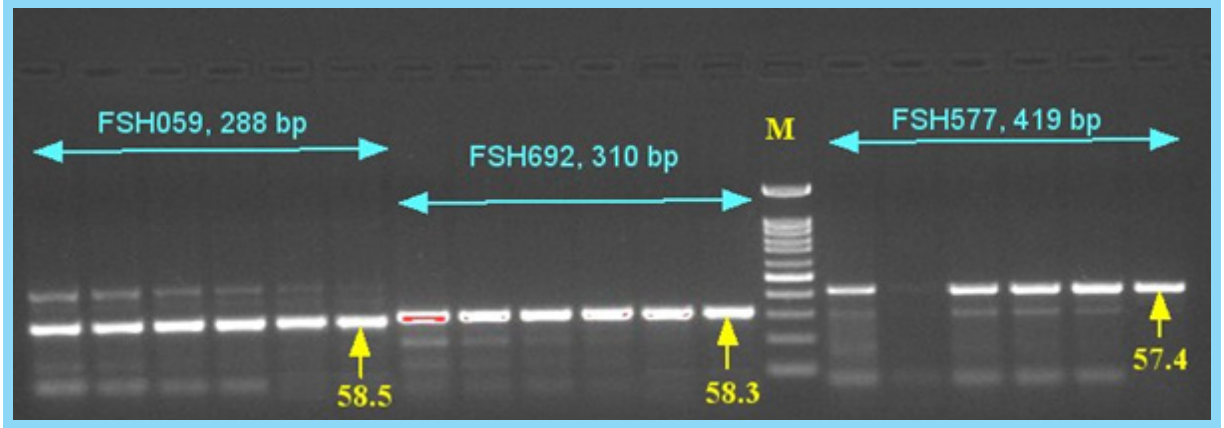


Fig. Agarose gel (2%) electrophoresis of gradient PCR for suitable annealing temperature of primers FSH059, FSH692 and FSH577. M represent 100bp DNA marker. Arrow indicate suitable annealing temperature for respective primers

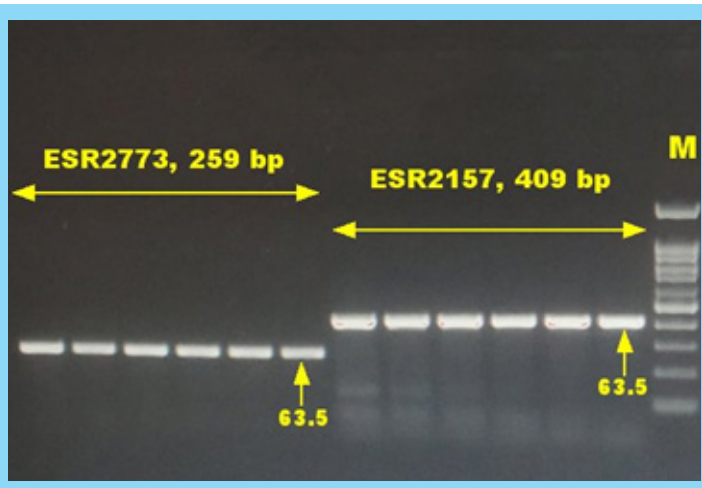


Fig. Agarose gel (2%) electrophoresis of gradient PCR for suitable annealing temperature of primers ESR2773 and ESR2157. M represent 100bp DNA marker. Arrow indicate suitable annealing temperature for respective primers

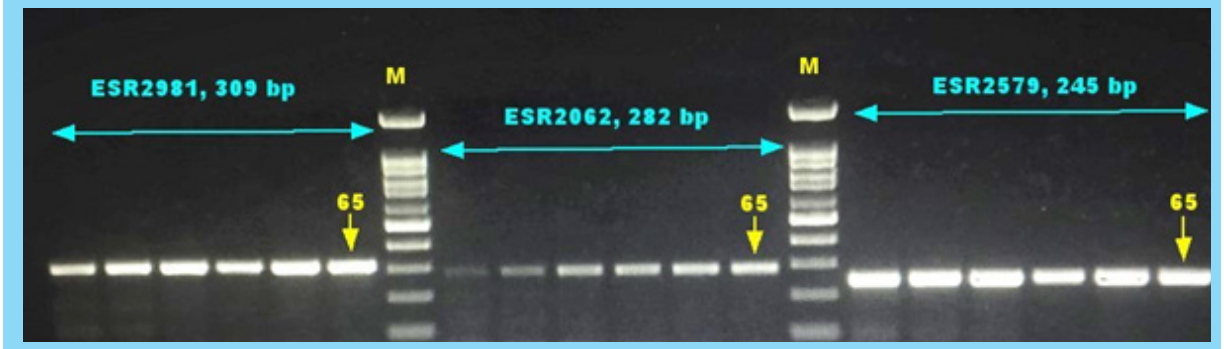


Fig. Agarose gel (2%) electrophoresis of gradient PCR for suitable annealing temperature of primers ESR2981, ESR2062 and ESR2579. M represent 100bp DNA marker. Arrow indicate suitable annealing temperature for respective primers

Table : The SNP ID, primer sequence, product size, RE used for genotyping of SNP and fragments after digestion

SNPs	Primer	Product size	RE	Fragments
rs789053059	F: CAGCCAGGTACTTTCACGGT R: CAGATCAGAAAACATGGCATAGCA	288	AccI	288, 206, 82
rs338948692	F: CCCGCCTTTTACAGACCTTCA R: GACCAGTTATTCAAGGTTTGG	310	BSAHI	310, 199, 111
rs81213577	F: ATAACCCCAATCAGGAAACAG R: GACTGGAGAGGATGAATAGACC	419	PvuII	245, 174, 419
rs45431507	F: AGCGGAGCGAGAGAGAAATG R: CTCACCAGTCTGCCTTCCAG	375	BstAPI	165, 210, 375
rs45431505			BtgI	204, 171, 375
rs701423985			BsaHI	230,145, 375
rs45431504	F: GAGGTTCTCCAGGTCATTCG R: CAAGGGCAGGAAGACAGAAG	403	HinfI	99, 304, 403

rs1110706811	F: CGACCTTGTCTCCCAGGC R: CACCGTCGCTTTCTTGATCC	436	TaqI	65, 371, 436
rs793436160	F: GCCACAGTTCGACCTTGTCT R: GCTCCCTTTGATCCGCAT	313	AluI	119, 194, 313
rs695579307			AgsI	123, 190, 313
rs1113239558			TaiI	125, 188, 313
rs694660564	F: TTCGGTAGGGAATTGCTGCT R:GGAGCCTGAAACCATTTCGG	327	PsuI	107, 220, 327
rs1113972516			HpyCH4V	141, 186, 327
rs322393640	F: TGTGCCTTCAGAGCAAGTAG R: ATGAAGAGAATGGGCTGTGG	361	Alw26I (BsmAI)	161, 200, 361
rs704329019	F: ACATCTTTCAGGAACCAGGCA R: TGAAGAGAATGGGCTGTGGG	311	Cac8I	131, 180, 311
rs707640403	F: GATCAGATGCCTTCCTCAGTT R: GCTACATCTTCCAAGCCTCTTA	386	Eco47I (AvaII)	116, 270, 386
rs699440955	F: TGGACCGCCTAGGATTA R: GGTGGCAGAGAGAGATTG	277	Eco81I (Bsu36I)	175, 102, 277
rs708729773	F: TACAGCCATACCTTTCCATGAC R: CACCACAGCAGGGCTATAAA	259	Eco32I	10,31,56,259
rs790299157	F: ATGTCCCTTTGTGCCTCTTC R: GTTCACAGGTAAGGTGTGTTCT	409	ApeKI	174, 235, 409
rs343283407			BseNI	175, 234, 409
rs322495865			BtsIMutI	283, 126, 409
rs708345040	F: TTGCCCCCAGAGAGACATTG R: AAACAATCCACCCCACCCTC	360	Mph1103I	116, 244, 360
rs342775108			Hin1II	14,52,15,360
rs1112366020			AdeI	116, 244, 360
rs1112875579	F: GGAGAGAACGGTGTGGGTAC R: CAGCTTGGTCAGGGACATCA	245	BclI	8,91,56,245
rs336266062	F: GACTGGGGGAACTTGTGGAG R: TCGGTGAAGGGCGTGCT	282	HpyAV	11,31,69,282
rs702631546	F: GGGTTGGAGACTGGAAAT R: CTCAGCACCTCACTCAAA	404	PagI (BspHI)	129,275, 404
rs693805542	F: TGGTCTCATTGCCACGTAAC R: AAACAGCATCTCTCCCTCATAAA	311	BseGI	134, 177, 311
rs703419496			AflIII	14,21,69,311
rs698912981	F: GAAAGGACACCATACACAGGAG R: ACTGCTGCTGGGAGGAGATA	309	AcuI	178, 131, 309
CAMB0000347	F: CCCAGGTATGTATCCTTCA R: CTTAGGACACCACAAACAG	394	Bsh1236I	74, 320, 394
rs707092198			DpnI	98,296, 394
rs691411429			BseGI	11,62,78,394
rs335601877	F: ATGAGGACTGGCTTTGT R: CACACAGCAGAAAGTCTATG	400	HpyCH4IV	135, 265, 400
rs80947737	F: CCCTGTTTTCTCTTGCGTGC R: TGAAACCAGTTGCGGGAAGT	421	BglI	123, 298,421
rs80878671			Eam1104I	14,82,73,421
rs80995712	F: TCGGTGTCTGTAAAGGTGCC R: TGGTCTCCTCTCTTCCCCAG	371	Hpy166II	267,104, 371
rs55618789	F: CCAGATGCCACTGACTTTA R: GCAAGATGGAATGGGTTTG	363	Eco24I	141, 242, 363
rs1109638302			EcoO109I	11,62,47,363
rs80815247			NcoI	128, 235, 363

Institute Project : Molecular characterization of indigenous pig breeds

Satish Kumar, Santanu Banik, Pranab Jyoti Das, Sunil Kumar and Amiya Ranjan sahu

The indigenous pig breeds were attempted to characterize by microsatellite markers. The markers used for molecular characterization were selected based on ISAG–*FAO* recommendation. The primers were standardized for suitable annealing temperature by thermo cycler gradient temperature. The primers that were amplified in our indigenous population were labelled by fluorescent tag for multiplex PCR. The name of primers their annealing temperature and fluorescent tag used for 5' labelling is depicted. The tagged primers were standardised for appropriate annealing temperature for the multiplex PCR reaction. The multiplexed PCR product will be sent for sequencing and automated genotyping to know the polymorphic parameters and heterozygosity for the particular microsatellite in the population.

Livestock Production and Management

Institute Project : Ethogram development and welfare assessment of desi and crossbred growing pig

Kalyan De, Nitin M. Attupuram, Souvik Paul, Rafiqul Islam, N.H. Mohan, B.C. Das

Activity 1. Effect of weaning on standing and lying behaviour of weaner pig

In the pig production system weaning is a common managemental practice. However, the piglets have psychological attachment and dependence on their mother. Therefore, separation from the mother may create susceptibility to stress and impair their behaviour and welfare. The comfort of the animal is expressed by time spent on standing and lying condition. Therefore, the present study was initiated to assess the effect of weaning on the standing and lying behaviour of weaner pigs. For this purpose, piglets of Rani and Large White Yorkshire (LWY) were observed immediately after weaning for three days. The observations were taken for two hours after feeding of one hour each day. The post weaned piglets spend 64.3±2.4 % and 35.2±2.4 % of the time in standing and lying conditions, respectively. The LWY weaner piglets spent higher ($P<0.01$) time in lying as compared to Rani piglets; whereas Rani piglets spent higher ($P<0.01$) time in standing conditions. The days of weaning and sex of piglets have no significant effect on the standing and lying behaviour. Although further studies required a large number of weaner piglets for a definite conclusion, however; on the available basis, the study indicated the LWY post-weaning piglets remained in a more relaxed condition.

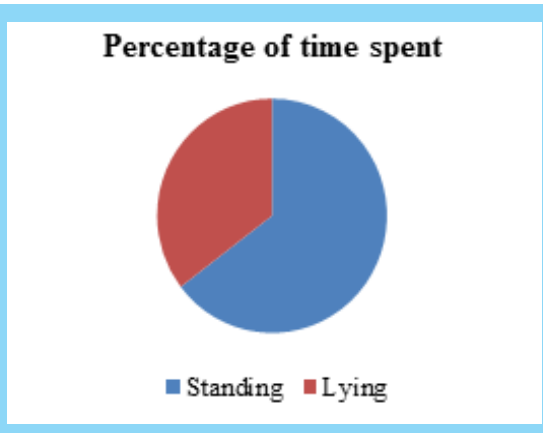


Fig. Percentage of time spent in standing and lying condition in weaner piglets.

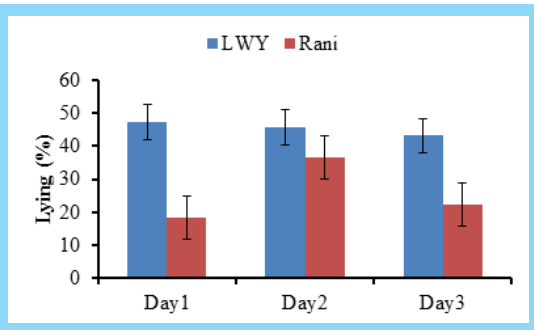


Fig. Percentage of time spent in lying condition in three consecutive days of the post-weaning period

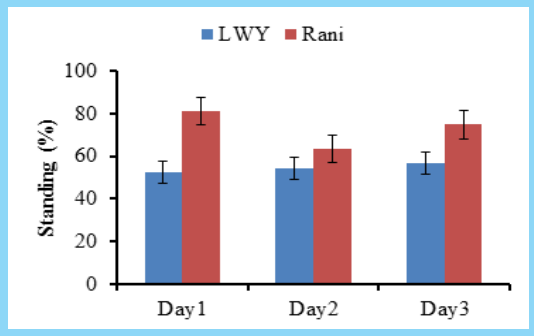


Fig. Percentage of time spent in the standing condition in three consecutive days of the post-weaning period.

Activity 2. Effect of microclimatic condition on the core temperature of newborn piglets

The newborn piglets do not have a well developed thermoregulatory system, which determines their dependency on the micro climatic condition. Therefore, the present study was initiated to assess the effect of microclimatic conditions on the core temperatures of the newborn piglets. For this purpose, the rectal temperature (RT) of the piglets were recorded from the 2nd day of their birth for three days at 2 hours interval during the day times (morning 0600h to evening 1600h). The microclimatic temperature, relative humidity and temperature-humidity index (THI) were recorded at the time of recording of rectal temperature. The RT is positively ($P<0.01$) correlated with environmental temperature and THI. The RT of the piglets follows a similar trend of environmental temperature and THI at the different hours of the days (Fig. 4). Comparable ($P>0.05$) RT was found in the piglets of LWY and Rani breeds in their early life; however, both the breed follows the corresponding trend of environmental temperature and THI. Furthermore, as the piglets get older i.e. with the progress of days in their life, the RT increased ($P<0.05$).

Table : Correlation between the rectal temperature and microclimatic variables.

		RT	Temp	RH	THI
RT	Pearson Correlation	1	.209**	-.298**	.189**
	Sig. (2-tailed)		0.001	<0.001	0.002
Temp	Pearson Correlation		1	-.851**	.998**
	Sig. (2-tailed)			<0.001	<0.001
RH	Pearson Correlation			1	-.819**
	Sig. (2-tailed)				<0.001
THI	Pearson Correlation				1
	Sig. (2-tailed)				

**. Correlation is significant at the 0.01 level (2-tailed)

Table : Rectal temperature of piglets and meteorological variables of the micro climatic condition in different hours of the day

	0600h	0800h	1000h	1200h	1400h	1600h
LWY (° C)	36.7±0.3	36.9±0.2	37.1±0.3	37.2±0.2	37.7±0.2	37.5±0.2
Rani (° C)	37.1±0.3	37.2±0.2	37.4±0.2	37.3±0.2	37.9±0.2	38.1±0.1
Temp (° C)	18.6±0.3	21.5±0.1	24.9±0.1	27.2±0.2	27.6±0.2	26.2±0.2
RH (%)	94.1±0.3	86.4±0.9	72.7±0.5	67.9±0.7	65.4±0.5	72.4±1
THI	18.5±0.3	21.2±0.1	24±0.1	25.9±0.2	26.2±0.2	25.1±0.2

LWY, Large white Yorkshire; Temp, micro-environmental temperature RH, relative humidity; THI,temperature-humidity index.

Temperature-humidity index were calculated with the formula of THI = db°C – {(0.31–0.31 RH) (db°C – 14.4)} given by Marai et al. (2007).

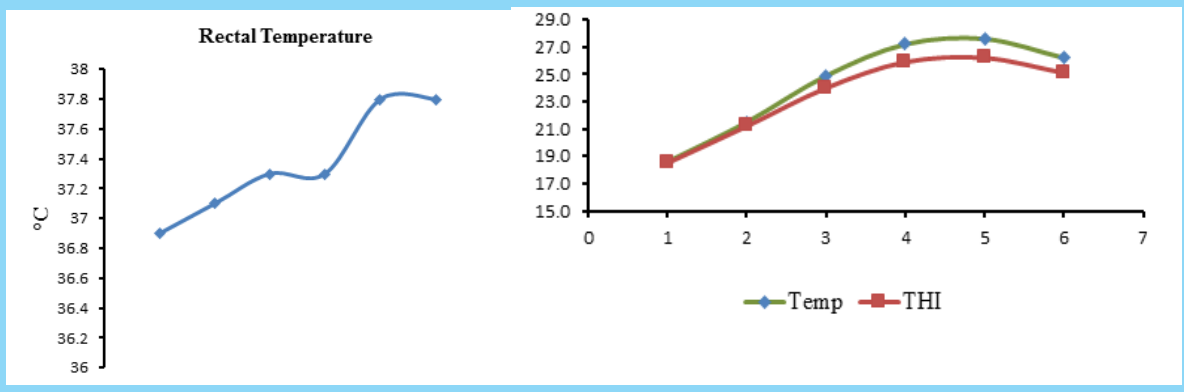


Fig. Rectal temperature, environmental temperature and temperature-humidity index in the different hours of the day.
Temp, micro-environmental temperature RH, relative humidity;
THI,temperature-humidity index.
Temperature-humidity index were calculated with the formula of THI = db°C – {(0.31–0.31 RH) (db°C – 14.4)} given by Marai et al. (2007).

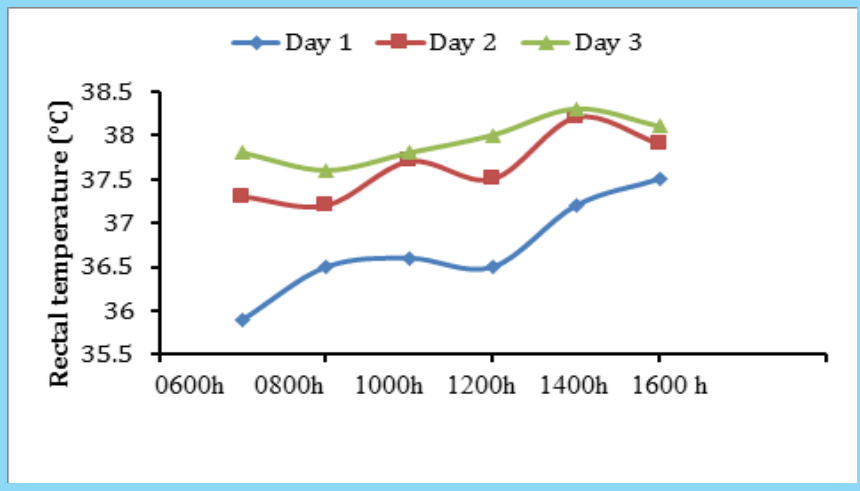


Fig. Rectal temperature of piglets in early days of life.

Institute project: Development of vegetable waste/fruit waste based pig feeds

Keshab Barman, R. Thomas and S.R. Pegu

Feeding value of guava fruit waste in crossbred pigs

Guava fruit waste was collected from the institute campus. Guava fruit was fed fresh. Eighteen crossbred (Hampshire x Ghungroo) grower pigs (weight 11.4-11.6 kg) of either sex were divided into three groups of six each in a randomized block design. The experimental pigs were fed with diets namely standard grower ration (SGR) supplemented with 0 % guava (*Psidium guajava*) fruit waste (GFW), 5% GFW and 10% GFW respectively by replacing maize grain in T_1, T_2 and T_3 groups. The average dry matter intake, digestibility coefficients (%) of nutrients were increased ($P<0.01$; $P<0.05$) with increased level of guava fruit waste in the experimental diet. Nitrogen balance (g/d) was found positive across all the groups. From this study, it is concluded that guava fruit waste can be supplemented at 10 % level in grower crossbred pigs for better nutrient utilization and also to reduce the feed cost.

Table : Effect of supplementation of guava on feed intake and nutrient utilization in crossbred grower pigs

	T_1	T_2	T_3	P value
DMI, g/d	736.00±7.30	837.20±9.81	887.80±20.66	0.00
Initial body weight, kg	11.43±1.26	11.78±1.72	11.65±2.66	0.991
Final Body weight , kg	12.38±1.27	13.03±1.73	12.95±2.72	0.969
Average Daily Gain, g/d	237.50±7.22	312.50±59.95	325.00±17.68	0.237
FCR: Feed conversion ratio	3.38±0.10	3.26±0.62	3.00±0.22	0.782
Feed cost per kg gain	81.07±2.46	78.27±14.80	72.07±5.19	0.782

T_1: supplementation of guava @ 0% by replacing maize; T_2: supplementation of guava @ 5% by replacing maize T_3: supplementation of guava @ 10% by replacing maize

Table : Effect of supplementation of guava on nitrogen balance in crossbred grower pigs

Group	N intake,g	NF,g	N-U, g	Total outgo,g	Balance	N-abs	N-abs as %Intake	NPU	BV
T_1	23.68 ±0.59	3.29 ±0.04	5.92^{c} ±0.59	9.21^{c} ±0.63	14.47 ±1.23	20.39 ±0.64	86.09 ±0.54	61.01 ±3.66	70.85^{a} ±3.81
T_2	24.88 ±0.27	3.64 ±0.14	3.08^{b} ±0.09	6.71^{b} ±0.05	18.17 ±0.22	21.25 ±0.13	85.39 ±0.41	73.02 ±0.09	85.52^{b} ±0.51
T_3	24.21 ±0.88	3.83 ±0.59	2.37^{a} ±0.24	6.21^{a} ±0.34	18.01 ±1.22	20.38 ±1.46	84.05 ±2.99	74.28 ±2.35	88.39^{c} ±0.35
P Value	0.492	0.594	0.013	0.027	0.131	0.767	0.736	0.057	0.021

T_1: supplementation of guava @ 0% by replacing maize; T_2: supplementation of guava @ 5% by replacing maize T_3: supplementation of guava @ 10% by replacing maize

N: Nitrogen, NF= Faecal Nitrogen; NU: Urinary nitrogen; abs: absorbed; NPU: Net protein utilization; BV: Biological value

Effect of feeding vegetable/fruit waste based silage on meat quality parameters in crossbred pigs

Protein content of the meat increased with increased level of silage in the ration. Moisture content decreased at higher level of silage in comparison to control diet; however, it did follow any pattern. Amino acid composition of meat did follow any pattern and found similar while mono unsaturated fatty acid content increased at higher level of silage in the diet.

Parameters	T_1	T_2	T_3
Proximate principles			
Fat	12.67	14.24	12.67
Moisture	64.85	63.06	64.49
Protein	19.71	20.66	20.72
Total Carbohydrate	10.88	12.83	11.68
Meat Amino Acid composition			
L-Alanine	0.64	0.61	0.64
L-Arginine	2.04	2.01	2.10
L-Ascorbic Acid	1.38	1.34	1.46
L-cystine	0.17	0.15	0.18
L-Glutamic acid	3.08	2.87	3.07
L-Glycine	0.01	0.00	0.02
L-Histidine	1.91	1.67	1.83
L-isoleucine	0.58	0.55	0.61
L-Leucine	1.11	1.08	1.19
L-Lysine	1.24	1.23	1.34
L-Methionine	0.39	0.35	0.41
L-Phenylalanine	0.57	0.55	0.61
L-Proline	1.35	1.27	1.35
L-Serine	0.84	0.78	0.84
L-Threonine	0.83	0.81	0.85
L-Tyrosine	0.73	0.70	0.74
L-Valine	0.81	0.76	0.81
L-Tryptophane	0.30	0.27	0.29
Meat Fatty Acid Composition			
Arachidonic acid	0.01	0.02	0.02
Butyric acid	0.01	0.02	0.02
C18:3n6	0.01	0.02	0.02
C20:3n3	0.01	0.02	0.02
C20:3n6	0.01	0.02	0.02

Capric acid	0.01	0.02	0.02
Caproic acid	0.01	0.02	0.02
Caprylic acid	0.01	0.02	0.02
Docosadienic acid	0.06	0.02	0.02
Docosahexaneic acid	0.01	0.02	0.02
Eicosapentanoic acid	0.01	0.09	0.02
Erucic acid	0.01	0.02	0.02
Lauric acid	0.01	0.02	0.02
Lenoleic acid	1.06	1.11	0.97
Mon unsatuarated FA	7.46	11.68	9.19
Myristic acid	0.51	0.50	0.49
Oleic acid	10.26	13.77	10.59
Palmitic acid	4.48	5.39	4.38
Palmitoleic acid	0.54	0.64	0.52
Poly unsaturated fatty acid	1.89	2.06	1.81
Saturated fatty acid	9.71	12.98	10.01
Stearic acid	1.37	2.70	1.83

T_1= Finisher ration containing 0 % vegetable waste silage, T_2= Finisher ration containing 10 % vegetable waste silage, T_3= Finisher ration containing 15 % vegetable waste silage; ^{a,b,c} superscript in a row differ significantly, $p<0.05$.

Inter-Institutional Project : Maize Production in NEH region for sustainable livestock production (Collaborative Collaborative project with IIMR, Ludhinana)

K. Barman, S. Banik, S.R. Pegu, Sunil Kumar and Swaraj Rajkhowa

Utilization of maize fodder and banana stems mixed silage on nutrient utilization in Large White Yorkshire grower pigs

Table : Nutritive value of maize fodder and banana stem

Ration	OM %	CP %	CF%	EE %	Ash %	NFE %
Maize fodder	90.65±0.08	7.95±0.04	32.84±0.49	3.59±0.31	9.35±0.08	46.26±0.14
Banana Stem	85.44±0.26	2.48±0.08	21.11±0.61	2.36±0.06	14.56±0.26	59.50±1.00

Fresh banana stem with banana leaf was used for making silage. The stems and leaves were cut into small pieces and exposed to sunlight for 2-3 hours. Similarly, green maize fodder at the time of flowering was cut into small pieces and then materials were mixed @ 2:1 ratio of banana stem : maize fodder. Then juggery and salt were added @ 4 % and 0.25 %.

Eighteen large white Yorkshire grower pigs (weight 11.7-11.9 kg) of either sex were divided into three groups of six each in a randomized block design. The experimental pigs were fed with diets namely standard grower ration (SGR) supplemented with 0 % banana stem with maize fodder silage, 10 % banana stem with maize fodder silage and 15% banana stem with maize fodder silage respectively in T_1, T_2 and T_3 groups. Analysis of samples is in progress.

Animal Reproduction

Flagship programme: Artificial Insemination in Pigs

Sunil Kumar and Rafiqul Islam

Demonstrations and lectures on artificial insemination in pigs were done in different trainings and awareness programmes sponsored by different agencies such as Kisan Biotech Project (DBT), Institute SCSP, Tribal Sub plan organized by ICAR-NRC on Pig, Rani.Sixspecific trainings including two National trainings on A.I. in Pig were conducted for farmers across the country. A total of 6 awareness programmes specifically for AI in Pigs for farmers were conducted in collaboration with KVK, Baksa, Dept. of Animal Husbandry, Govt. of Assam, Institute SCSP and Tribal Sub plan. The institute developed technology of 'A.I. in Pig' was transferred to Royal Orchid Land Pig Farms, Dibrugarh (Assam). Modern Boar Semen Production centre at ICAR- NRC on Pig, Rani is establishedfunded by North East Council, DoNER, Shillong. Further, under APART project, A.I. laboratories are being established at Diphu (Karbi Anglong), Sibsagar, Johrat and Khanapara in collaboration with State Veterinary Dept., Govt. of Assam. During the reported period 111 new farmers were trained as inseminators for self employment generation. During the reported period, 85 new farmers have bred their sows by artificial insemination with liquid semen supplied by ICAR- NRC on Pig, Rani.

Institute Project: Preservation of boar semen using different additives in liquid and frozen state

Rafiqul Islam, Sunil Kumar, Keshab Barman and Santanu Banik

Artificial insemination (AI) in pig is very much essential to get rid of the inbreeding problem that generally occurred in the pig farms due to lack of availability of quality boar either in the farm or within vicinity. This leads to breeding of sows at farmers' field either with inferior sires or with the related sires. AI is the only solution to all the problems particularly for reproductive management of pigs. For successful insemination quality semen doses must be available to the farmers with ease. Use of frozen semen does not exceed 1% of all the AIs done on the various swine farms worldwide, because cryopreserved boar sperm are more sensitive to the cell stress caused mainly by osmotic shock, the production of reactive oxygen species, exposure to low temperatures and the toxicity of the cryoprotectants. Due to the composition of sperm membranes with high protein to phospholipid and low cholesterol to phospholipid ratios, boar spermatozoa are highly sensitive to low temperatures. Consequently, fresh semen is almost exclusively used in pig artificial insemination. Therefore, a major challenge for the industry is to maintain the fertilizing capacity of the sperm for several days in extenders. The present study was planned to determine a promising extender for preservation of boar semen at 17^0C.

Semen samples were collected from adult healthy boars twice weekly with gloved hand methods. Immediately after collection semen samples were evaluated for motility, livability, sperm abnormality and sperm concentration. The samples showing more than 70 percent initial sperm motility and ≤20 percent sperm abnormality were initially held for 4h at 22^0C in a BOD incubator and subsequently extended with 4 different extenders (EXT) *viz.* EXT I: Androhep, EXT II: BTS (Beltsville Thawing Solution), EXT III: GEPS and EXT IV: Modena at 40 $X10^6$ sperm/ml and stored at 17^0C up to 96H in a refrigerator. A total of twelve samples was processed and stored during the

period up to 96 h. The quality of the stored semen sample was evaluated at 0 (Immediately after dilution), 24, 48, 72 and 96h of preservation. The percentage of spermatozoa that move in forward direction was estimated as the percent progressive motility.

Table: Effect of different extenders on the motility of boar spermatozoa during storage at 17^{0}C

Extender	0h	24h	48h	72h	96h
Androhep	87.12^{a}±1.29	75.00^{a} ±0.94	69.29^{a} ±1.70	59.17^{a}±3.52	50.00^{a}±2.24
BTS	88.75^{a} ±1.25	58.12^{b}±4.52	20.71^{b} ±8.76	0.83^{b}±0.83	0.00^{c}±0.00
GEPS	87.12^{a} ±1.60	72.50^{a} ±1.34	53.57^{a} ±7.38	45.83^{a}±6.63	36.00^{b}±7.31
Modena	86.88^{a} ±1.31	31.25^{c}±8.28	21.43^{b}±10.56	16.67^{b}±12.09	4.00^{c}±2.91
Overall	**87.47±0.66**	**59.22±3.86**	**41.25±5.46**	**30.62±5.85**	**22.50±5.20**

Mean with different superscripts (a,b,c) within a column differ significantly (p<0.01)

The progressive sperm motility of boar spermatozoa differed significantly (P=0.000) between the extenders at 24, 48, 72 and 96h of preservation at 17^{0}C. The sperm motility did not differ significantly at 0h of preservation. The Androhep and GEPS extender maintained significantly (p=0.000) higher motility than BTS and Modena upto 72 h of preservation and Androhep extender maintained significantly (p=0.000) higher sperm motility than other three extenders at 96h of preservation. From the present study, it is concluded that boar semen extended in Androhep and GEPS extender can be used for insemination up to 48h of preservation and only Androhep extender has the potential to use for AI upto 96h of preservation at 17^{0}C.

Fig. AI in Pigs (Awareness programme, Training and Capacity building)

Institute Project : Propagation of Artificial Insemination for establishment of multiplier units and optimizing reproductive efficiency in pigs at farmers' field

Sunil Kumar and Rafiqul Islam

Propagation of Artificial Insemination for establishment of Multiplier units at farmers' field

Several farmers were demonstrated A.I. in Pig and they were provided AI doses and insemination was done. Some of the sows and gilts farrowed. Pregnancy diagnostic and necessary veterinary aids were provided whenever needed. The further multiplication of pigs at their units is in progress. Some of the success stories on Propagation of Artificial Insemination are below:

1. Mr. Dipankar Rabha, Puijula, Block Jarubori: Performed AI and obtained the litter

2. Mr. Munindra Rabha, Andherijuli, Rani: Performed AI and gilt is pregnant

3. Mr. Harkant Rabha, Kamrup: AI done and on farrowing male and female piglet ratio was 5:3

4. Mrs. Beauti Boro, Rani, Kamrup: Performed AI in female and obtained the litter



5. Mrs. Sunita Rabha, Andherijuli Rani: Performed AI and gilt is pregnant


6. Mr. Ranjit Rabha, Kathalguri: Performed AI and gilt is pregnant 7. Mr. Sanjay Sarkar, Rani: Performed AI and litter obtained


Low cost boar semen preservation tool

Low cost semen preservation tool has been standardized and evaluated for the maintenance of controlled temperature required for boar semen preservation. The devices have been designed as portable one as well as for laboratory use also. The accuracy of temperature maintained is excellent at par with standards.

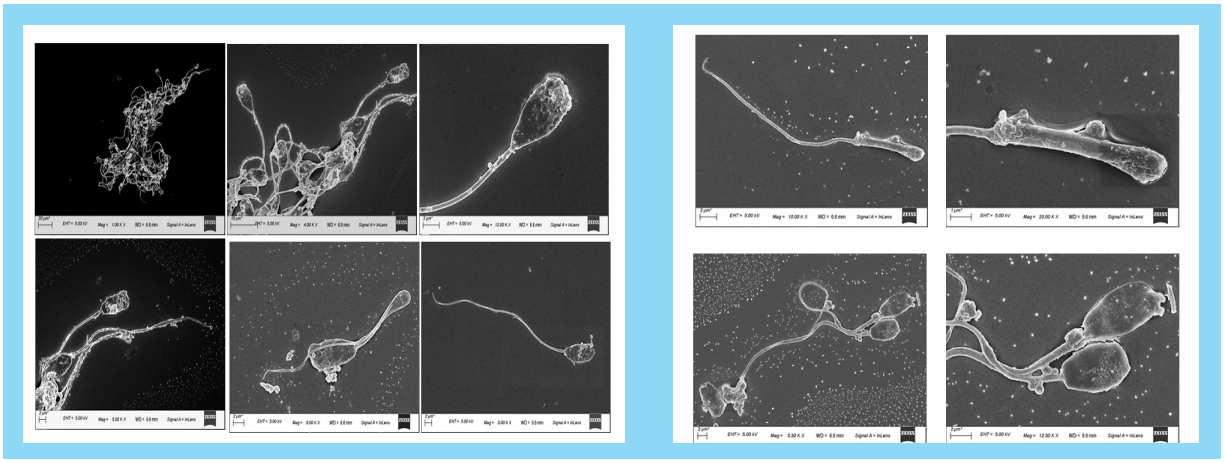
Low cost estrus induction and synchronization methods for optimizing reproductive efficiency

Estrous synchronization was done in some female pigs at farmers' field. The estrus synchronization was done using combination of chorulon and folligon.

Mr. Ujjal Bhuyan, Palasbari, Kamrup : Technical gudience was provided, synchronization was done and litter obtained

Electron Microscopic studies on Boar sperm

Electron microscopic studies were carried out for boar sperm. Further experimentation and data interpretation is in progress.



3. Biochemical characterization of seminal gel and its application for biostimulation in pigs

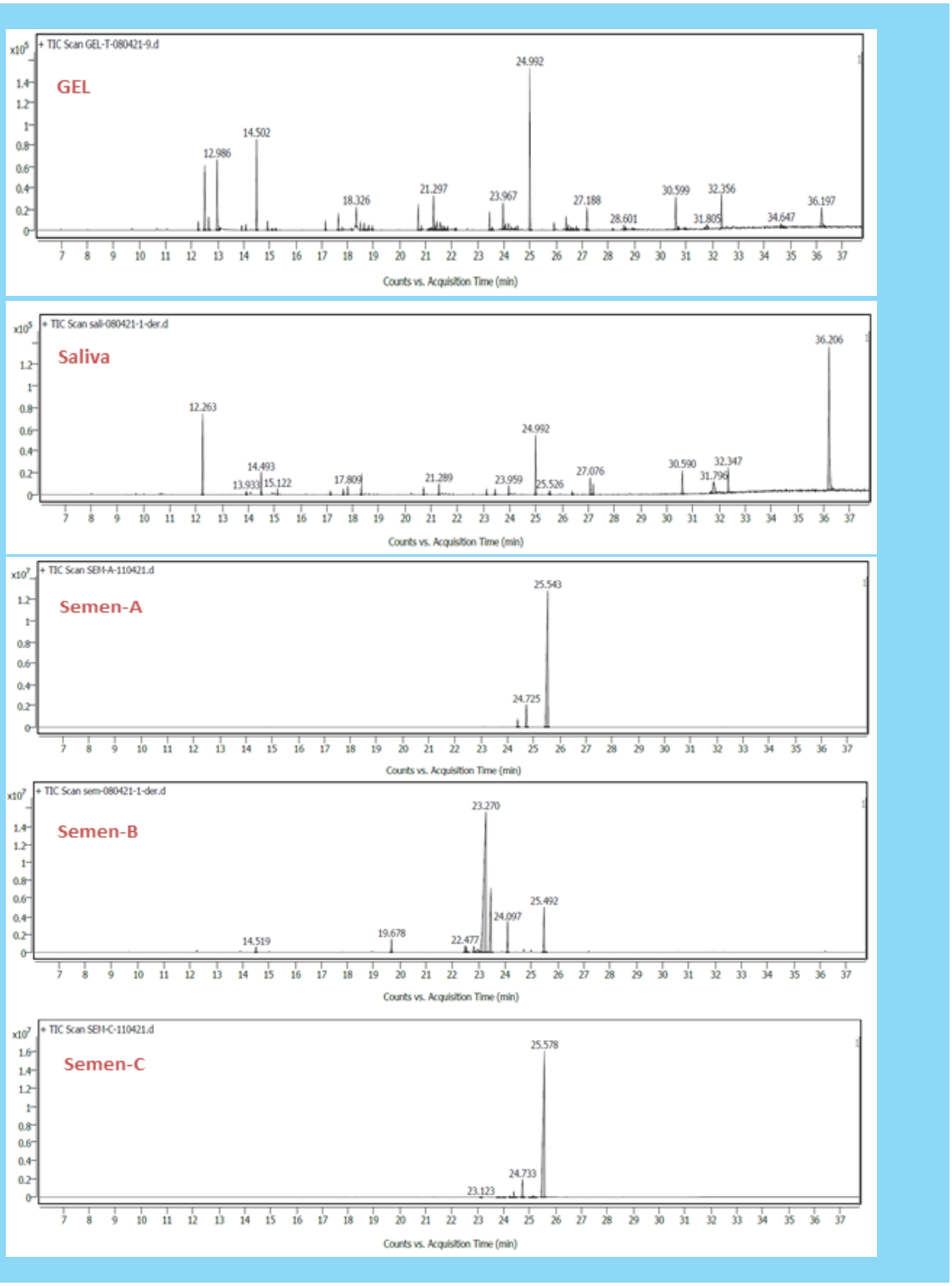
Artificial insemination is the first generation biotechnology which has reached at farmer's door step. In this technique, training of males for semen collection is one of the toughest tasks.

To train the young males, requires patience, good understanding of the psychological behavior of the male, handler's experience and comfort environment. Further, Only a very few reports are available on biochemical composition of boar seminal gel and its application with respect to biostimulation. Gel mass gets putrefied at room temperature over a period of more than 6 hours and subsequent to which it gives bad smell. For the same, preservation of gel mass has been standardized.

Biochemical Characterization of boar seminal gel, saliva and semen

The evoprated samples under vaccum concentrator then reconstituted with 100µL of n-hexane and injected 1µL into GC_MS for sample analysis. The dried sample after derivatization was mixed with n-hexane (300µL) and vortexed. An aliquot of 1 µL was injected into GC-MS (GC 9000 and MS of G7077B, Agilent Technologies, Palo Alto, CA, USA) for further analysis. The GC-MS analysis was carried with the following conditions. The injector temperature was maintained at 280 °C and the

oven temperature program with initial oven temperature was held at 70 °C for 4 min, then increased to 300 °C at a rate of 10ºC/min and finally held for 5 min. Helium was a carrier gas with a flow rate of 1 ml/min. The DB -5MS capillary column (30 m X 250 µm i.d. X 0.25 µm film thickness in split less mode was used. The data was acquired with electron ionization mode at 70 eV. The MS source and transferline temperature were set at 230 °C and 290 °C respectively. Full scan mass spectra were acquired in the mass range of m/z 29-600 with an initial solvent delay of 6 min. The peaks acquired by GC-MS were identified by comparing their mass spectra with NIST library mass spectra's.



Estimation of biostimulatory effect of seminal gel for training of boars

The gel mass was used for training of young males. For training of males, a total of 19 males were daily exposed to gel mass by rubbing on the dummy sow. Subsequent to which sexual behavioral parameters like hours taken to smell to gel, interest in dummy, biting to dummy, salivation, licking to dummy, erection of penis, mounting on dummy and hours after first gel exposure to first semen collection was estimated. A total of 19 males were used as experimental animals for exposure to seminal gel. Out of 19 males, 12(63.15%) males were able to get trained. It was observed that boars get trained after 300.00±39.72 hours of daily exposure to seminal gel.

Further, six (6/12) animals were exposed to combination of seminal gel and boar saliva for the comparison of exposure of gel only and combined mixture of gel and saliva. It was found that time (hrs) taken by boars to get trained on exposure to combination of seminal gel and saliva (244±22.19) was lesser than on exposure to gel alone (356±61.85). In conclusion, seminal gel can be used as a measure to train the boars efficiently.

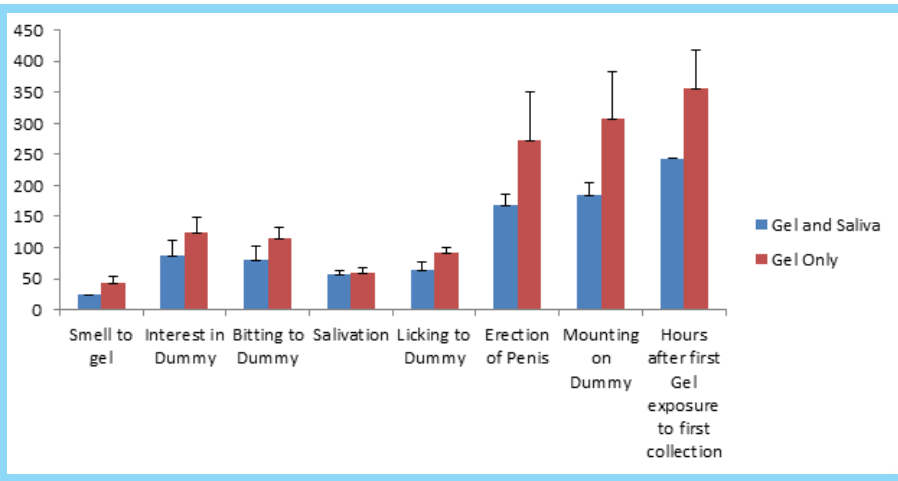


Fig. Comparison of effects on sexual behavior for boar training using seminal gel alone and combination of Gel and saliva. The graph indicates that sexual behavior parameters were observed faster on exposure to combination of Gel and saliva than Gel alone.

Table : Comparison of effects on sexual behavior for boar training using seminal gel alone (12) and combination (6) of Gel & saliva and for all seven trained males using gel exposure

Treatment (No. of Animals)	Hours (Hrs) from treatment/exposure to observation of sexual behavior							
	Smell to gel	Interest in Dummy	Biting to Dummy	Salivation	Licking to Dumm	Erection of Penis	Mounting on Dummy	Hours after first Gel exposure to first collection
Gel + Saliva (6)	24±00	88±24.26	80±22.62	56±07.15	64±07.15	168±17.52	184±20.86	244±22.19
Gel (6)	44±9.03	124±24.49	116±15.94	60±6.57	92±9.03	276±79.14	308±74.90	356±61.85
Gel (12)	34.00±6.06	106.00±17.91	98±14.70	56±04.46	76.00±08.50	218.00±46.64	246.00±46.27	300.00±39.72

Estimation of biostimulatory effect of seminal gel for estrus induction in gilts and sows

The preserved gel mass was used for estrus induction in females. A total of 80 females were exposed to gel mass by keeping in the pen of female near to snout as much as possible. Subsequent to which parameters such as restlessness, urination, homosexual mounting, vulvar swelling,

and redness of vulva were noted. The heat was confirmed by back pressure test in combination with other visual signs. It was observed that 49 females showed induction of heat after exposure to gel. The positive back pressure test in all estrus induced females (n=40) was observed after 262.45±20.06 hrs. from first time exposure of gel only. All heat induced animals did not showed the all the parameters undertaken to identify the females in heat.

Table : Hours taken for expression of different signs by estrus females on daily exposure to boar seminal gel and combination of Gel and saliva

Estrus Signs observed after daily exposure of Gel/Saliva combination	Hrs from First exposure of Gel/Saliva combination	
	Gel Alone (40)	Gel +Saliva (9)
Interest in Gel	28.20±1.92	24
Movement of tail	105.23±09.74	128±18.76
Restlessness	74.40±7.52	64±13.26
Frequent Urination	96±9.68	144
Redness of Vulva	78.6±6.18	82.66±16.05
Swelling of Vulva	106.66±8.32	114.66±17.78
Mounting on Mates	226.88±29.45	192±12.39
Positive Back Pressure	262.14±20.06	216±12.64

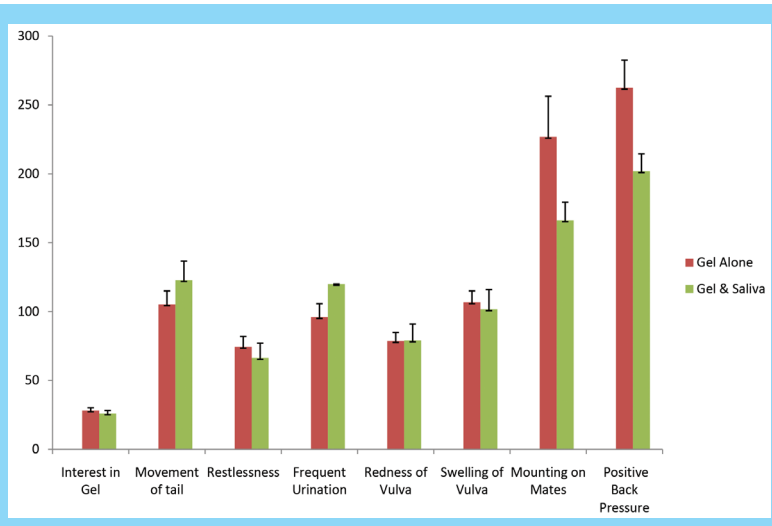


Fig. Comparison of effects on observations of different signs of estrus using seminal gel alone and combination of Gel and saliva. The graph indicates that estrous was observed earlier on exposure to combination of Gel and saliva than Gel alone.

Further, to intensify the effect of gel, addition of boar saliva was also tried to induce the heat in the females. A total of 9 females showed heat in response to exposure to combination of gel and saliva. It was found that time taken to get in heat was lesser in females exposed to combination of gel and saliva than gel alone. In conclusion, it is shown that gel can be used effectively to induce the heat in females which can be intensified further in combination with boar saliva.

In conclusions, seminal gel can be used to induce estrus and synchronization in females and training of males for artificial insemination purpose in swine. Combination of seminal gel and saliva has more intense biostimulation effect than gel alone for training of males as well as induction of estrus in gilts and sows.

Inter institutional project : Physio-genomic responses and MCT profiling of exotic and Indigenous pig breeds in heat stress during different seasons

(Inter institutional collaborative project with College of Veterinary Science & Animal Husbandry, Tripura)

B C Das, Mohan N H, Jaya, Kalyan De, Juwar Doley and Avishek Paul

Under this objective some work have been carried out in indigenous Mali pig for Tripura. Tripura is home to important indigenous breed or desi pig mainly dome and Mali among which Mali has been very recently recognized as breed by National Bureau of Animal Genetic Resources, India. The Mali pig is mostly reared by tribal population in Tripura and is very much preferred due to certain characteristics like less susceptibility to diseases, easy rearing by traditional rearing system and feeding on local forage and kitchen waste. Under this present project blood and tissue samples were collected from Mali pigs during slaughter in local market of Dhalai Tripura in the month of December, 2020 (Winter Season). The Blood samples were aseptically collected from animals in vacutainer tubes (4ml) and plasma was separated by centrifugation at 1500 RPM for 30 min. The serum/plasma and tissue (thigh muscle and colon tissue) samples were stored at –20 °C until further analysis. Hematological parameters were analyzed using Auto Haemato-analyzer (Model. BC 2800 vet). The serum samples were used for estimation of important metabolites including total protein, albumin, globulin and enzymes levels like aspartate transaminase (AST) and alanine transaminase (ALT) levels by spectrophotometric (Double Beam Spectrophotometer 2202, Systronics, India) methods using commercially available diagnostic kits (Coral) following standard protocol. The results of Blood biochemical parameters are listed below.

Sl no.	Blood Parameters	Observations
1.	Total RBC (*10^6/µl)	9.335 ± 0.30
2.	Hemoglobin (gm/dl)	14.683 ± 0.22
3.	Total WBC (*10^3/µl)	30.25 ± 0.60
4.	Total Lymphocyte %	71.00 ± 2.38
5.	Total Granulocyte %	25.16 ± 2.05
6.	Monocyte %	4.03 ± 0.42
7.	MCV	49.566 ± 1.21
8.	MCH	15.750 ± 0.38
9.	MCHC	31.261 ± 0.29
10.	Platelet count ((*105/µl)	2.166 ± 7.96
11.	Plasma Total Protein (gm/dl)	6.56 ± 0.145
12.	Plasma Albumin (gm/dl)	3.95 ± 0.08
13.	Plasma Globulin (gm/dl)	2.65 ± 0.12
14.	A/G ratio	1.23 ± 0.06
15.	Plasma AST (IU/L)	37.34 ± 1.81
16.	Plasma ALT (IU/L)	35.00 ± 2.40

Besides the estimation of blood biochemical parameters, the primers of HSPs and MCTs have been designed and process for procurement has been initiated.

ICAR-National Fellow Project: Development of thermo-tolerant pig through biomarker assisted selection

Mohan. N.H

During the period of report (Jan to Dec 2020) experiments were conducted to identify the pathways related to thermal stress through both *in vivo* and *in vitro* experiments. For *in vitro* experiments a fibroblast based primary cell lines were used as a model for studying heat stress.

Experiments were undertaken in the primary fibroblast cultures isolated from porcine dermal tissue maintained in a humidified atmosphere with 5% CO_2 at 37°C in Dulbecco's Modified Eagle's Medium with 10% Foetal Bovine Serum (FBS) and antibiotic-antimycotics. Porcine fibroblast cells were subjected to acute heat shock by incubating at 41°C in a humidified atmosphere with 5% CO_2 for one hour. The control cell line (maintained at 37°C) and treated (41°C for 1 hr) were user for experiments. The RNA isolated from heat shock treated and control cells were subjected to whole transcriptome analysis. The bioinformatics analysis shows that significant difference in the number of transcripts, especially protein coding RNAs during heat shock. The distribution of genes and gene ontology is shown in following figures.

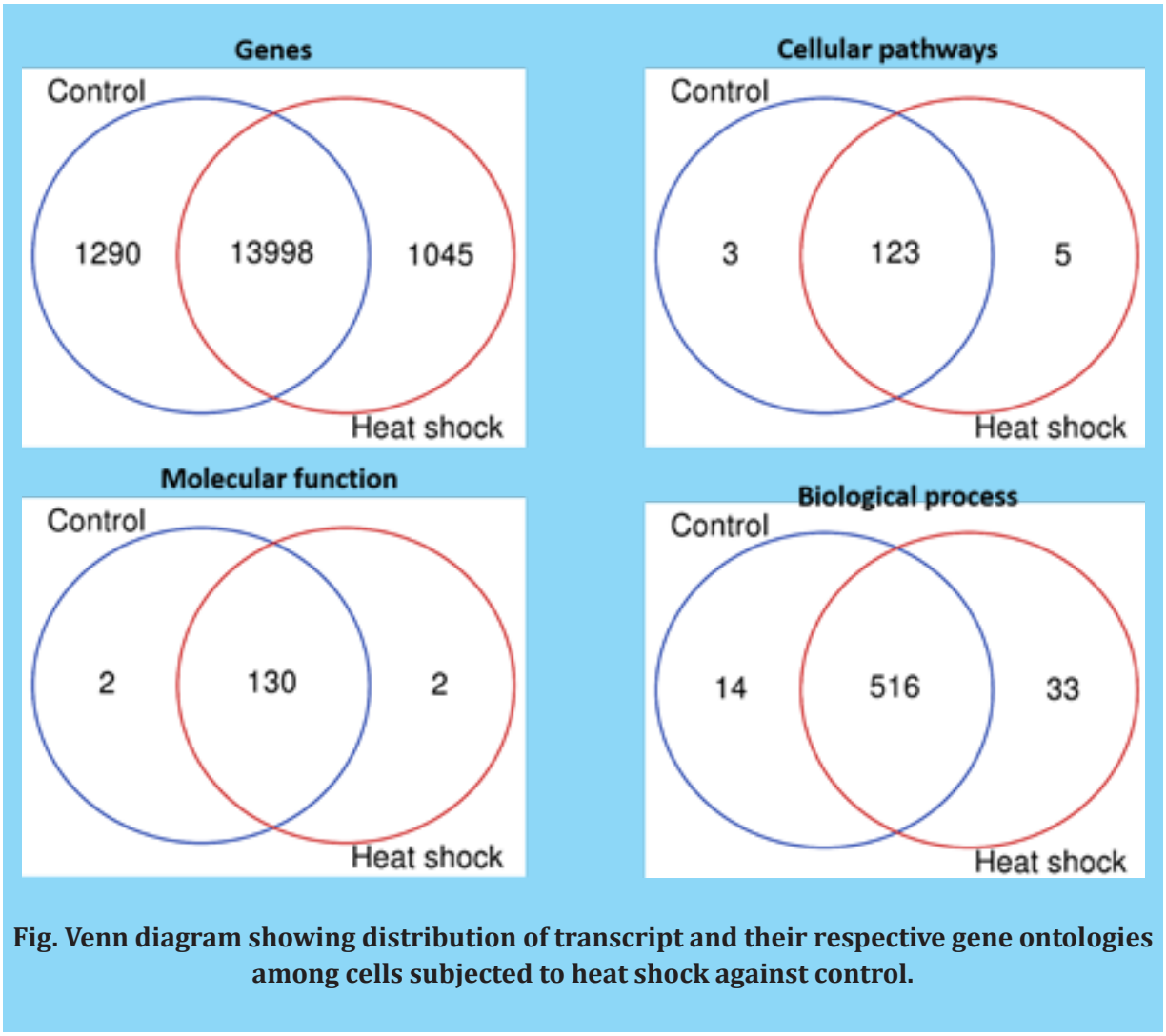


Fig. Venn diagram showing distribution of transcript and their respective gene ontologies among cells subjected to heat shock against control.

Of the total 15288 transcripts detected, there were 13998 genes commonly expressed between control and heat shock treated cells. Functional analysis of differentially expressed genes (366 nos) indicate significant enrichment for chaperone cofactor-dependent protein refolding (GO:0051085), 'de novo' posttranslational protein folding (GO:0051084), chromosome condensation (GO:0030261), 'de novo' protein folding (GO:0006458), chaperone-mediated protein folding (GO:0061077), positive regulation of ATPase activity (GO:0032781)response to unfolded protein (GO:0006986), cellular response to unfolded protein (GO:0034620), positive regulation of fibroblast proliferation (GO:0048146), endoplasmic reticulum unfolded protein response (GO:0030968), negative regulation of MAP kinase activity (GO:0043407), regulation of cell cycle arrest (GO:0071156), cellular response to topologically incorrect protein (GO:0035967), response to topologically incorrect protein (GO:0035966) pathways indicating cellular response to stress through several responses to promote protein folding. Among the reactome pathways, HSF1-dependent transactivation (R-SSC-3371571), HSP90 chaperone cycle for steroid hormone receptors (SHR) (R-SSC-3371497), Cellular response to heat stress (R-SSC-3371556), Cellular responses to stress (R-SSC-2262752), Cellular responses to external stimuli (R-SSC-8953897) were significantly enriched (P<0.01).

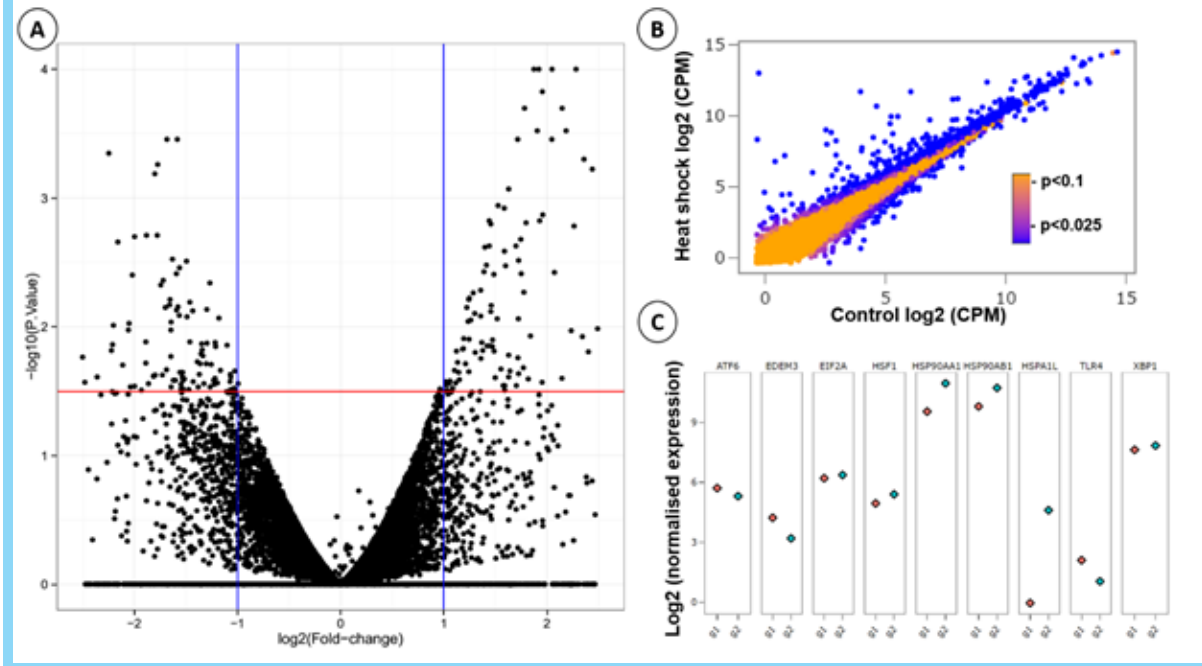
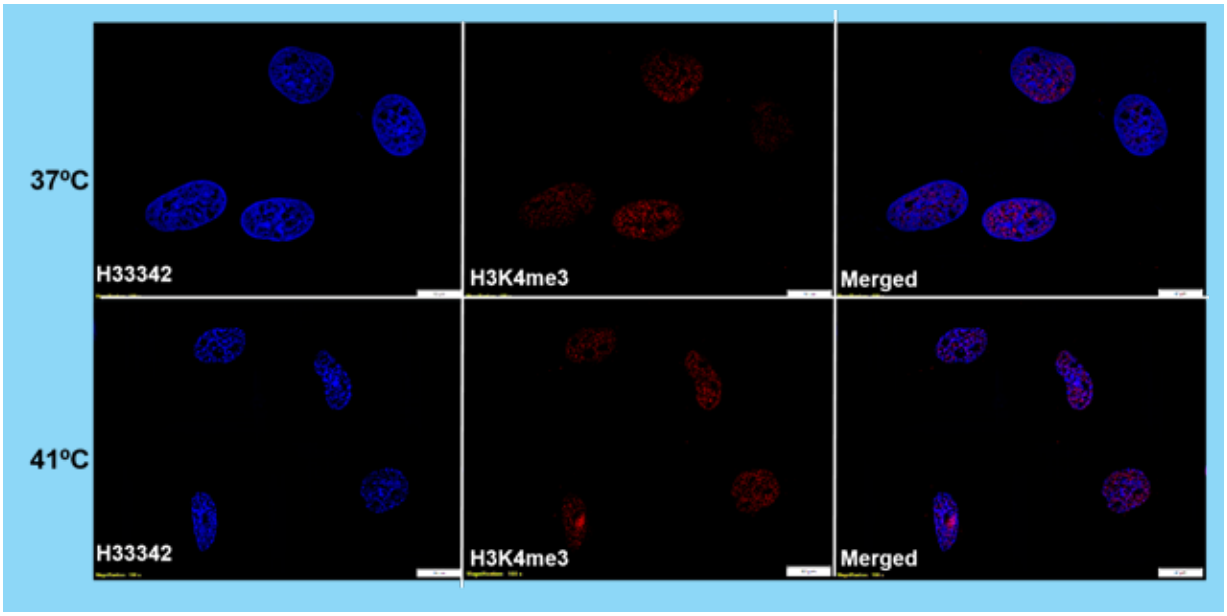


Fig. Distribution of transcript levels in porcine fibroblasts subjected to heat stress

A. volcano plot showing p values against the fold changes. B. Distribution of PFKM values in control and heat stressed cells C. Box and whisker plots of log2(FPKM) values with dot plots superimposed to show the raw data and averages are denoted by open diamonds. Green diamond-heat shock; red diamond- control.

Further, immunofluorescence experiments were also conducted to understand role of tri-methylation at the 4th lysine residue of the histone H3 protein during heat shock response.



Based on the genomic data and previous studies, a draft microarray for screening animals with relative increased tolerance as well as minimum level of major production traits adaptation traits. For identification and development of heat tolerant animals, pigs from different breeds (Large White Yorkshire and Ghungroo) reared at ICAR-NRC on Pigs were identified and screening for presence/expression levels of thermotolerance related genes. The animals were selected based on performance of parents and individual animal for maker screening. Blood samples were collected were processed for RNA isolation, cDNA synthesis and Real-time PCR. The pigs of selected breeds (Ghungroo and Large White Yorkshire) were subjected to variable temperature and humidity in a controlled climate chamber.

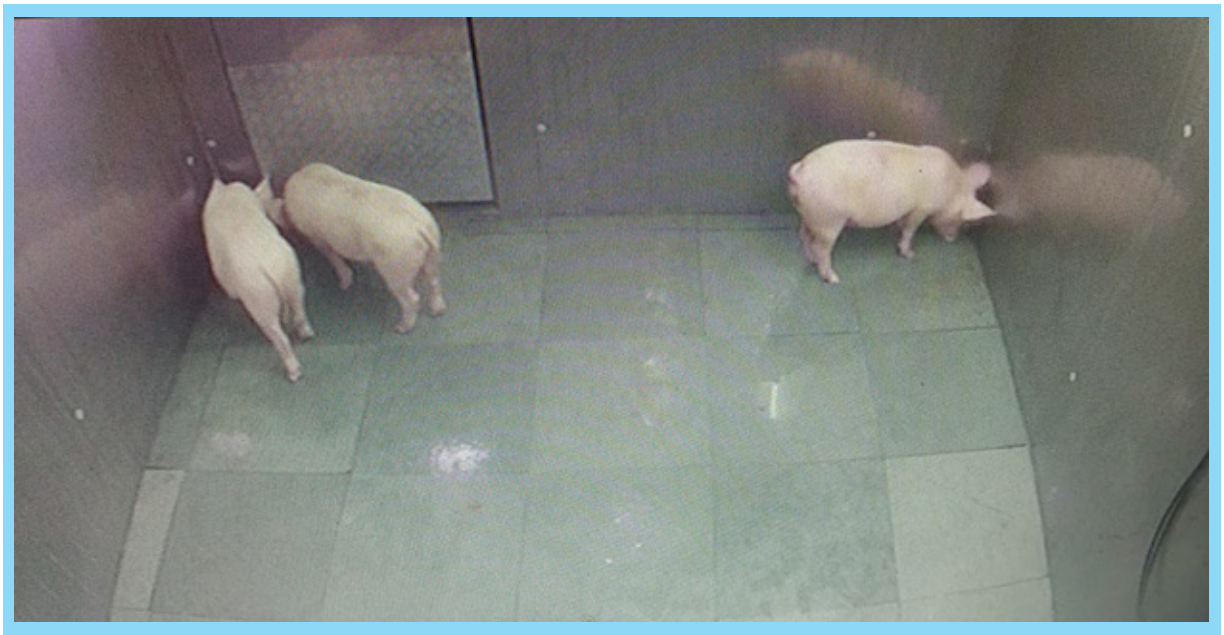


Fig. Animal experiments in climatic chamber under controlled microclimate conditions

Based on the screening of animals for expression profile of genes and in vitro transcriptomic changes during heat shock response signaling, the animals with higher heat tolerance will be used for further experimentation.

ICAR-LBS award project : MicroRNA mediated regulation of physiological responses during heat stress in pigs

Mohan. N.H

In the present project, porcine microRNAs (miRNA) during heat stress response was extensively examined using three different approaches, namely miRNA sequencing, isolation of RNA associated with degradation pathways of mRNA using RNA immunoprecipitation (RIP) followed by deep sequencing and examination of products of miRNA directed mRNA degradation using degradome sequencing. The fibroblast cells were subjected to acute heat shock (41 deg C), (control at 37 deg C) and processed for isolation of RNA and subsequently processed for synthesis of cDNA library and analysis. During the study 336, 84 and 10 miRNA were identified using small RNA sequencing, RIP with Argonaute protein 2 (AGO2) antibody and degradome sequencing. Overall, 396 miRNAs known and novel miRNAs were identified during the study. With the assistance of online tools, 9067 target genes of miRNA in pigs were also identified. The results of the study was validated using real time PCR. The distribution of miRNA identified using different approaches and its comparison with existing data available in miRNET data base is shown in below.

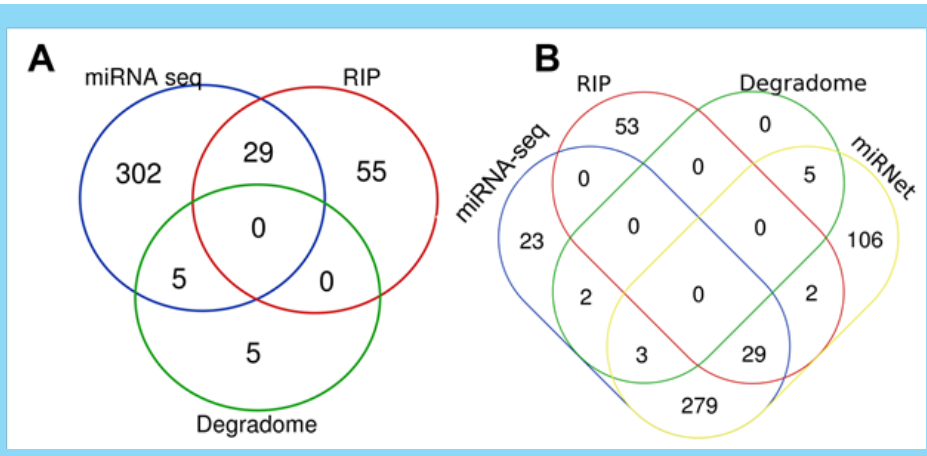


Fig. Overall distribution of miRNA identified using different approaches

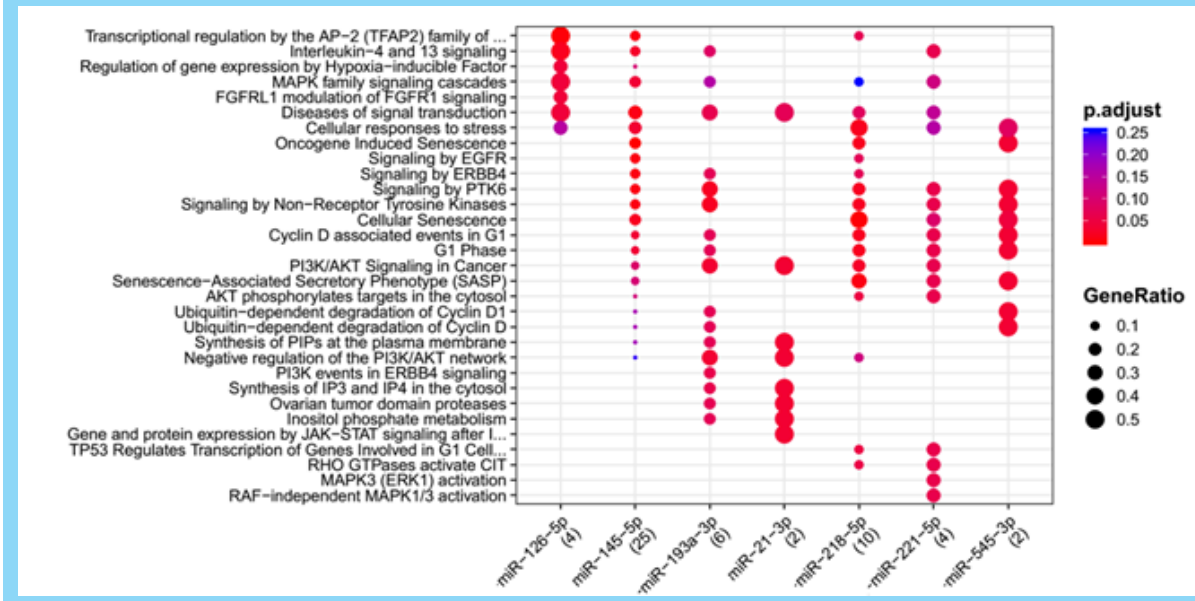


Fig. Distribution of pathways by differentially expressed miRNA

The distribution of pathways by differentially expressed miRNA and network of miRNA with its targets are shown following figures.

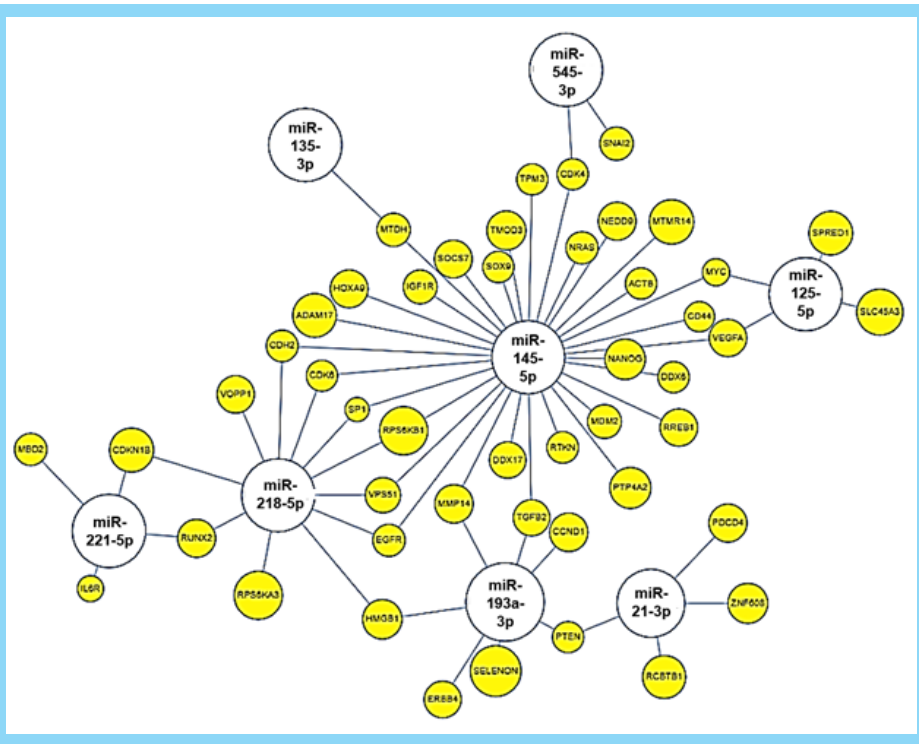


Fig. Network diagram showing the interaction between miRNAs and heat shock response.

The structure of selected precursor hairpin miRNA and the mature miRNA based on the experiments are shown in fig 15. The representative T plots (Fig 1) indicate the site and cleavage of targets by miRNAs including miRNA sequence and location of degradome binding.

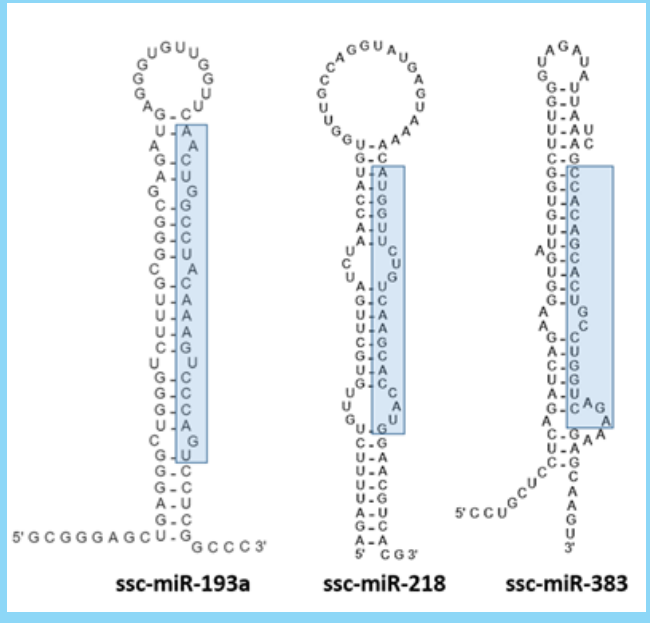


Fig. Structure of selected precursor miRNA in Sus scrofa. The sequences inside the colored box indicates mature 3p miRNA sequence.

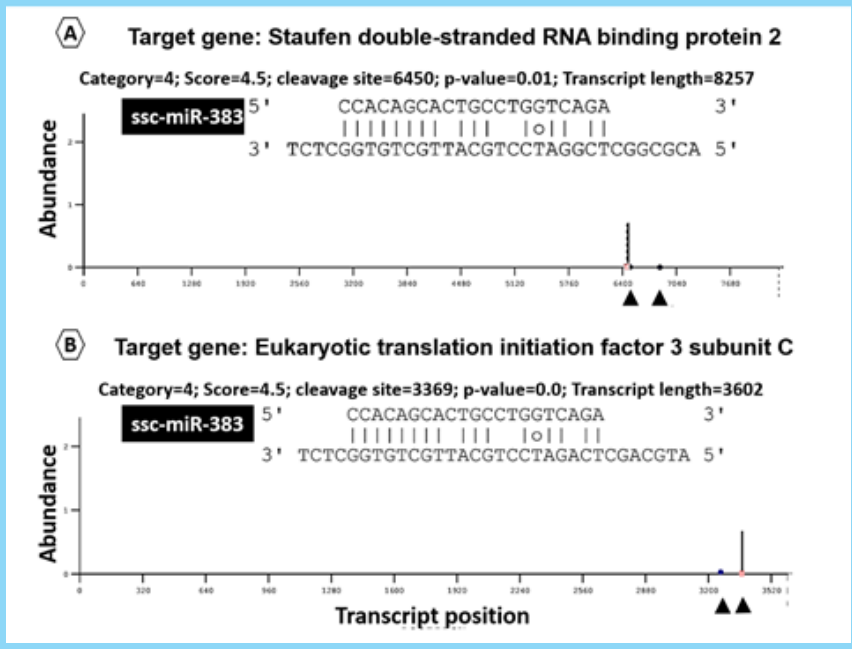


Fig. T-plots of the predicted targets cleaved by miRNAs confirmed by degradome sequencing. The alignment along with the detected cleavage frequencies and miRNA target sequence. Category 4 indicated that there is one raw read in position and alignment score was 4.5. The T-plots showed the distribution of 3′ end of the degradome tags within the full-length of the predicted target mRNA sequence. The arrows show the alignment position of degradome.

Validation of results of sequencing study with real-time PCR

Concentration of selected mIRNA transcripts were assessed using specially designed primers commercially available (Fig 17). The results of PCR was in line with the results of miRNA sequencing and degradome sequencing.

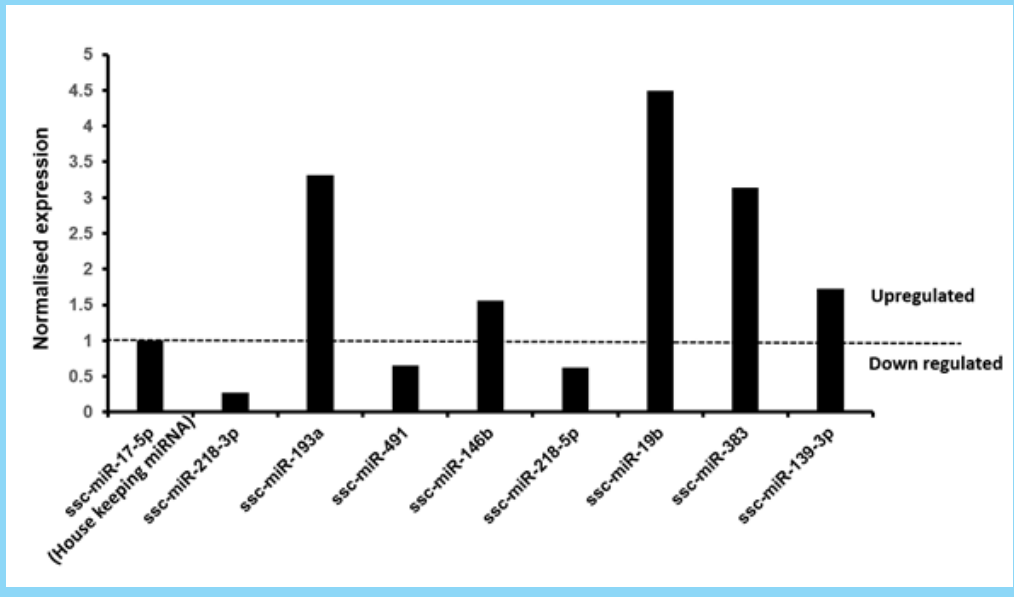


Fig. Relative expression of selected miRNAs during acute heat shock. The expression was calculated against control conditions and housekeeping miRNA (ssc-miR-17-p).

Institute project: Development of early fertility markers in pigs

Mohan. N.H, Sunil Kumar and R.Thomas

Evaluation of semen quality through microscopic analysis of morphology, acrosome, cell membrane and functional tests such as spermatozoal motility, methylene blue reduction, mitochondrial potential has been used effectively assess the male fertility and fertilisation related events. However, increasing number of idiopathic infertility and inability of explain differential fertility of boars with similar motility and morphological parameters points to the inadequacy of conventional methods for more precise assessment of fertility. In the present study, boar semen from 4 more animals examined to assess spermatozoal transcriptome using RNA-seq and compared with the fertility status of boars used in the AI programme of the institute. The expression statistics of genes during spermatozoal RNA sequencing was reported earlier. Based on the transcriptome, genes were selected representing roles in the spermatogenesis, spermatozoa, fertilisation and zygote development. The expression profile of these genes in the spermatozoa of 18 boars with known fertility status to validate the transcriptome study. During the period of report, six semen samples were subjected to whole transcriptome analysis to identify differentially expressed RNAs in the animals with varying fertility. A total of 27881 and 27997 transcripts were detected in boars with low and high fertility, respectively. There were 27018 common genes with 979 genes unique to animals with high fertility.

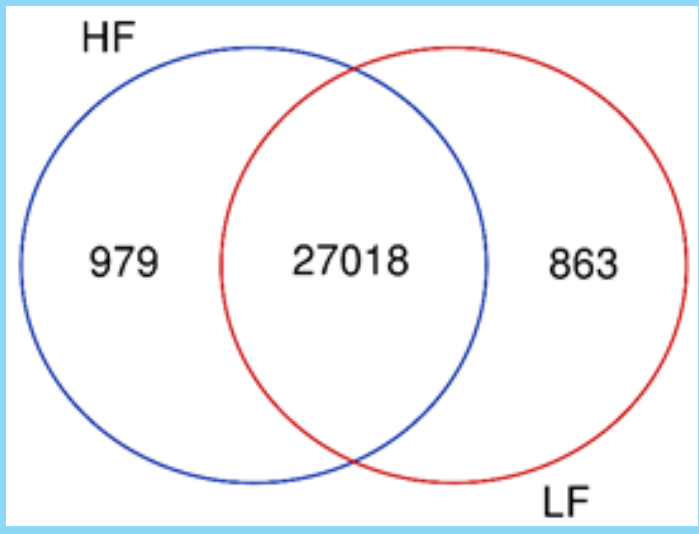


Fig. Distribution of transcripts in boars with high (HF) and low (LF) fertility

The distribution of pathways associated with genes with highest abundance (FPKM) values in high fertile animals is shown in fig 6. Analysis of significantly different genes ($P<0.05$) indicates a major role for olfactory signaling or chemical stimuli reception in determining fertility.

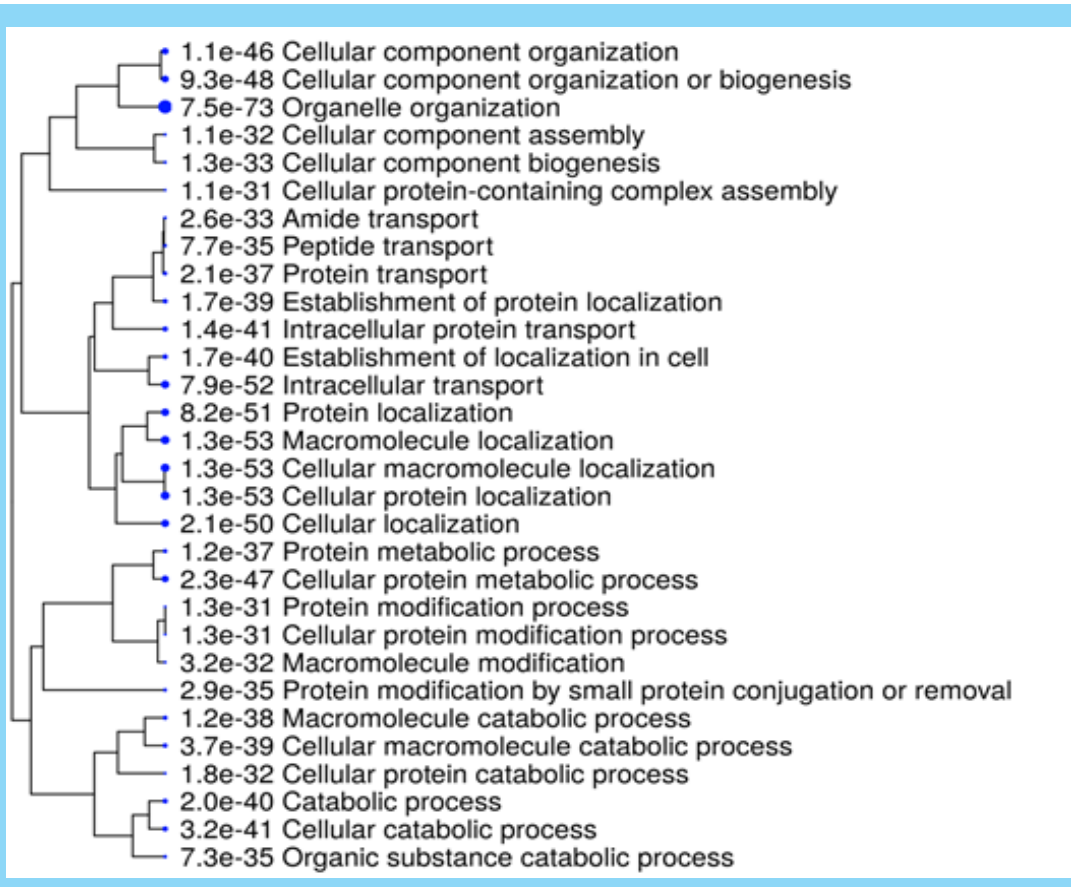


Fig. Hierarchical clustering tree summarizing the correlation among significant pathways in top 5000 genes in animals with high fertility.

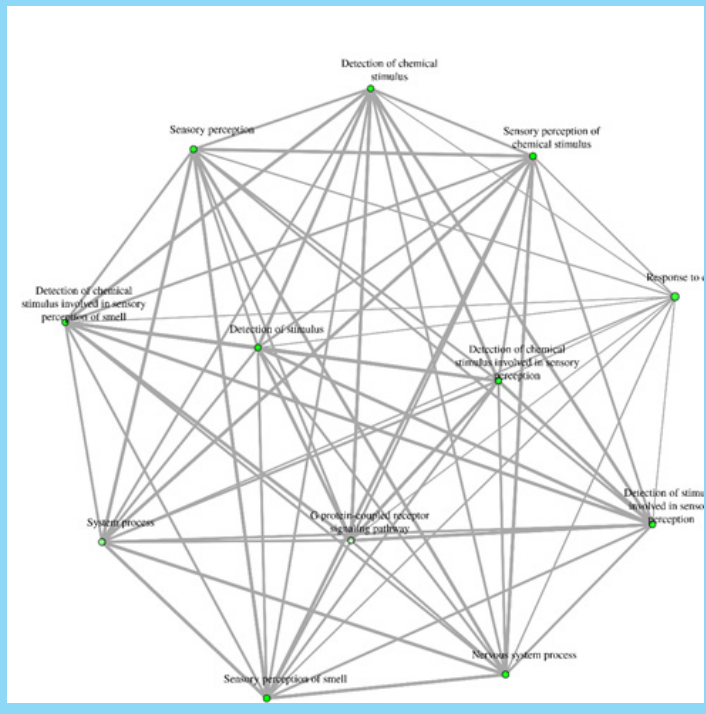


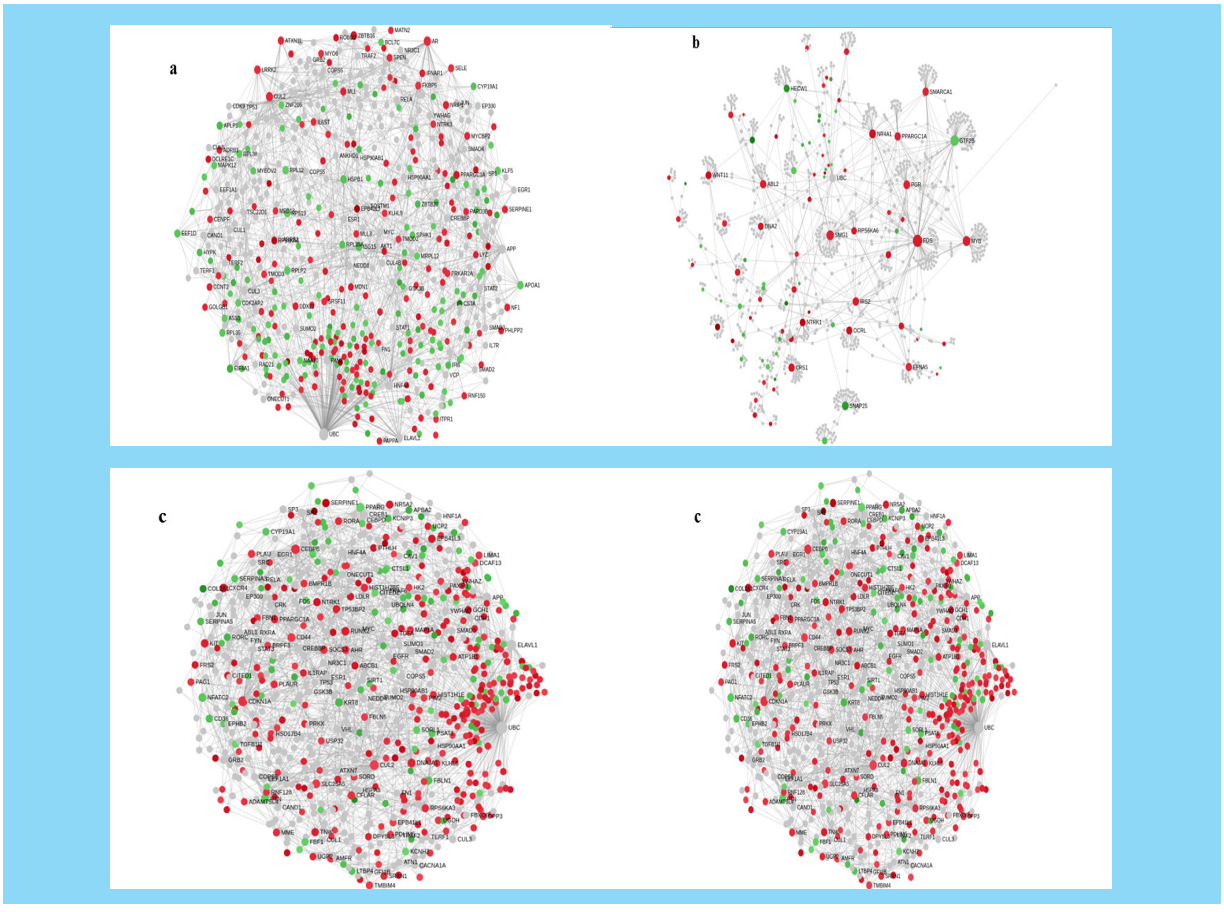
Fig . Network of functional annotation of differentially expressed genes in animals with differing fertility were related to olfactory sensation or reception of chemical stimuli

Institute Project: Characterization of immunogenic and angiogenic growth factors regulating ovarian function in pigs

Jaya, Mohan N.H., P.J. Das, Seema R. Pegu, Sunil Kumar, Satish Kumar

Network analysis for differentially expressed genes

To gain insight into physiological processes differing between different developmental stages of corpus luteum (CL) viz. early luteal (EL), mid luteal (ML), late luteal (LL) and regressed (R), network enrichment analysis was carried out with differentially expressed genes (DEGs) with ±2 FC (fold change) using the IMEx Interactome database employing NetworkAnalyst online tool. In this repository, genetic interactions in humans are well defined, whereas those in *Sus scrofa* are absent. Hence, g:Orth in g:Profiler web server was employed to produce human ensemble orthologues (functionally equivalent genes), which were imported as seed genes. 'Minimum order Network' option was selected to retain only the seed nodes (DEGs with FC ±2 present in our list) and essential connecting nodes for better visualization. The diameter of the node was based on the degree of connectivity and betweenness centrality of the gene in the network. The FC is shown by colour; the darker a dot is the more extreme is the FC. Therefore, larger diameter meant higher potential to be a 'hub' gene. Highly interconnected hub gene of functional network like AR (Androgen receptor), ISG15 (ISG15 ubiquitin like modifier), FOS (Fos proto-oncogene, AP-1 transcription factor subunit), GTF2B (general transcription factor IIB), CUL2 (cullin2), CDKN1A (cyclin dependent kinase inhibitor 1A), PTN (pleiotrophin), GHR (growth hormone receptor) and NEDD8 (neural precursor cell expressed developmentally down-regulated 8). These hub genes were further analysed through the literature mining and were found to be associated with diverse cellular functions like luteal angiogenesis, growth, steroidogenesis, luteolytic sensitivity and regression which has definite role in controlling CL function.



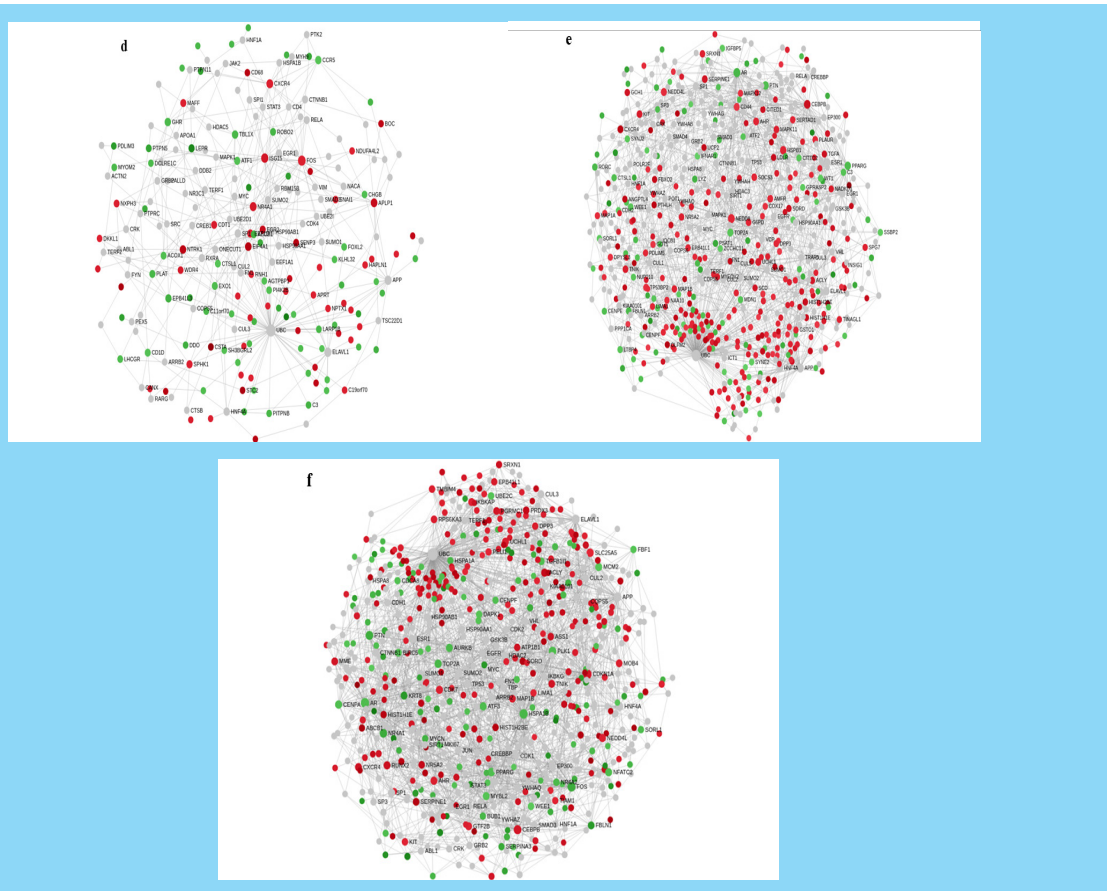


Fig. Network analysis diagram representing hub genes between (a) EL vs. ML; (b) EL vs. LL; (c) EL vs. R; (d) ML vs. LL; (e) ML vs. R; (f) LL vs. R stages. Red and green dots refers to upregulated and downregulated hub genes respectively. Grey means connecting nodes not present in our list.

Establishment of porcine luteal cell culture system

Entire reproductive tract from Large White Yorkshire sows were collected from abattoir within 20-30 minutes of slaughter and were transferred to the laboratory in 1X phosphate buffer saline solution with antibiotic maintained at 37^0 C. Only ovaries with morphological evidence of at least one recent cycle were selected for the study. Ovaries were graded on scale of (+) to (+ + + + +) and they were assigned to functional stages of the estrous cycle. Early stage CLs were excised from the ovary and were then sliced up using BP blades. The minced luteal tissue were then digested by incubating in (DMEM) medium containing collagenase, DNase I and bovine serum albumin (BSA). The cells were then filtered through a 70 µm filter and resuspended in culture medium with 12% fetal bovine serum and and 1X antibiotic–antimycotic solution. Trypan blue vital stain was used for determining cell viability. The cells were then plated out at 1.5 $\times 10^5$ viable cells per well in a 12-well plate in triplicates with 2 mL culture medium in a humidified CO2 (5%) incubator at 37 °C. First time cell culture media was changed after 24 hours, and then every third day until the cells become 80%-90% confluent. Following figures shows growing shows growing luteal cells after 5 days of seeding and confluent monolayer of luteal cells after 12 days of seeding. These cells are then harvested for total protein, total RNA isolation and cDNA synthesis which will be used for downstream analysis.

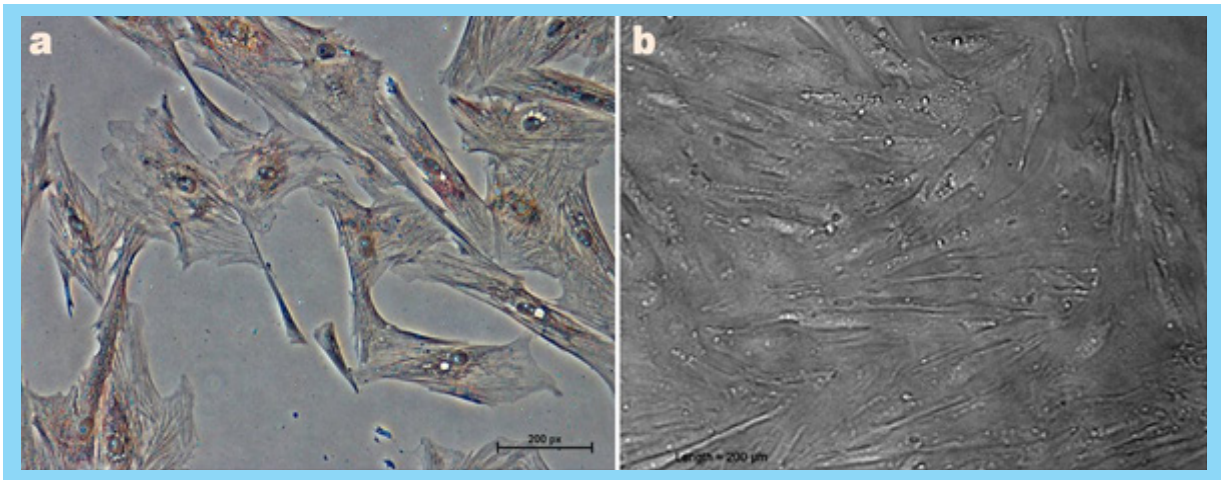


Fig. Porcine luteal cells (a) after 5 days of seeding; (b) confluent monolayer after 12 days of seeding. 20X magnification.

Oil Red O (ORO) and Methylene Blue Staining of Luteal Cells

Cultured luteal cells were fixed with 4% paraformaldehyde and incubated with 60% isopropyl alcohol for 5 minutes. Then they were incubated with 0.5% ORO stain for 20 minutes. The cells were then washed 3 times with distilled water and incubated with methylene blue for 5 minutes. The cells were then washed in tap water and observed under microscope.

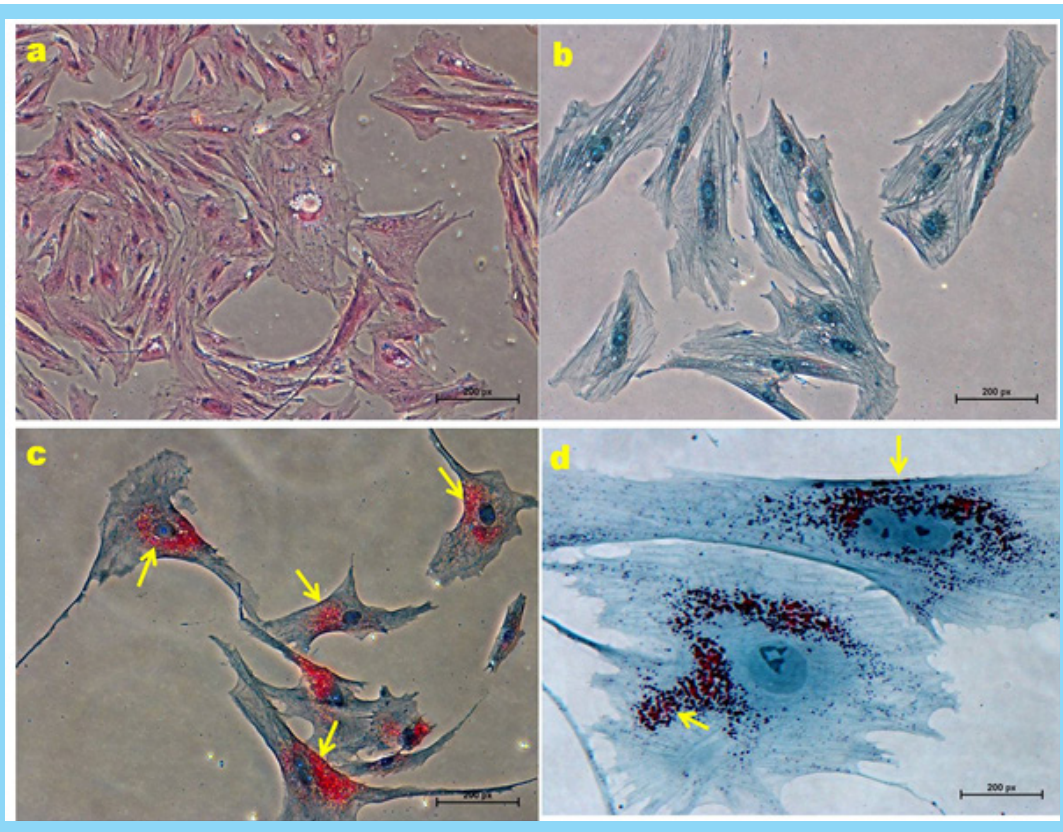


Fig. Porcine luteal cells fixed in 4% paraformaldehyde. (a) H/E stained after 10 days of seeding; (b) stained with methylene blue; (c) methylene blue and ORO stained, yellow arrows indicate red stained lipid droplets, 20X magnification; (d) lipid droplets in luteal cells, 40X magnification.

Production of VEGF knock out (KO) luteal cells. Based on the results obtained in objective 1 of this study, VEGF gene was identified as the key gene regulating multiple signaling pathways associated with angiogenesis and hence it was chosen to be knock out by CRISPR/Cas9 genome editing tool. For the purpose, three VEGF gene specific guide (G1, G2, G3) was designed in silico by using available software. For SgRNA synthesis, the T7 promoter sequence was added to SgRNA template and the in vitro transcription (IVT) template was then generated by polymerase chain reaction (PCR) amplification using designed primers. The PCR template assembly was then confirmed by running 5 µL of PCR product against a marker on 2 % agarose gel. After obtaining a sharp band of 120 bp in the gel for all the three guides, the SgRNA was generated from SgRNA-DNA template by IVT and immediately after IVT reaction, 1 µL of DNAse I was added to reaction mix to remove DNA template. The quality of in-vitro transcribed SgRNA was then determined by 2% agrose gel electrophoresis against RNA ladder. Discrete band at 100 bases indicated intact RNA. The in vitro-transcribed SgRNA was purified using purification columns kit and the concentration of purified SgRNA was measured by Nanodrop spectrophotometer. The ratio $A_{260/280}$ ranged between 2.11 and 2.00.

Table : VEGF guide and T7E1 assay primer sequence, amplicon size and annealing temperature (Tm)

	SEQUENCE (5'-3')	Amplicon Size	Annealing Temperature (Tm)
VEGF GUIDE	TCGGGATCCCGCGTCGGACC	---------	
VEGFT7E1 PRIMER	F: GCCGATCGTTTGGGGAGATTGC	830 bp	54.5 ^{0}C
	R: CAAGGCTCCAATGCACCCAA		

Transfection. Luteal cells were seeded 24 hrs prior to transfection in 96 well cell culture plates. Cultured porcine luteal cells with 30-50% confluency were used for transfection with the components of CRISPR/Cas9 system (single guide RNA and Cas9 protein) via lipofection. After adding the Cas9-SgRNA lipid complex to the cells, the plate was gently swirled to allow mixing of transfection mixture with culture medium. The cells were then incubated for 2-3 days at 37^{0}C at 5% CO_2.

Genomic Cleavage Detection. Primers for T7E1 assay were designed using suitable primer3 online software. Annealing temperature of each primer was optimised using end point PCR. Information on primer sequence and annealing temperature is provided in Table 1. Genomic DNA was extracted from both wild type and genome edited cells and PCR was run to amplify the region of interest encompassing the indel site. The G3 guide was found to be working in our samples, out of three guides choosen for genome editing as depicted in Figure 4c. The PCR products of genome edited (GE), Wild type (WT) and control (C) samples were subjected to denaturation, reannealing and enzyme digestion. The digestion products were then run on 2% agarose gel electrophoresis, where cleaved bands were observed (Figure 4d). The cleavage efficiency of the VEGF knock out was measured by the following equation: Cleavage efficiency= [sum of cleaved band intensities]/ (sum of cleaved and parental band intensities) × 100%. The wild type cells and GE cells were then cultured in triplicates Followed by the completion of each duration, cell viability assay was performed to determine the cell viability, the spent media was stored at -20^{0}C for estimating progesterone (P4) and estradiol (E2) concentrations and cells were harvested for total RNA isolation.

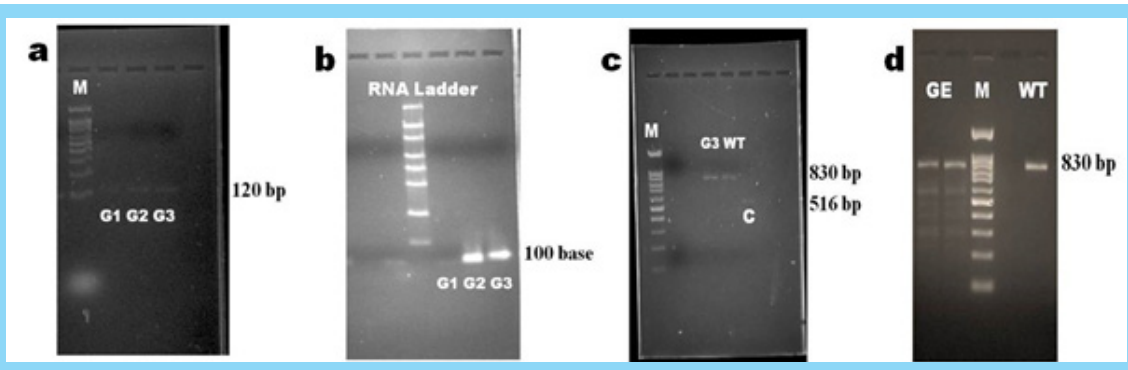


Fig. Agarose gel electrophoresis image showing (a) sharp band of PCR template assembly of 120 bp for all the three guides; (b) discrete band of SgRNA at 100 bases; (c) genomic region encompassing the indel site amplified with T7E1 primer, 830 bp product; (d) cleaved bands of heteroduplex DNA after T7E1 assay; M represents 100 bp marker lane; G1, G2 and G3 represents three different SgRNA chosen for optimization of KO efficiency; WT indicates wild type; C indicates positive internal control samples; GE indicates genome edited PCR products with indels.

Trypan blue exclusion test. After 3 days when the WT and GE cells reached 80-90% confluency, cells were trypsinised and the cell suspension was subjected to trypan blue dye exclusion test. Viable and dead cells were counted and percentage viability was calculated out. Then the cells were seeded for MTT assay. Similar test was repeated after first and second passage of both WT and GE cells. Demonstrates the non-significant difference in cell viability between WT and GE cells.

MTT Assay. The cells were seeded on 96 well plates and cultured at 37°C for 24 hrs. After culture, 10 µl of 5mg/ml of 3-(4,5-dimethylthiazole-2-yl)-2,5-diphenyltertrazolium bromide (MTT) was added in to each well to get a final concentration of 0.5mg/mL media/well. The cells were further incubated for 4 hrs at 37°C and followed by discarding the media along with MTT reagent. Then, 200 µl of DMSO was added and the absorbance at 450nm was recorded within 15 min. There was a non-significant difference in cell viability between WT and GE cells.

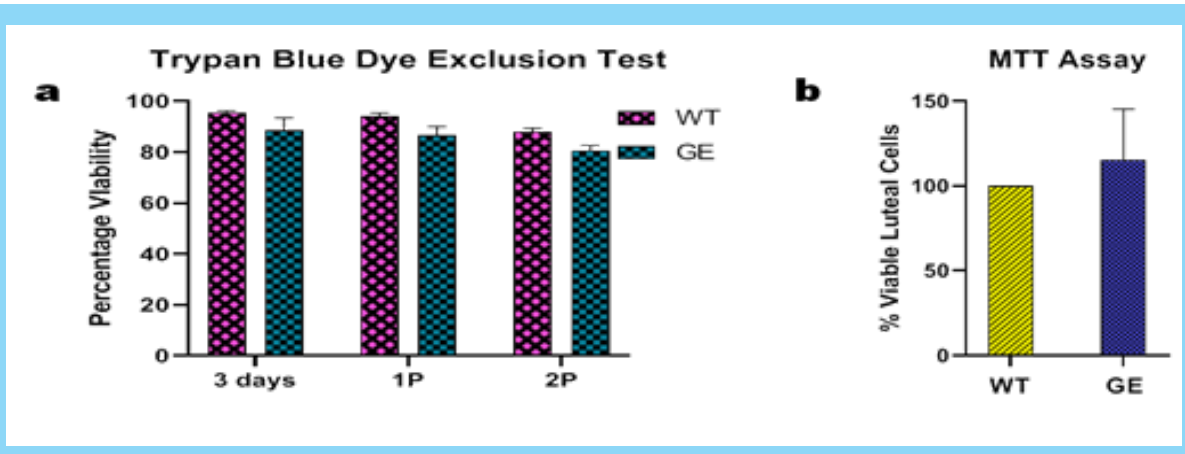


Fig. Demonstration of percentage viable luteal cells in WT and GE cells. (a) Shows percentage viability of cells determined after trypan blue dye exclusion test after 3 days of culture during KO experiment, after first passage (1P) and second passage (2P); (b) shows percentage viability as determined after MTT assay. WT indicates wild type; GE indicates genome edited. All values are shown as mean ± SEM.

Wound Healing Assay

Wound was created in luteal cell monolayer (both WT and GE in replicates) in a 6 well cell culture plate with the help of pipette tip. The cell culture plates was rinsed with 1X PBS to remove debris and fresh culture medium was added. Time at the time of wound creation was counted as zero hour. The plates were then kept for 12 hours in a humidified CO2 (5%) incubator at 37 °C. Observation was made for wound gap closure. The gap was tracked by drawing lines along the edges of wound front, and then measuring the decrease in the average distances of the lines as the wound closes. It was observed that there was a significant difference ($p<0.05$) between WT and GE wound gap after 12 hr of wound creation.

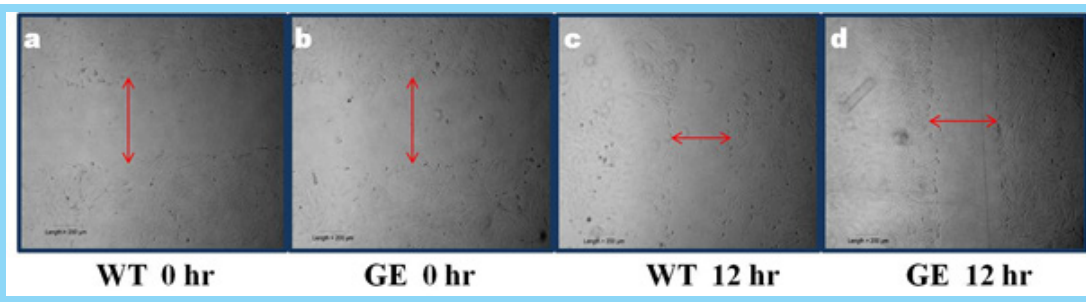


Fig. Determination of wound gap closure in luteal cell monolayer. (a) and (b) indicates wound gap in WT and GE cells respectively at beginning of wound creation; (c) and (d) indicates wound gap closure after 12 hours.WT indicates wild type; GE indicates genome edited luteal cell monolayer. Red line indicates distance in mm. 4X magnification.

Annexin Assay

The differentiation between the apoptotic and healthy cells in both the KO and WT cells was performed by Annexin V apoptosis detection asaay. Both wild type and VEGF KO luteal cells were cultured at 37 °C for 72 hrs until 70-80% confluency and cells were trypsinized using 0.05% Trypsin/EDTA solution and were harvested and treated with 5 µl of annexin V and 2 µl of PI in annexin binding buffer. The apoptotic signal was detected by microscope. This assay also showed a non-significant difference between WT and GE cells with respect to cellular apoptosis.

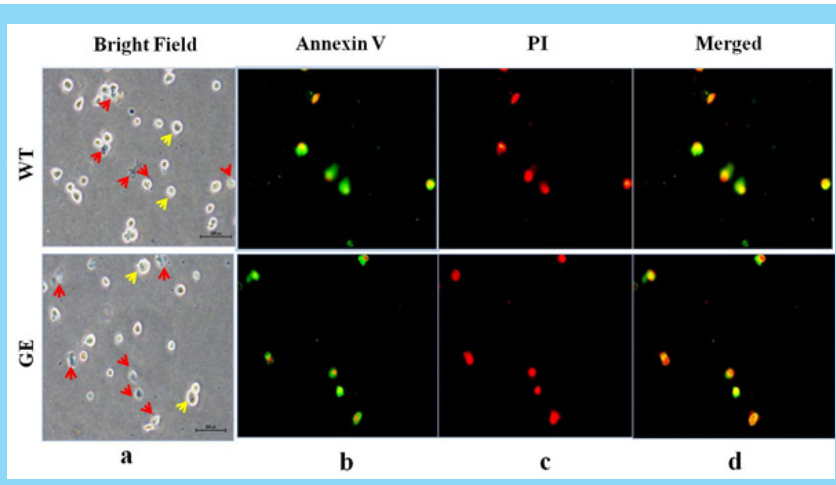


Fig. Demonstration of percentage viable luteal cells in wild type (WT) and genome edited (GE) cells after 72 hrs of culture. WT and GE luteal cells under bright field (a); Green fluorescence, signal for FITC Annexin V (b); Red fluorescence, signal for Propidium iodide (c); Annexin V FITC and PI merged (d) at 20X magnification.

Institute Project : Investigation of Notch Signalling in Regulation of Ovarian Function in Pig.

Jaya, B.C. Das, N.H. Mohan and Satish Kumar

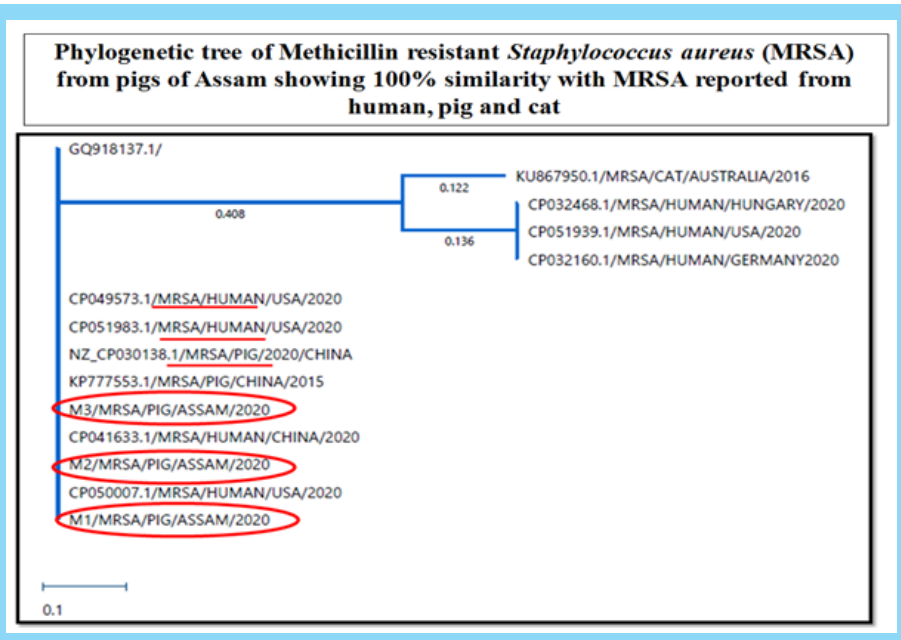
Notch system involves juxtacrine signaling and remains in dynamic cross-talk with various endocrine and paracrine signals. Hence to explore the role of Notch signaling in the formation and growth of ovarian follicles and CL during different stages of estrous cycle, primers targeting different genes involving notch system viz. Notch receptors, ligands, targets and modulators were designed using Primer3 and NCBI primer designing tool. Primers for qPCR analysis of steroidogenesis (3beta HSD, CYP19A1), angiogenesis (VEGF, vWF, FGF, IGF) and cell proliferation (PCNA), HIF1, BCL2 were standardized by gradient PCR. Sampling for respective stages of porcine ovary and downstream analysis are currently under study. Granulosa and luteal cell culture system have been established for in-vitro study.

Animal Health

External project: All-India Network Project on Neonatal Mortality in Pigs (ICAR)

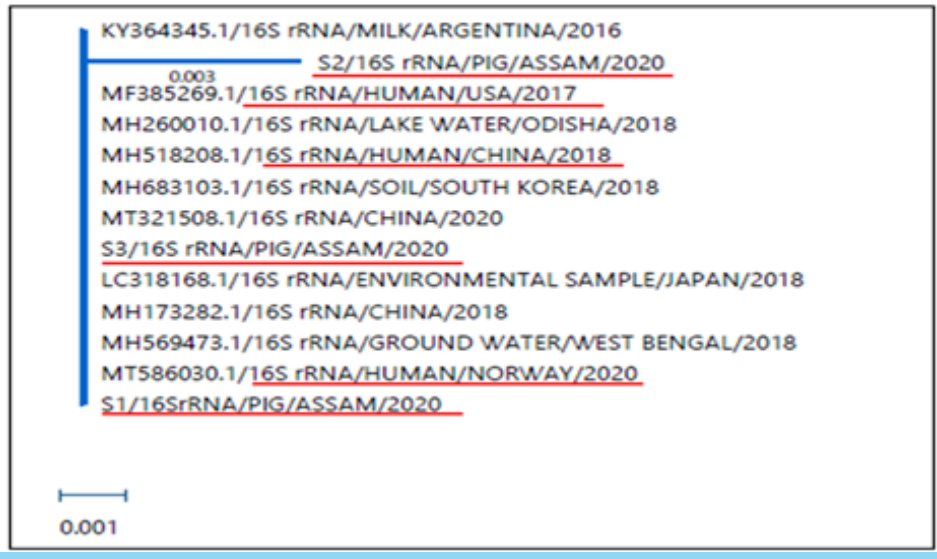
S. Rajkhowa and S. R. Pegu

Under this project during the reported period we have analysed a total number of 232 samples *viz.* faecal (87), Nasal swab (83) and tissue sample (62) from different organised and unorganised pig farms of Assam. We could isolate *Streptococcus suis*, *Pasteurella multocida*, *E. coli* and methicillin resistant *Staphylococcus aureus* (MRSA) from pre-weaned/stillborn pig samples collected during antimortem and post-mortem examinations. These isolates were initially identified based on staining morphology, biochemical tests and further confirmed by PCR using specific primers. A number of these PCR confirmed bacterial isolates were Sanger sequenced and their phylogenetic analyses were performed.



MRSA isolated from pigs of Assam revealed 100% similarity with MRSA from Human reported from USA in 2020, MRSA from Human reported from CHINA in 2020, MRSA from Pig reported from CHINA in 2015 and 2020 and MRSA reported in 2010.

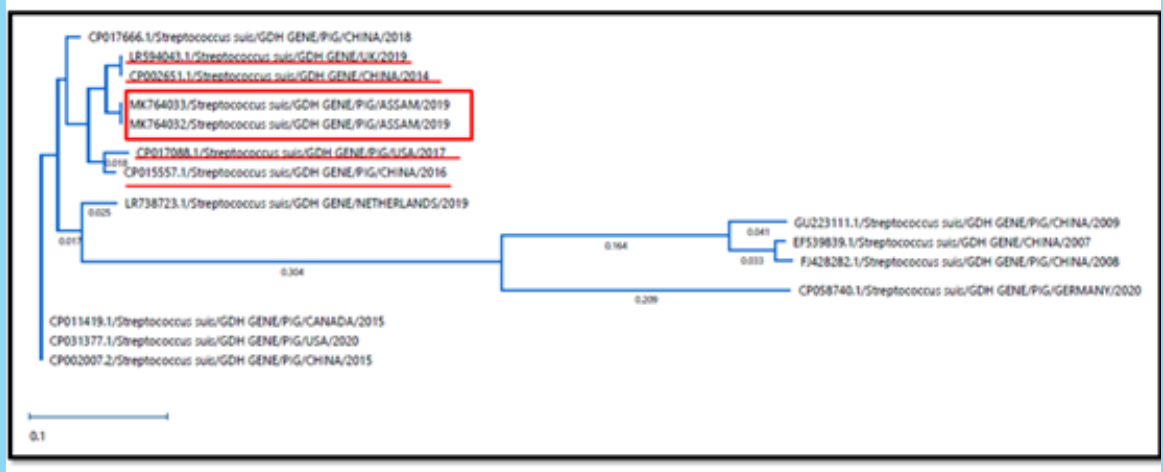
Phylogenetic tree of 16s ribosomal RNA gene of *Staphylococcus aureus* from pigs of Assam showing 100% similarity with *Staphylococcus aureus* reported from human



Staphylococcus aureus isolated from pigs of Assam revealed 100% similarity with ***Staphylococcus aureus*** from Human reported from NORWAY in 2020, ***Staphylococcus aureus*** from Human reported from CHINA in 2018 and ***Staphylococcus aureus*** from Pig reported from USA in 2017.

Phylogenetic analysis of *Streptococcus suis*

Phylogenetic tree of GDH gene of *Streptococcus suis* from pigs of Assam showing 93-98% similarity with *Streptococcus suis* reported from pigs



Streptococcus suis isolated from pigs of Assam revealed 93-98% similarity with ***Streptococcus suis*** from pig reported from CHINA in 2016, ***Streptococcus suis*** from pig reported from CHINA in 2018, ***Streptococcus suis*** reported from CHINA in 2014 and ***Streptococcus suis*** reported from UK in 2019.

External project : DBT-NER Centre for Advanced Animal Disease Diagnosis and Management Consortium (ADMaC)

S. Rajkhowa, S. R. Pegu and D. K. Sarma

The project ended in April 2020. Further compilation and documentation of the salient achievements during the project period (2014-2019) is mentioned hereunder:

Sero-surveillance and molecular characterization of porcine viral pathogens: Screening for the presence of PCV2 and PPV by done by PCR. Genotypic characterization of PCV2 and PPV positive samples in the porcine population was done. Screening for the presence of CSFV antigen by ELISA and RT- PCR was done and E2F, NS5B AND 5'-NTR genes were targeted using RT-PCR. Screening for the presence of Group A Rotavirus antigen by ELISA and RT-PCR was done. The VP6, VP7 and VP4 genes were targeted using RT-PCR. Genotypic analysis of VP6 gene positive Rotavirus samples in the porcine population was also done. Human stool samples of children less than 4 years showing symptoms of watery diarrhea or loose stool and associated with pig handlers were also screened for the presence of Group A Rotavirus. RT-PCR analysis in blood, tissue samples and boar semen samples were analyzed for PRRSV by targeting ORF 5 and ORF 7 genes. However, no semen samples were found to be positive for PRRSV. Genoptypic characterization was done for the circulating PRRSV positive pig samples

Isolation and molecular detection of porcine bacterial pathogens: Samples comprising of nasal swab, heart fluid, heart and lung tissue, joint fluid, diarrheic stool, rectal swab and intestinal content were screened for bacterial detection viz. *Staphylococcus* species, Methicillin-resistant *Staphylococcus aureus* (MRSA), *Staphylococcus hyicus, Streptococcus suis, Clostridium perfringens* type A by PCR. The presence of *Cryptosporidium* sp. was confirmed in faecal samples screened by PCR. Initially *Cryptosporidium* oocytes were detected by staining with Ziehl-Neelsen stain.

Development of Diagnostic assays: A number of diagnostic kits were developed during the project period which include LAMP assay for detection of Porcine Circovirus Type –II (PCV-2), LAMP assay for detection of Porcine Parvovirus (PPV), MULTIPLEX PCR assay for simultaneous detection of Porcine Circovirus -2 (PCV-2), Porcine Parvovirus (PPV) and Classical Swine Fever Virus (CSFV).

External project : Development of rapid laboratory and field assays for microbiological quality assessment of pork (DBT Funded collaboration with IVRI)

S. Rajkhowa, S. R. Pegu and Girish Patil S

During the reported year, meat samples were collected from slaughter house and open markets of Guwahati, Assam. A total of 101 meat samples were collected and screened for the presence of bacteria such as *Staphylococcus* species, *Salmonella* species and *E. coli*. Initially the organisms were isolated by standard bacteriological methods and finally confirmed by species specific PCRs. In addition, during the third year, we have tested 32 MRSA isolates by using the multiplex PCR assay which was specifically developed (during third year) for detection of MRSA from pork samples.

External project : Development of LAMP assay for rapid detection of important zoonotic bacterial pathogens of pig (Institute funded)

S. Rajkhowa and S. R. Pegu

Under this project developed a LAMP assay for rapid visual detection of *Streptococcus suis* from pigs targeting glutamate dehydrogenase gene.

Institute project : Evaluation of efficacy of *Typhonium trilobatum* schott tuber extract against important bacterial pathogens associated with respiratory tract infection in pigs.

S. R. Pegu, S. Rajkhowa, A. K. Yadav, K. Barman, P. J. Das and D. K. Sarma

Emergence of antimicrobial resistance due to indiscriminate use of antimicrobials in the piggery sector is major concern. Respiratory diseases of pigs caused due to bacterial species *Pasteurella multocida, Streptococcus suis* and *Staphylococcus aureus* etc are commonly found in the respiratory tract infection of pigs. Out of the several ways to reduce the emergence of antibiotic resistance bacteria, one is the use of herbal compounds as drug to treat bacterial infections. Several herbal products are used in the treatment of various ailments of man and animals. Typhonium trilobatum (L.)Schott was used in this study to determine its efficacy against selected bacterial pathogens associated with respiratory tract infections of pigs.

Plant material collection for preparation of plant fractions: Typhonium trilobatum plants were collected and leaves were dried. In hot extraction method, dried leaf powders of T. tylobactum were used for obtaining the hydro-ethanolic (6:4) extract with soxhlet apparatus for 24 h; the extract filtered and the filtrate was dried using rotary evaporator at 60 c for 4 hrs. The hydro-ethanolic crude extract was subjected to bioassay-guided fractionation by solubilising in water and sequential partition with n-hexane, chloroform, ethyl acetate, dichloromethane and n-butanol, while the end product was termed as methanol-fraction. Each collected fraction was concentrated under reduced pressure for a dark residue.

Plant extract: Aqueous extract of *Typhonium trilobatum (L.) Schott* was prepared and purified at the Science Foundation for Tribal and rural resources development centre, Odisa was used in the study.

Collection of samples for bacterial isolation: During the reported period nasal swabs and tissue samples from pigs affected with respiratory tract infection were collected from different pig farms of Kamrup, Jorhat, Tinsukia and Nalbari District of Assam. The samples were collected aseptically and immediately brought to laboratory for further downstream processing.Samples were cultured on suitable agar media and the bacterial isolates were identified by using standard biochemical procedures followed by Clinical and Laboratory Standards Institute (CLSI) guidelines. Standard microbial type culture collection (MTCC) strains of bacteria were used as reference controls. Isolated gram positive and gram negative bacteria (MRSA, Streptococcus suis and Pasteurella multocida) were used in this study.

In vitro screening of crude extracts for anti-bacterial activity : The antimicrobial activity of the plant extract was studied using the macrodilution method (NCCLS, 2000). The antimicrobial activity of the plant extract was studied in vitro using the macrodilutionmethod (NCCLS, 2000) with four different concentrations of the plant extract and found that the plant extract at 200 and 300 mg/ml could inhibit the growth of the bacteria as indicated by the absence of turbidity in the tubes. Comparison with commercial biotrim DS @200mg/ml could also inhibit the growth of the bacteria.

Antimicrobial sensitivity of plant extract was also conducted by disc diffusion method (NCCLS, 2000)and comparision was made with other commercially available broad spectrum antibiotics, Sterile discs impregnated with 300mg/ml and 500mg/ml of the plant extract was dried in incubator and used in the test along with the commercially available three antibiotic discs and biotrim DS disc of 500mg/ml. Broth culture of the three bacteria containing approximately 1x 10^8 CFU/mL was uniformly spread separately over sterile nutrient agar plates and the discs containing the plant extract along with the commercially available antibiotic discs and were placed at uniform distance and incubated for 24 hours at 37^0 C. After incubation the zone of inhibition

surrounding the discs was measured by using the Hi zone antibiotic scale; (Hi Media Laboratories Pvt. Ltd., Mumbai, India). Although all the broad spectrum antibiotics viz. eteracycline, ceftriazone, ampicillin andamikacin showed slightly higher zone of inhibition against the bacteria than the zone of inhibition produced by the plant extract @ 300mg/ml and 500mg/ml, Hence the plant extract which showed inhibition of growth and zone of inhibition of the bacteria at 300 and 500mg/ml could be the choice of treatment of respiratory infections of pigs mostly associated with the bacterial species.

Minimum inhibitory concentration (MIC) and minimal bactericidal concentration (MBC) were determined for staphylococcus, streptococcus and pasteurella strains that had shown susceptibility to the crude extracts using the broth microdilution method. The minimal inhibitory concentration and minimal bactericidal concentration values were found to have equal or differed.

External Project : Molecular Epidemiology of Japanese Encephalitis Virus in Pigs and Mosquitoes in Assam (DBT-Twinning)

Seema Rani Pegu, B.R.Gulati, Swaraj Rajkhowa and D.K.Sarma

Seroprevalence of Japanese encephalitis in pigs from different districts of Assam: The project was aimed to determine the prevalence of JEV in pig population of Assam. Seasonal distribution of JE seropositiveity in pigs were evaluated from January 2017 to December 2020. 3236 field sera samples from nine JEV endemic districts of Assam were screened for detection of JEV antibodies during the project period. Highest prevalence of JEV antibodies were recorded in samples collected during June-July followed by May-June (pre-Monsoon)

Molecular detection and genotypic characterization of JEV positive porcine samples: Porcine blood and tissue samples were screened for the presence of JEV antigen by RT- PCR. The E gene and 3'NTR genes were targeted using RT-PCR. The PCR positive samples of the E gene were cloned and were Sanger sequenced. The phylogenetic analysis of the JE positive RT- PCR samples belonged to the genotype GIII and was found to be closely related to the human isolates of JEV from Malda (West Bengal), Nadia (West Bengal) and Vellore, India. The whole genome sequencing (WGS) of one of the representative RT-PCR JEV positive sample was done and showed 99.6 % similar with the sequences reported from Yunnan and China.

Isolation of JEV from porcine sample: Positive blood and tissue samples were sent to NRCE for isolation. Isolation of JE virus was done in PS cells and suckling mice inoculation. Passage in PS cells and suckling mice yielded positive result. Virus isolation was confirmed by VNT using HIS against JEV raised in rabbits. Virus identity was also confirmed by RT-PCR amplification of a partial 3´NTR and E gene.

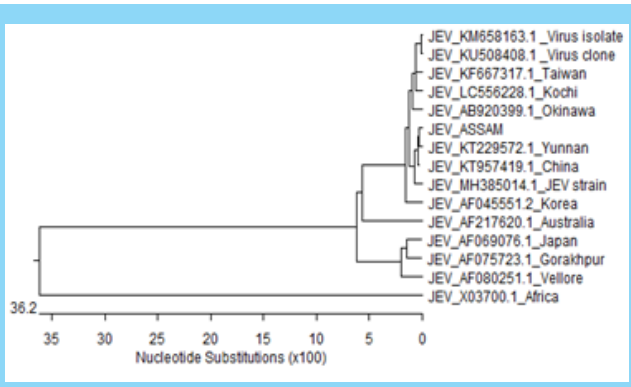


Fig: Whole Genome analysis of JEV from one pig samples of Assam showed 99.6 % similar with the sequences of Yunnan and China.

Identification of Mosquito Vector : Mosquito samples were collected from **Jorhat, Nalbari, Sonitpur, Dibrugarh, Lakhimpur,** and **Kamrup**, identified with the help of State Surveillance Unit, Guwahati, Assam. Most prevalent vectors identified were ***Culex tritaeniorhynchus, Cx.*** Quinquefasciatus, Cx. Whitmorei, ***Mansonia spp***. and Cx. Gelidus and found significantly higher during monsoon season (June -September) than in winter months (November-February).

Development of Diagnostic assay: Developed a realtime RT- PCR assay for detection of JE virus from porcine tissue sample targeting E gene in collaboration with NRCE, Hisar. A duplex RT-PCR assay was also developed targeting E and PrM genes for detection of JEV from porcine samples. Developed an RT- LAMP assay for detection of JE virus from porcine tissue samples targeting E gene.

Institute Project: Sero-prevalence and molecular epidemiology of important porcine viral diseases in pigs in northeastern part of india with special reference to assam.

S.R.Pegu, B. Saikia, S. Rajkhowa, A.K.Yadav, P. J. Das , J. Doley, S.Paul and R. Deb

To study the sero-prevalence of important viral diseases of pigs:

During the reported period a total of 231 nos. of serum sample screened against CSFV, PCV-2, PRRS and JEV from Assam (141) and Tripura (90). Sample positive for CSFV (28), JEV(19) and PCV-2 (14).

Fig. PCV2 infection showing stillborn and mummified fetuses

Molecular detection and characterization:

A total number of 58 tissue and 23 blood samples were analyzed and 8 sample positive for PCV2 and 6 sample positive for CSFV and 12 sample positive for ASFV.

Molecular characterization of ASFV

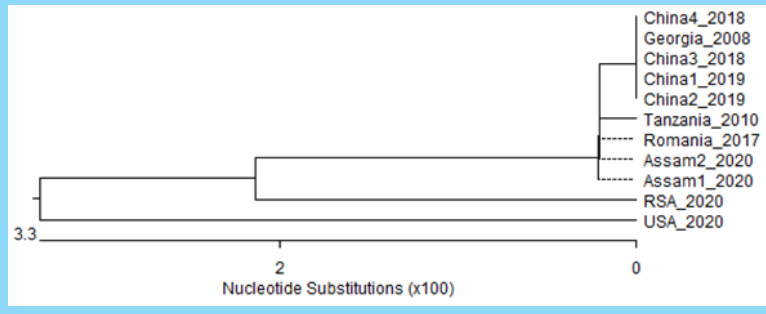
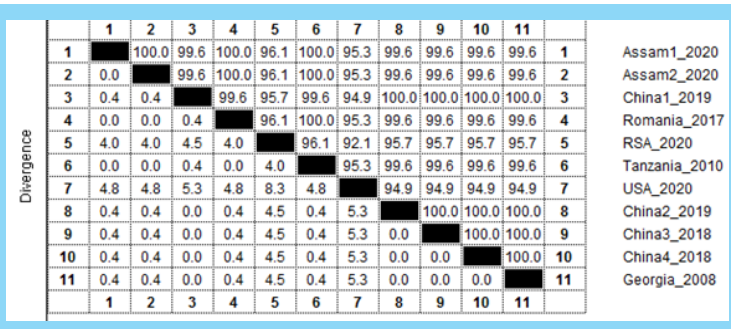


Fig. Phylogenetic tree showing ASFV sequences of Assam similar with Tanzania and China



	1	2	3	4	5	6	7	8	9	10	11		
1		100.0	99.6	100.0	96.1	100.0	95.3	99.6	99.6	99.6	99.6	1	Assam1_2020
2	0.0		99.6	100.0	96.1	100.0	95.3	99.6	99.6	99.6	99.6	2	Assam2_2020
3	0.4	0.4		99.6	95.7	99.6	94.9	100.0	100.0	100.0	100.0	3	China1_2019
4	0.0	0.0	0.4		96.1	100.0	95.3	99.6	99.6	99.6	99.6	4	Romania_2017
5	4.0	4.0	4.5	4.0		96.1	92.1	95.7	95.7	95.7	95.7	5	RSA_2020
6	0.0	0.0	0.4	0.0	4.0		95.3	99.6	99.6	99.6	99.6	6	Tanzania_2010
7	4.8	4.8	5.3	4.8	8.3	4.8		94.9	94.9	94.9	94.9	7	USA_2020
8	0.4	0.4	0.0	0.4	4.5	0.4	5.3		100.0	100.0	100.0	8	China2_2019
9	0.4	0.4	0.0	0.4	4.5	0.4	5.3	0.0		100.0	100.0	9	China3_2018
10	0.4	0.4	0.0	0.4	4.5	0.4	5.3	0.0	0.0		100.0	10	China4_2018
11	0.4	0.4	0.0	0.4	4.5	0.4	5.3	0.0	0.0	0.0		11	Georgia_2008
	1	2	3	4	5	6	7	8	9	10	11		

Divergence

Fig. Distance matrix showing ASFV sequences of Assam similar with Tanzania and China

The two representative PCR positive ASFV samples were Sanger sequenced. The phylogenetic analysis revealed that the ASF sequences from Assam was found to be 100% similar with ASFV sequences reported from Tanzania in 2010 and 99.6% similar with ASFV sequences reported from China in 2018 and 2019.

Institute Project: Expression and evaluation of diagnostic potential of immunogenic proteins of porcine reproductive and respiratory syndrome virus

Ajay Kumar Yadav, Seema Rani Pegu, Rajib Deb, Pranab Jyoti Das and Swaraj Rajkhowa

The targeted Nucleocapsid (N), Matrix (M) and Glycoprotein-5 (GP-5/ORF-5) genes of the PRRSV have been PCR amplified from the clinical samples. All the three (N, M and ORF-5) genes have been cloned in the *pJET1.2* cloning vector and positive clones were confirmed by colony/PCR or touch-up PCR and sequencing. The clones were found in the correct frame and orientation in the vector. The gene sequences were submitted to GenBank with accession numbers MT347585 (N gene), MT347586 (M gene) and MT347587 (ORF-5) respectively. The phylogenetic analysis was done using MEGA7.0 software using the Maximum Likelihood model and Kimura2 parameters and gamma distribution. The isolate in the present study clusters with other Indian isolates in the North American lineage or Genotype-II distinct from the European one or Genotype-I. The expression primers were designed using amplified sequences and genes re-amplified with PCR using rec. clones as template for sub-cloning. The amplified genes were directionally sub-cloned into *pET6xHN* Expression Vector and confirmed by colony PCR, Plasmid PCR and restriction digestion analysis.

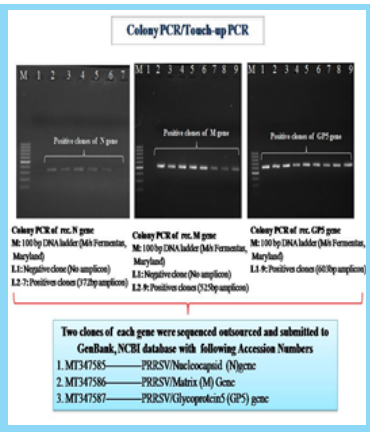
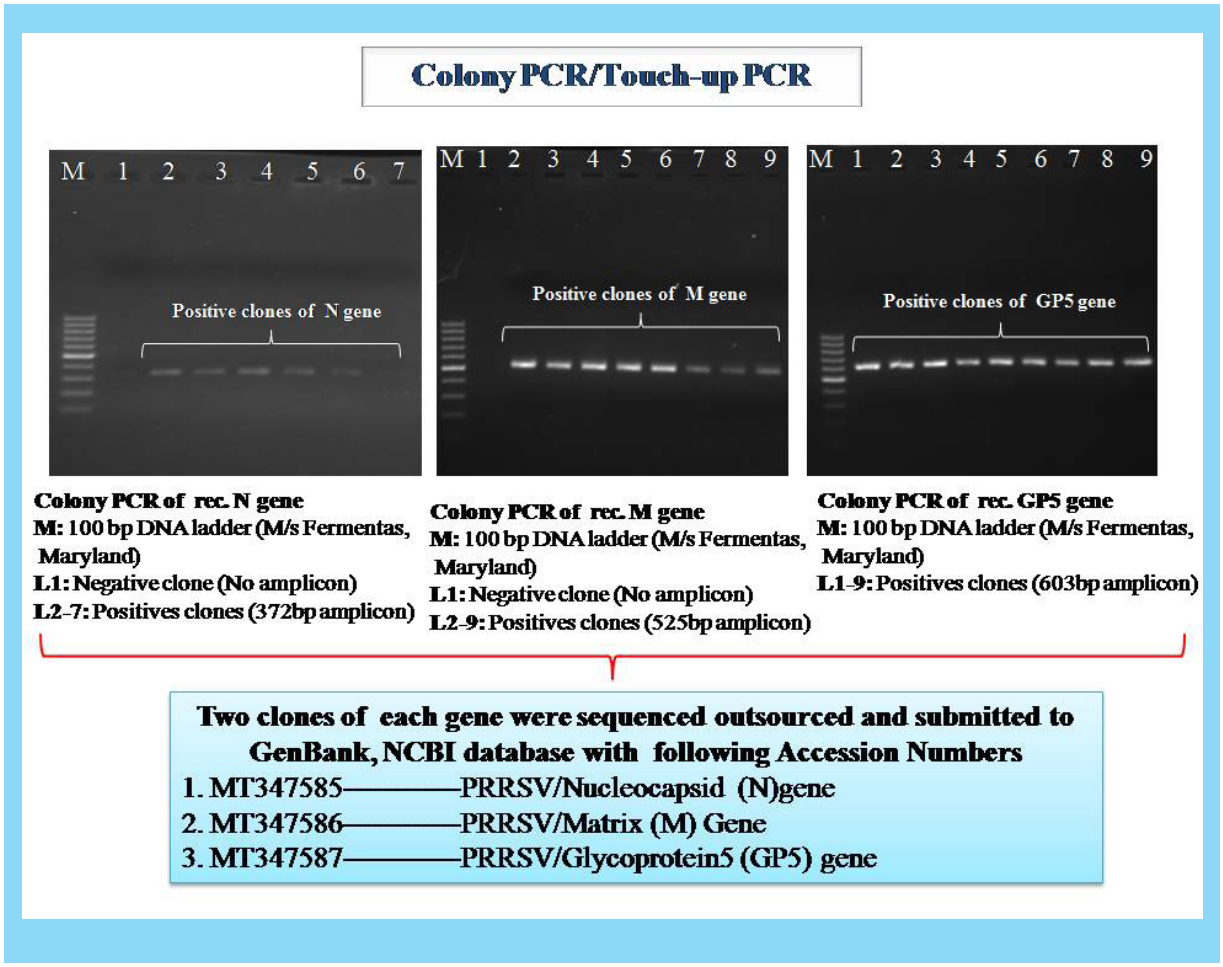


Fig. Confirmation of positive clones of N, M & GP-5 gene of PRRSV and accession numbers of the submitted sequences in the GenBank



Institute Project: Epidemiology, Patho-physiology and Development of Nucleo-diagnostics against Porcine Coronaviruses from North-Eastern India

Ajay Kumar Yadav, Swaraj Rajkhowa, Kaushal Kishor Rajak, Seema Rani Pegu, Rajib Deb, Juwar Doley & Souvik Paul

The primers for RT-PCR, real-time PCR, Polymerase Spiral Reaction (PSR), Reverse transcriptase-Loop-mediated isothermal amplification (RT-LAMP) were designed and custom synthesized against Nucleocapsid (N), Spike (S) and Matrix (M) gene of porcine respiratory coronavirus (PRCoV), Transmissible gastroenteritis virus (TGEV), Porcine epidemic diarrhoea virus (PEDV), Porcine haemagglutinating encephalomyelitis virus (PHEV), Porcine deltacoronavirus (PDCoV) and Swine acute diarrhea syndrome coronavirus (SADS-CoV).

Institute project : Development of CD163 host receptor based sero-diagnostic for early detection of porcine respiratory and reproductive syndrome virus

Rajib Deb, Ajay Kumar Yadav, Seema Rani Pegu, JuwarDoley, Souvik Paul, Swaraj Rajkhowa, Hemanta Maity (West Bengal University of Animal& Fishery Sciences, Kolkata)

Porcine reproductive and respiratory syndrome (PRRS) is one of the important economically devastating diseases distressing the global pork industry. PRRS is caused by an enveloped, positive-sense, single-stranded RNA virus of the Arterivirus genus within the order Nidovirales. PRRSV infection causes severe reproductive failure in sows and respiratory disease in piglets.

PRRSV infection arises largely through porcine alveolar macrophages (PAMs) in the lung. CD163, a macrophage-specific membrane scavenger receptor, is a known to be the key receptor protein for PRRSV infection in swine. In the present study we identified the PRRSV (Indian isolates from NE region, India) docked site at porcine CD163 host receptor. It was observed that exon 7 of porcine CD163 host receptor can interact with glycoprotein 4 (GP4) (which complexed with glycoprotein 2a/GP2a)of PRRSV. Further, the docked nucleotide sequence was amplified from different Indian Pig breeds viz. Ghungroo, Mali, NyangMegha and Large White Yorkshire. Sequencing of the amplified products from the representative breeds revealed that, Large White Yorkshire exhibit SNP (CA genotype) at 74th nucleotide position, while all the indigenous breeds having CC genotypes. This study may reflect the variation in the susceptibility of PRRS infection among native vs exotic pig breeds.

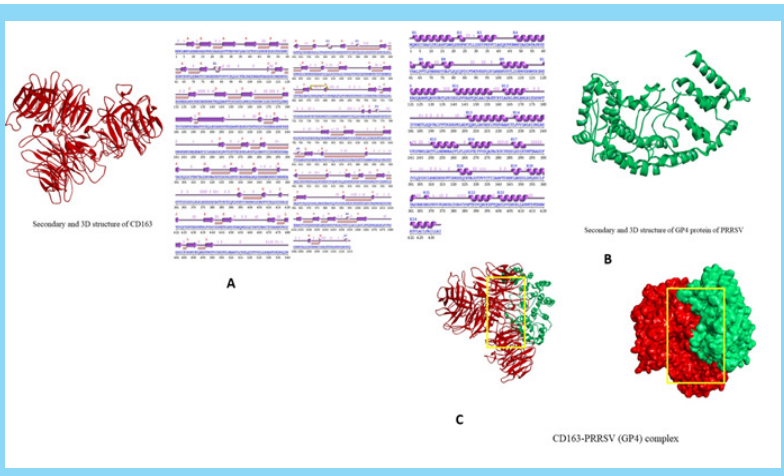


Fig. Molecular Docking of porcine CD163 receptor and glycoprotein 4 (GP4) of Indian isolate Porcine Respiratory and Reproductive Syndrome (PRRS) virus revealed the viral interaction site located at Exon 7 region of CD163 CDS. A: Secondary and 3D model structure of porcine CD163; B: Secondary and 3D model structure of glycoprotein 4(GP4) of Indian isolate PRRSV; C: Docked site location at CD163. RED:CD163, GREEN:GP4

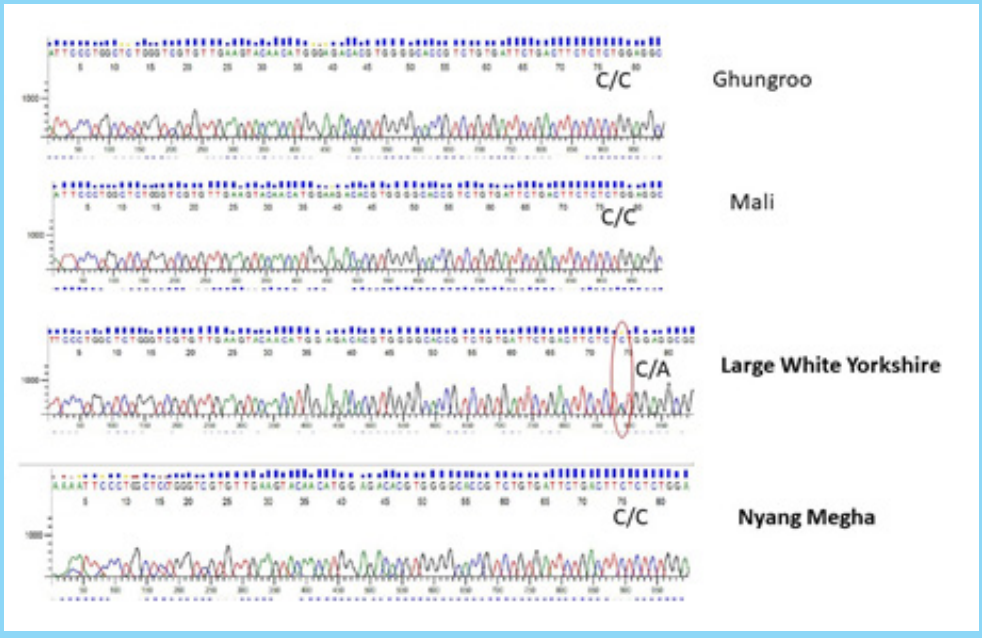


Fig. Dendrogram representation of Exon-7 region of CD163 among different pig breeds

Institute Project: Epidemiology of Intestinal protozoan parasitic diseases of Pigs

Souvik Paul, Swaraj Rajkhowa, Seema Rani Pegu, Juwar Doley, Rajib Deb, Kalyan De, Santanu Banik

North Eastern region (NER) of India contributes about 25-30 % of India's total pig population. Traditional system of pig rearing and eating pork is deep rooted with local culture and about half of the pork produced in the country is consumed in the NER. This reveals the popularity of pork and importance of pig farming in the region. The system of pig production in NER is largely unorganized and essentially in the form of small scale household unit as an important part of integrated farming system. Households rear pigs because of their high feed conversion ratio, high reproductive rate, low cost of feeding, requirement for minimal capital input and availability of ready market. Pig farming in the NER strengthens rural livelihood security and at the same time elevates the socio economic status of tribal people.

Coccidiosis is one of the most common causes of diarrhoea in piglets, especially in animals reared under intensive management systems. Piglets below one month of age are mostly affected and the symptoms generally appear 2-4 days post infection; the diarrhoea lasts for about 3-4 days. Porcine coccidiosis is clinically manifested by diarrhoea, dehydration, roughness of hair coat, reduced growth rate, weakness, loss of body weight, mortality and morbidity varies with the intensity of infection and antibiotic therapies doesn't yield fruitful results. At initial phase, diarrhoea is the most distinguishing clinical symptom, later the consistency of faeces may vary from pasty to watery and the color may vary from yellow to grey or green or bloody according to the severity of the condition and the intensity of infection. Studies have reported that the prevalence of coccidiosis may be as high as 75- 76% in the pig farms, and 40-100% of the piglets on a farm may be infected irrespective of the management and hygiene standards. Coccidiosis is more common in the suckling piglets but occasionally growers, finishers and boars are also affected when they are introduced into endemically infected areas. Diarrhoea in young pigs that doesn't respond to antibiotic therapy is generally suggestive of coccidiosis. Coccidiosis is one of the major causes of diarrhoea in neonatal piglets, it damages the intestinal mucosa and thus impairs the normal intestinal functions and processes. The reduction in ADG may reach at total of 1000 grams till weaning (7 weeks).

Under the current study a random approach was envisaged in the beginning as no preliminary data were available. At first the animals in the herd were noticed for probable clinical signs related to intestinal protozoan infection. Then in next step pooled faecal samples were collected from enclosures where few pigs showed the related signs like roughness of hair coat, reduced growth rate, unthrieftiness etc. Stoll's technique was used with minor operative modifications.

Among the 38 pooled faecal samples collected, all showed the presence of coccidian oocysts.

Table : Details of Pooled Samples Collected (samples positive/samples collected)

Age Wise		Season Wise					
Adults	Finisher	Summer		Monsoon		Winter	
Positive/Collected		Adults	Finisher	Adults	Finisher	Adults	Finisher
24/24	14/14	7/7	5/5	8/8	4/4	9/9	5/5

Among adults and finishers *Isospora* sp. and *Eimeria* spp. were found.

After examination of pooled samples under the study, individual samples were also examined. A total of 64 individual faecal samples were examined randomly. Among 64 faecal samples 42 sample showed the presence of oocysts as shown in the following table.

Table : Details of Individual Samples Collected (samples positive/samples collected)

Age Wise		Season wise					
		Summer		Monsoon		Winter	
Adults	Finisher	Adults	Finisher	Adults	Finisher	Adults	Finisher
24/35	18/29	5/13	4/8	9/10	9/12	10/12	5/9
68.57%	62.06%	38.46%	50%	90%	75%	83.34%	55.56%

Analysis of individual samples revealed that the incidence of intestinal protozoan infection was higher in adults than in the finishers (Fig. 1), which is quite to the contrary because generally the growers and finishers are more affected by coccidiosis. However the possible explanation may be that the adults harbored the infection and maintained a lower shedding rate due to existent pre-immunity and were mostly asymptomatic. But another aspect to be kept in mind is that these asymptomatic animals also contribute towards environmental contamination of parasitic load. Seasonal distribution (Fig.2) showed that the rate of infection with intestinal protozoa was highest during monsoon months, which is as per the epidemiological pattern of coccidial disease, because in general hot and humid climate aids to the spread and development of intestinal protozoan diseases. In addition the incidence of infection during monsoon was higher in adults than in the finishers. This trend continued and in summer and winter also the incidence of infection was higher in adults than in the finishers. Such finding corroborates our assumption that the adult animals are the source of infection and the disease could easily be prevented if the young animals are separated early from the adults and moved into a sanitized shelter. Infection rate in winter was higher than that of summer months, which may be due to the presence of humidity during winters in the region and moreover due to hurdling of animals during winter the chances of acquiring and propagation of infection is also much higher. Although it must be added that to prove our prediction on the disease dynamics processing of more samples and further analysis of sample data is required.

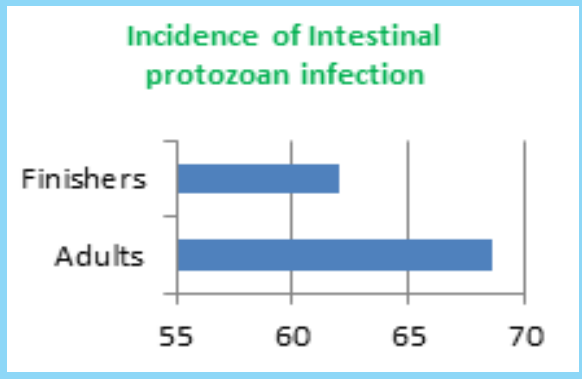


Fig. Intestinal protozoan infection in adult and finisher pigs

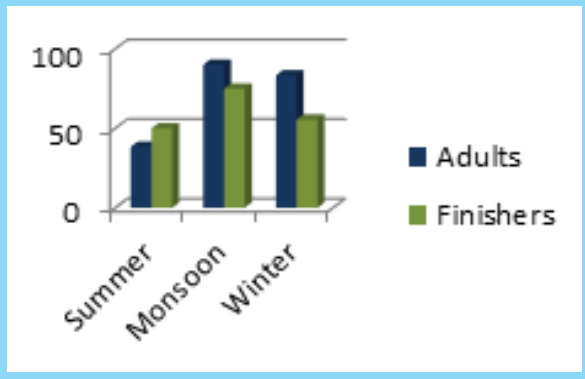


Fig. Seasonal distribution of intestinal protozoan infection in adult and finisher pigs

Institute Project: *Molecular and Serological detection of Porcine Parvovirus (PPV) and its characterization"*

Juwar Doley, Pankaj Deka, Rajib Deb, Seema Rani pegu, Pranab Jyoti Das, Souvik Paul, Ajay Kumar Yadav, N H Mohan and Swaraj Rajkhowa

Infectious diseases in pigs cause significant economic losses to the pig industry.Reproductive failure in sows, like abortion, is a significant factor that increases the cost of pig breeding, especially within high-density breeding areas where infectious agents are transferred more easily. Because reproductive failure in pig herds significantly affects the profits of the farming business, it is important to reduce its impact.Porcine parvovirus (PPV) is among the most important infectious agents causing infertility in Pigs. PPV is ubiquitous in swine throughout the world. Parvoviruses are small, non-enveloped, single-stranded DNA viruses with a genome of 4–6.3 kb in size. They belong to the genus *Parvovirus*, subfamily *Parvovirinae*, family *Parvoviridae*.PPV is found to commonly infect animals of all ages and were detected mostly in growing-finishing pigs and the infection persisted until the late fattening period, which may suggest the chronic character of the infection. There is no clinically apparent disease in non-pregnant pigs. Disease occurs when sero-negative dams are infected in the first half of gestation and the virus crosses placenta.

The disease dynamics, progression and subsequent outcome is dependent on the time of infection of the pregnant sow. In case an infection occurswithin day 30 of gestation it leads to fetal death and resorption, while infection between days 30 and 65 leads to fetal death and subsequent foetal mummification. If the fetuses are infected after day 70 of gestation, they usually develop antibodies against PPV and eliminate the virus. Infection with PPV can lead to stillbirth, mummification of the fetus, embryonic death and infertility (termed SMEDI syndrome) and delayed return of oestrus. The severity of these reproductive failures depends on the pathogenicity of the virus strain and on the stage of gestation also. Since its discovery, PPV has remained a constant worldwide problem of the industry, still being one of the most common and important infectious agents of infertility.PPV can be introduced to previously diseases free herds via infected animals,semen,embryos and fomites.Thus, healthy animals get infected on contact with infected or diseased animal. It is of outmost importance to identify the affected animal and thereby prevent the risk of transmission and for eradication of the disease. Laboratory tests are required to arrive at a definitive diagnosis.Various serological tests, *viz*., hemagglutination inhibition (HI), immunodiffusion test, virus neutralization test, and ELISA can be used for detection of antibodies against virus in serum samples. ELISA is an effective and more reliable method to detect PPV antibodies in serum samples.The pathological effect of the virus in a pregnant sow and its foetuses is due to the tropism it has for actively replicating cells such as foetal myocardiocytes, which makes foetal infection often results in death, depending on the stage of sow gestation. More recently, nucleic acid-based techniques can be used for viral detection in clinical samples with a better sensitivity. The PCR, a useful technique in fetal tissues, possesses higher sensibility and even specificity than the HA.Besides, numerous real-time PCR protocols have been reported using Taqman probes or SYBR Green which can be used for viral DNA detection and quantification.

Therefore, early diagnosis of PPV is of significant importance for implementation of effective interventions and prevention of the spread of infection. Though few preliminary reports are available on sero-prevalence of PPV affecting swine, limited scientific data is available. Till date, no such systematic study has been carried out for detection of this virus associated with swine reproductive problems causing economic losses to the pig farmers in this Kamrup region which is pre-requisite for adopting a successful disease control strategy.

Sero-prevalence study was carried out in samples from organized herd and field.

A total of 88 Serum was screened for detection of antibodies against Porcine Parvovirus employing ELISA (Priocheck).The sero-prevalence rate of PPV in organized (20/59) and unorganized herd (23/29) were 33.89 % and 79.31% respectively (Table 1). The overall sero-prevalemce rate (43/88) for PPV was found to be 48.86% (Table 1). Among the organized herds the sero-prevalence of PPV in general was very high, samples from Dhemaji and Tinsukia showed 100 % seropositivity for PPV infection. Samples from Dudhnoi too showed high seropositivity (93.3 %). The lowest occurrence was seen among the samples from Kamrup district (12 %) (Table 2). Such variation in seropositivity may be attributed to the uneven sample size, more samples have to be collected and tested for getting a clear picture.

Table : Overall Sero-prevalence of PPV

Organized Herds		Unorganized Herds		Total	
Samples Collected	Samples Positive	Samples Collected	Samples Positive	Samples Collected	Samples Positive
59	20 (33.89 %)	29	23 (79.31 %)	88	43 (48.86 %)

Table : Sero-prevalence of PPV(District wise)

Dudhnoi		Kamrup		Tinsukia		Dhemaji	
Samples Collected	Samples Positive	Samples Collected	Samples Positive	Samples Collected	Samples Positive	Samples Collected	Samples Positive
15	14(93.3 %)	50	6 (12 %)	16	16 (100%)	07	7 (100%)

Studies for molecular characterization of PPV isolates will be undertaken after collection of more number of samples.

Livestock Products Technology

Institute project: Development of pork based ready to serve functional products

R. Thomas and K. Barman

The objective of the project was to develop value added functional pork products through the addition of critical ingredients to cater the needs of the health-conscious consumers and to evaluate the nutritional, physicochemical, microbiological and sensory attributes of developed products. Types of functional pork products developed include the following categories: 1. PUFA enhanced, 2. Fibre enriched, 3. Antioxidant rich, 4. Low salt and 5. Low fat/ low calorie. Different parameters studied on the day of processing include pH, cooking yield, proximate composition/ nutritional value, water activity, hunter colour values, texture profiles and Warner-Bratzler shear force. The parameters studied during the storage period include: Physico-chemical parameters - pH,Proximate composition/ Nutritional value, TBARS value, Tyrosine value, Free Fatty Acid and Titratable acidity; Microbiological parameters- Aerobic count, Psychrotropic count, Coliform count, Salmonella sp. count, Lactobacillus count, Staph. aureus count, Yeast and mold count and Sensory characteristics- Appearance, Flavour, Juiciness, Texture, Binding, Overall acceptability. Viable technologies were developed for commercial processing of value-added pork products with consumer acceptability. Simple processes were developed to incorporate the locally available

medicinal plant parts (leaves/ fruits/ buds etc.) in the pork product's formulations. These materials were found to have positive effect on preventing microbial spoilage and fatty acid oxidation during the storage period. Scientific interventions were introduced in the packaging of pork and pork products to improve the brand value of the products during marketing. Both laboratory and pilot scale testing of the developed formulations were conducted before the commercialization of the products. Formulations were modified based on the suggestions received during the pilot scale marketing phase, in order to ensure market acceptability of the products. The technologies developed were commercialized through Public-Private- Partnership mode.

I. Effect of different levels of added fat on the quality of pork loaves

Physico-chemical characteristics: The pH of emulsions and loaves containing different levels of fat did not differ significantly ($P>0.05$) but a slight reduction in pH was observed with increased levels of fat. The emulsion stability (ES) and cooking yield (CY) increased slightly with increase in fat level in the formulation. Emulsion stability indicates the percent cooking loss of moisture, fat and solids from emulsion when heated, the higher the values better the emulsion stability, and cooking yield of a product has positive correlation with its ES. Comparatively higher ES and CY in loaves with higher fat content might be due to their lower moisture content, leading to lower moisture loss during cooking. Moisture and protein contents were significantly different ($P<0.05$) and inversely proportional to the fat content. The moisture content was 63.01, 58.74 and 55.21% and the protein content was 17.77, 16.68 and 15.85%, respectively for 10, 15 and 20% formulations. The fat content of the loaves did not exactly match the targeted values. Actual fat contents were 12.91, 18.27 and 22.63% for the 10, 15 and 20% formulations, respectively. Warner-Bratzler shear force (W-B shear force) and work of shearing the samples were decreased significantly ($P<0.01$) with increase in fat level. Addition of 20% fat reduced the water activity of the loaves from 0.97 to 0.96 which could be a direct reflection of the relatively lower moisture content in that formulation.

Fat level significantly affected ($P<0.01$) the redness (a-values), yellowness (b-values) and hue angle of the loaves and the effect was more pronounced in samples containing 20% fat. The higher the fat level, the higher the b-values indicating a lighter product. This was obviously due to the presence of higher back fat content in the loaves. Texture profile analysis (TPA) revealed a significant reduction ($P<0.01$) in all textural parameters of pork loaves with increase of fat percent in the formulation. Significant decrease in hardness observed with 15 and 20% fat could be due to soft texture of pork fat and these values are in agreement with the shear force values. Springiness decreased significantly with increase of fat percent because an increase in fat content in the formulation might have resulted in the reduction of elasticity in the loaves. Replacement of lean with fat could have contributed to the significant reduction in cohesiveness, gumminess and chewiness of loaves with increase of fat percent.

Sensory Evaluation: A significant effect ($P<0.01$) of fat level was found on flavour, juiciness and texture of the pork loaves. Loaves with 20% fat rated highest for flavour and juiciness while the difference in texture among the samples with 15 and 20% fat was non-significant ($P>0.05$). It indicated that the panelists had higher liking for the soft texture that observed in loaves with 20% fat. The sensory scores for texture were in agreement with the instrumental scores for shear force and hardness. Products with 10% fat had lowest scores for all the sensory attributes. A similar pattern was also observed for overall acceptability of the loaves. Loaves with 20% fat had highest overall acceptability which indicated that panel scores for this parameter was mostly influenced by the flavour, juiciness and texture of the products.

II. Incorporation of fermented bamboo shoot mince on quality of pork loaves

Bamboo is not merely the poor man's timber but is also the rich man's delicacy. Bamboo shoots exhibit a great potential as a food resource and is gaining popularity worldwide in the utilization of

its shoots as healthy and nutritious food. Several available reports indicate that fermented bamboo shoots have further benefits of providing bio-nutrients and minerals and enhancement of flavour and aroma. In view of the limited information on the effects of addition of fermented bamboo shoot in the processed meat products, the present study was undertaken to optimize the level of addition of fermented bamboo shoot mince in pork loaves. The products thus developed were stored at refrigeration temperature (4±1°C) and the various quality changes viz. physico-chemical, microbiological and sensory attributes, were evaluated in detail during the storage period.

Processing of treatment groups: Four different levels (2%, 4%, 6% and 8%) of fermented bamboo shoot mince (FBSM) were assessed. In each case, the base formulation remained same as that mentioned for the control batch (2.0 kilogram batches) and the fermented bamboo shoot mince (contained both solid and liquid portions in the ratio of 2:1) was added over and above the 100% level in the respective formulations. In each treatment group, the bamboo shoot mince was added to the meat cutter after the emulsification of fat was over and an additional chopping time of 0.5 min was given. Five separate, two kilogram batches (one control batch and four treatment batches) of meat emulsions were prepared in each replication. The entire experiment was replicated 4 times.

Quality changes in cooked pork loaves with FBSM during refrigeration storage: The loaves were not subjected to sensory evaluation on the day they were spoiled, but physico-chemical and microbiological parameters were determined. The acceptable/unacceptable distinction was made mostly on the basis of flavour changes detected at the time of opening of the packets. The colour changes and sliminess developed were also considered.

Physico-chemical and sensory characteristics: Loaves with FBSM had significantly (P<0.01) lower pH compared to the control on the day of processing and reduction in pH was proportional to the level of FBSM in the product. A similar trend was also observed in all the samples while evaluating the products at 7 days interval during the entire 35 days storage period. However, the loaves with 6% and 8% FBSM had significantly (P<0.01) lower pH values during the entire course of storage period and even at the 35th day of storage, they had a pH of 6.29 and 6.18 respectively, while the control loaves had a pH of 6.47 on 35th day. Sensory evaluation of the loaves by experienced panelists indicated that control loaves and loaves with 2% FBSM were spoiled and unacceptable on 28th day, while those with 6% and 8% FBSM were acceptable even on day 35. The lower microbial load and better stability of loaves with 6% and 8% FBSM could partly be attributed to the direct inhibitory action of lower pH on microbial growth and to the anti-microbial properties of FBSM as bamboo shoot is reported to contain good amount of flavones and glycosides, which are known for their anti-microbial activity. Estimation of TBARS value, which indicates the oxidative stability of products, revealed that loaves with 6% and 8% FBSM had significantly lower (P<0.01) TBARS values on the day of processing compared to the control. Also, TBARS values, expressed in mg malonaldehyde/kg units, showed an increasing trend during subsequent storage period in all the groups. Although, the tyrosine value cannot be considered specific for proteolysis, it has been regarded as a good general index of meat protein breakdown and could prove useful for the assessment of spoilage in meat and meat products. The tyrosine value was significantly higher for the loaves containing FBSM on the day of processing.

Titratable acidity (TA) was significantly higher (P<0.01) in all the treatment groups and was due to the addition of fermented bamboo shoot mince with lower pH and higher titratable acidity. Loaves with 6% FBSM had 0.105 units higher and those with 8% FBSM had 0.120 units higher TA compared to the control on the day of processing. All the samples showed a reduction in TA on day 7, while it increased on day 14, but further decreased from day 21 onwards. The results of instrumental colour evaluation of loaves during the storage period indicated that the control loaves had lower lightness (L*) (47.65 vs 53.41 in loaves with 6%FBSM and 59.16 in loaves with

8%FBSM) and higher redness (a*) (20.12 vs 15.00 in loaves with 6%FBSM and 11.67 in loaves with 8%FBSM) and yellowness (b*) (24.49 vs 21.84 in loaves with 6%FBSM and 19.81 in loaves with 8%FBSM), values on the day of processing. As the storage time elapses the L* values shown an increasing trend while a* and b* values decreased in all the samples. For example, in control loaves, the L* increased to 49.81 and 51.07 on 28th and 35th day of storage. The corresponding values in loaves with 6% and 8% FBSM were 58.98/59.45 and 60.39/61.18 respectively, on 28th and 35th day of storage.

Microbiological characteristics: Addition of FBSM at 8% level has resulted in about 1.30 log reduction in total plate count (TPC) in the loaves compared to control. This could very well be attributed to the direct inhibitory action of lower pH on microbial growth and to the anti-microbial properties of FBSM as bamboo shoot is reported to contain good amount of flavones and glycosides, which are known for their anti-microbial activity. TPC increased significantly in all samples throughout storage period, but addition of FBSM at higher levels significantly lowered the rate of increase of TPC in treatment groups. It reached about 7 log cfu/g in the control loaves on day 35, while it was only about 4.5 log cfu/g in loaves containing FBSM at 6% and 8% levels. This could be due to a combined effect of initial cell injury resulted from low pH and subsequent prolongation of lag phase by antimicrobial substances present in FBSM. Sliminess was detected in control group and nuggets with 2% FBSM on day 28 while those with 4% FBSM had sliminess on day 35. However, no such sliminess was observed in loaves containing 6% and 8% FBSM. Psychrotropic organisms were detected only in control group and nuggets with 2% FBSM on the day of processing. The absence of psychrotrophic bacteria in the loaves containing higher levels of FBSM during the initial periods of storage might be attributed to a retardation of the log phase as a result of reduced metabolic rate due to a sudden change in the physical environment at lower pH ranges. The pattern of changes in psychrotropic counts during the storage period in all the groups were similar to that observed for TPC. Coliforms, considered as an indicator of post processing contamination, were detected during storage. They were detected only in control and loaves with 2% and 4% FBSM on the day of processing. The occurrence of coliforms in loaves with 6% and 8% FBSM were not only occasional in nature but was also significantly (P<0.01) less at any interval during the entire length of 35 days storage period, which clearly indicated the benefit of addition of FBSM at higher levels.

Sensory attributes: The results indicated that the loaves prepared with the addition of FBSM had better appearance and flavor characteristics on the day of processing. Incorporation of FBSM has resulted in an initial reduction in juiciness, texture and binding attributes, however, they maintained these attributes for a longer time compared to control. The reduction in textural properties could be attributed to the increased denaturation of proteins and subsequent decrease in fat and water binding properties at low pH resulted from FBSM addition and to the changes in disulphide bonds due to increased protein denaturation as a result of increased microbial activity. Sensory evaluation of the control group and loaves with 2% FBSM were done only up to 21st day of storage due to the development of off-odour and sliminess on the 28th day. Due to the same reason, sensory evaluation of loaves with 4% FBSM was not carried out on 35th day of storage. Incorporation of FBSM significantly improved (P<0.01) the desirable flavour of pork loaves on the day of processing and the scores were higher for the loaves processed with higher levels of FBSM addition. Even at 8% level of addition, panelists had rated the flavor of pork loaves 'very good', suggesting that the flavor imparted to the products from the addition of fermented bamboo shoot was very much desirable. Further, overall acceptability of the loaves with FBSM followed the same pattern observed for that of flavor and a significant decrease (P<0.05) in the overall acceptance of all types of loaves was found towards the end of storage period. However, the sensory attributes of pork loaves with 8% FBSM was in the 'very palatable' category of acceptability even on 35th day of storage and thus had a shelf life of at least 35 days at refrigeration storage (4±1^{o}C).

Institute project: Optimizing the processing conditions to prevent the occurrence of selected FSSAI listed food borne pathogens in pork and pork products and to develop risk mitigation strategies.

R. Thomas, K. Barman and S.R. Pegu

Meat processors follow varied processing steps to process meat products, some of which adversely affect their sensory attributes. Food borne infections from livestock products are being reported every year, especially in Assam, Meghalaya and Nagaland. However, systematic efforts were not taken earlier to identify the pathogenic strains associated with the traditional meat products in NER. Also, no authentic report exist with respect to different strains of food borne pathogens (very limited number of field isolates from meat) present in NER. Further, risk assessment and mitigation strategies with respect to these organisms and products are largely missing. Therefore, a systematic study has been initiated to optimize the different processing parameters viz. NaCl concentration, water activity (aw), pH (acidity), temperature and packaging conditions to inactivate the selected food borne pathogens (Salmonella spp., Listeria spp. and Yersinia spp.) in value added pork products including traditional pork products and to develop risk mitigation strategy (ies) to prevent their occurrence in pork and processed pork products.

Sample collection is being carried out from the States of Assam, Meghalaya, Arunachal Pradesh and Nagaland and processed in the laboratory to isolate the pathogens viz. Salmonella spp., Listeria spp., Yersinia spp., if present. Standard microbiological procedures are being followed for isolation, identification and preservation of local serotype and ATCC reference cultures are used as positive control. The work has been initiated and it is expected to develop ideal processing condition(s) for pork products (which will retain the best possible sensory characteristics while ensuring inactivation of each pathogen). Risk mitigation strategies for small scale processing units will also be developed based on the observations.

ICAR-LBS Award Project: Farm-to-Fork Risk profiling of hazards associated with pork supply chain in India, developing a database on hazards and associated unique pig husbandry / processing practices, developing food safety interventions towards reducing hazards and effective risk communication strategies as guidance to the industry.

R. Thomas

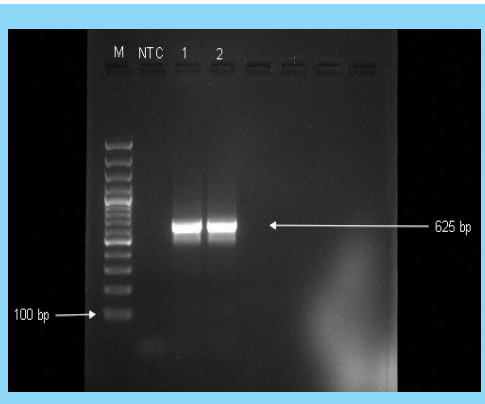
The project is being carried out with the objective to undertake Farm-to-Fork Risk profiling of hazards (microorganisms of public health concern, veterinary drug residues, pesticide residues and heavy metals) associated with pork supply chain in India and to develop their database. The survey work envisaged in the project has completed and covered 05 North Eastern States i.e. Assam, Meghalaya, Arunachal Pradesh, Mizoram and Nagaland. Samples were also collected from South India (Kerala, Karnataka, TN, Andhra Pradesh and Telengana); North India (Haryana, Punjab and Delhi) and East India (WB and Jharkhand). Seventy one numbers of pig farms (backyard/ small/medium) and 58 numbers of pork retail units (roadside shops and organized shops) were visited during the reported period. Details were collected w.r.t. the production practices, feeding practices, health management etc. Emphasis was given to identity and documents the probable factors which could contribute to the risks in the existing piggery and pork value chain. During the survey different samples (feed samples, pork samples, edible visceral organs etc.) were also collected for evaluation of the probable risk factors associated with them which could enter into the pig/pork value chain at some point. Different quality characteristics (carcass measurements, physico-chemical and microbiological) of pork marketed in these areas were evaluated. Samples

were taken to assess hygienic status of meat personnel/butchers and meat shops (which handle pork). Further, the project involved a survey to understand the quality awareness and requirements of pork consumers in the survey areas.

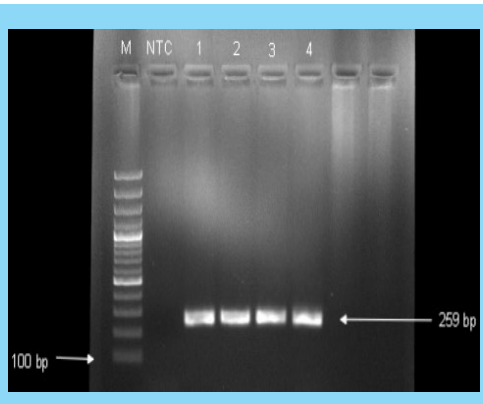
1. Detection of food borne pathogens in meat and meat products by molecular means

PCR based methods were developed for detection of FSSAI listed pathogenic bacteria viz. *Salmonella* Enteritidis; *Salmonella* Typhimurium; *Salmonella* Cholerasuis; *E. coli* O157:H7, *Compylobacter jejuni*, *Listeria monocytogenes*, and *Yersinia enterocolitica*. Moreover, methods have been developed to identify *Escherichia coli* and *Staphylococcus aureus* in meat and meat products. The American Type Culture Collection (ATCC) of these pathogenic microorganisms is taken as positive control and PCR based methods have been standardized for detection.

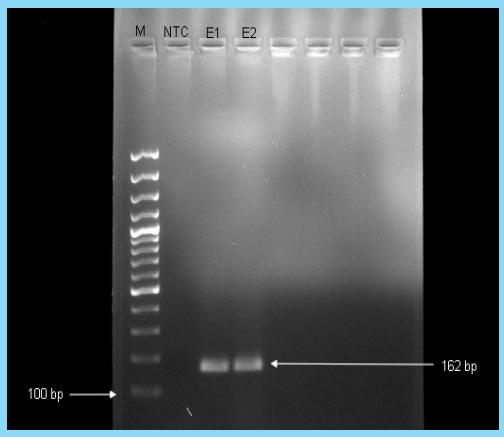
Sl. No.	Name of the food borne pathogen	Gene studied	Primer details	Product size
1	*Escherichia coli*	uidA (β-D-glucuronidase)	F: 5'-TGGTAATTACCGACGAAAACGGC-3', R: 5'-ACGCGTGGTTACAGTCTTGCG-3'	162 bp
2	*E. coli O157:H7*	flicH7 (flagellar antigen H7)	F: 5'-GCGCTGTCGAGTTCTATCGAG-3' R: 5'-CAACGGTGACTTTATCGCCATTCC-3'	625 bp
		rfbO157 (somatic antigen O157)	F: 5'-CGGACATCCATGTGATATGG-3', R: 5'-TTGCCTATGTACAGCTAATCC-3'	259 bp
3	*Salmonella enterica serovar* Enteritidis	InvA (responsible for invasion)	F : 5'-GTGAAATTATCGCCACGTTCGGGCAA-3' R: 5'TCATCGCACCGTCAAAGGAACC-3'.	284 bp
		sefA (encodes the structural subunit of SEF14)	F: 5'- GCAGCGGTTACTATTGCAGC-3' R: 5' –TGTGACAGGGACATTTAGCG-3'.	310 bp
4	*Listeria monocytogenes*	hlyA1	F: 5'-GAATGTAAACTTCGGCGCAATCAG-3' R: 5'-GCCGTCGATGATTTGAACTTCATC-3'	388 bp
		hlyA2	F: 5'-CGGAGGTTCCGCAAAAGATG-3' R: 5'-CCTCCAGAGTGATCGATGTT-3'	234 bp
5	*Yersinia enterocolitica*	16SrRNA	F: 5'-AATACCGCATAACGTCTTCG-3' R: 5'-CTTCTTCTGCGAGTAACGTC-3'	330 bp



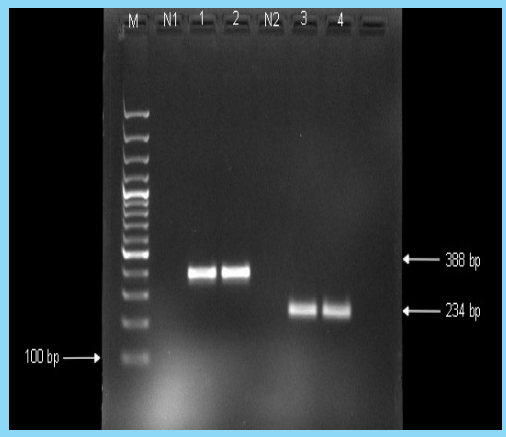
PCR amplification of E. coli DNA with uidA primer. The lanes are M= 100 bp, NTC= Non template control, E1 & E2= E. coli



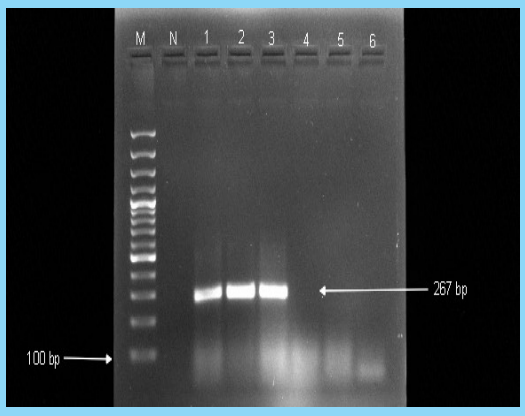
PCR amplification of flicH7 gene of E. coli O157:H7. The lanes M= 100 bp DNA ladder, NTC= Non template control, 1 & 2 = E. coli O157:H7



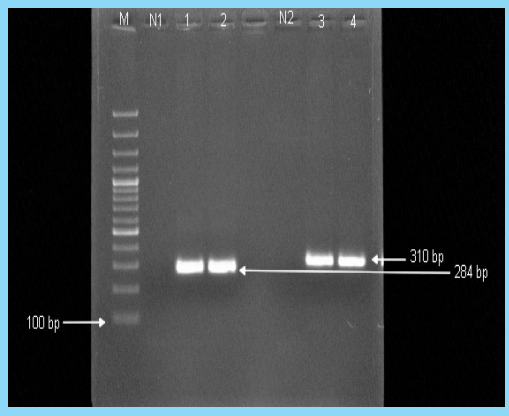
PCR amplification of rfbO157 gene of *E. coli* O157:H7. The lanes M= 100 bp DNA ladder, NTC= Non template control, 1-4 = *E. coli* O157:H7



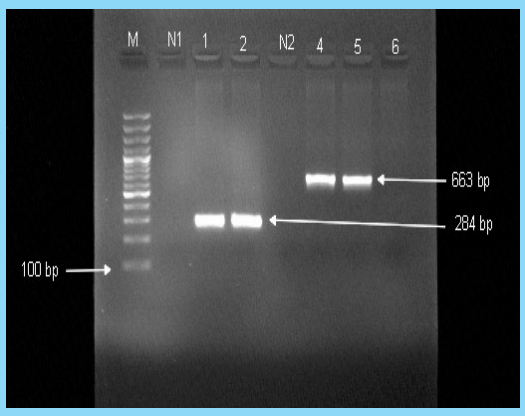
PCR amplification of *Inv*Agene. The lanes M= 100 bp DNA ladder, NTC= Non template control, 1= *S.* Enteritidis; 2=*S.* Typhimurium; 3=*S.* Choleraesuis

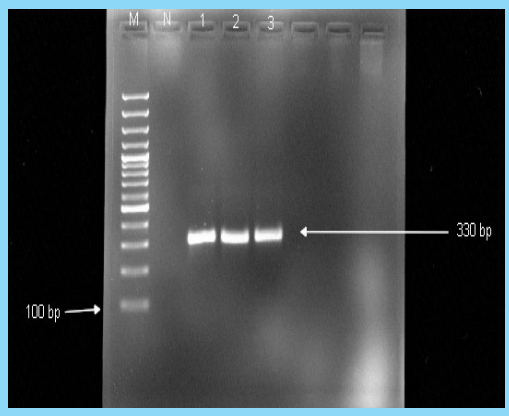


PCR amplification of InvA and SefAgenes. The lanes M= 100 bp DNA ladder, N1 and N2= Non template controls, 1 &2 = Salmonella Enteritidis with InvAgene; 3&4=Salmonella Enteritidis with SefA gene



PCR amplification of hylA1 and hylA2 genes. The lanes M= 100 bp DNA ladder, N= Non template control, 1 to 3= Listeria monocytogeneswith hylA1 gene; 4 to 6= Listeria monocytogenes with hylA2 gene





PCR amplification of 16S rRNAgene. The lanes M= 100 bp DNA ladder, N= Non template control, 1 to 3= *Yersinia enterocolitica*

2. Detection of Pork in raw, processed and binary mixture of meat using Species-Specific Marker of Mitochondrial DNA D-loop region

Detection of origin of meat species by PCR using species-specific markers of mitochondrial DNA origin is relatively quick, precise, sensitive and economical as compared to other PCR based assays. Due to high mutation rate of mitochondrial DNA, it is possible to select the sequences, which are specific to particular species. Besides, mitochondrial DNA is maternally inherited so normally only one allele exists in an individual and thus no sequence ambiguities are to be expected from the presence of more than one allele. Chances of survival of copies of mitochondrial genome during extreme conditions of heating, processing and storage are very high due to the high copy number.

In this study, the amplification of species-specific marker of mitochondrial DNA D-loop region was carried out to detect pork in raw meat from different breeds/varieties of pig viz. Hampshire, Yorkshire, Ghungroo, Duroc, Rani, and Asha. Moreover, pork was also detected in processed pork products viz. sausage, salami, cocktail, slice, ham, kabab, patis, nuggets, meatball, retort, and pickle subjected to different cooking temperatures ranging from 70-121°C, and meat mixtures containing varying concentrations of pork (1-100%). Meat species identification of pork was further validated by checking it for cross amplification in other meat.

Table : Preparation of binary meat mixtures

Binary Meat mixtures	Pork (mg)	Other meat (mg)
1% pork	1	99
10% pork	10	90
30% pork	30	70
50% pork	50	50
75% pork	75	25
100 % pork	100	0

The amplification of species-specific mt DNA D-loop region resulted in an amplicon of 712 bp in raw meat of all the breeds /varieties of Pig i.e. Hampshire, Yorkshire, Ghungroo, Duroc, Rani, and Asha. The results were consistent in processed pork products viz. sausage, salami, cocktail, slice, ham, kabab, patis, nuggets, meatball, retort, and pickle. In case of all the mixtures with different concentrations of pork, similar results were observed. The pig mt DNA D-loop primer set successfully amplified the 712 bp DNA fragment from pork, whereas no amplification products were obtained with DNA from beef, carabeef, chevon, chicken, and duck meat samples. The results suggested that the mt DNA D-loop marker used in this study is highly species-specific and reliable to detect pork, unambiguously, in raw, processed as well as in meat mixtures containing pork.

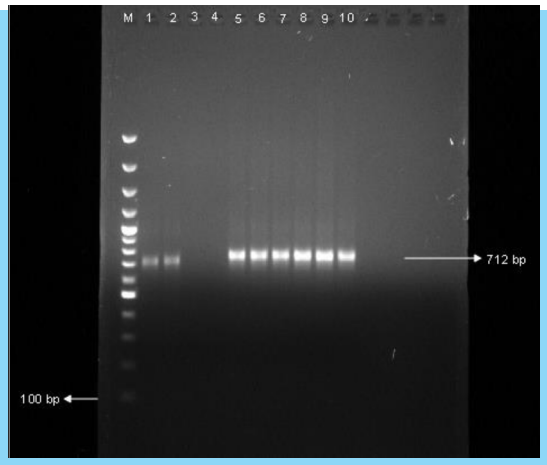


Fig. PCR amplification of DNA from different breeds/varieties of Pig with mt D-loop marker. The lanes are L= 100 bp DNA ladder, 1= Positive DNA target control, 2=Positive extraction blank, 3= Extraction blank, 4=Negative DNA target control, 5= Hampshire, 6= Yorkshire, 7= Ghungroo, 8= Duroc, 9= Rani, and10= Asha

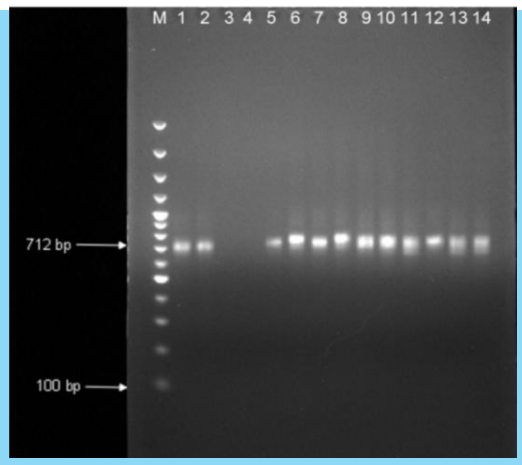


Fig. PCR amplification of mt D-loop marker in processed pork products. The lanes are M=100 bp DNA ladder, 1=Positive extraction control, 2=Positive DNA target control, 3=Negative DNA target control 4=PCR reagent control, 5=Sausage, 6=Salami, 7=Cocktail, 8=Slice, 9=Kabab, 10=Patis, 11=Nuggets, 12=Meatball, 13=Retort, and 14=Pickle

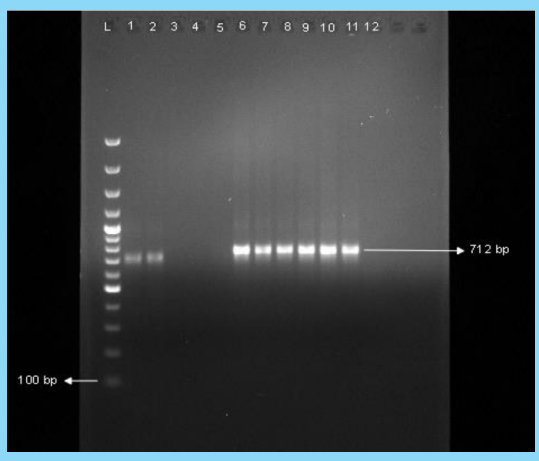


Fig. PCR amplification of mt D-loop marker in binary meat mixture. The lanes are L=100 bp DNA ladder, 1=Positive extraction control, 2=Positive DNA target control, 3=Negative DNA target control 4=Extraction blank, 5=PCR reagent control, 6=1% pork, 7=10% pork, 8=30% pork, 9=50% pork, 10=75% pork. 11= 100% pork

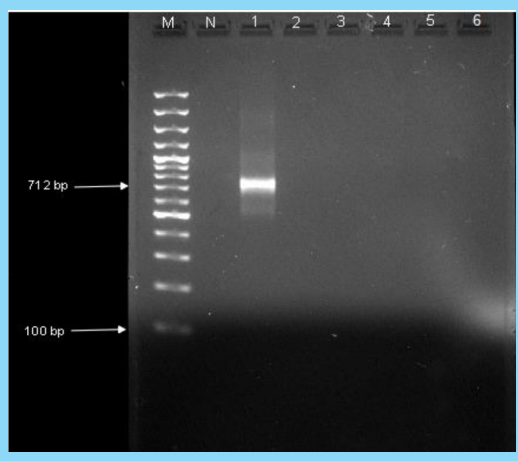


Fig. PCR amplification of mt D-loop marker in pork and cross checking with other meat. The lanes are M= 100 bp DNA ladder, N= Non template control, 1=Pork, 2=Beef, 3=Carabeef, 4=Chevon, 5=Chicken and 6= Duck

3. Development and validation of multi-residue method for detection of pesticide residues in food samples using LC MS/MS

Currently the methods were optimized for six pesticides viz. Carbofuran, Malathion, Dimethoate, Chlorpyrifos, Diazinon and Dichlorvos. Validation of the method and the determination of LOD and LOQ are in progress.

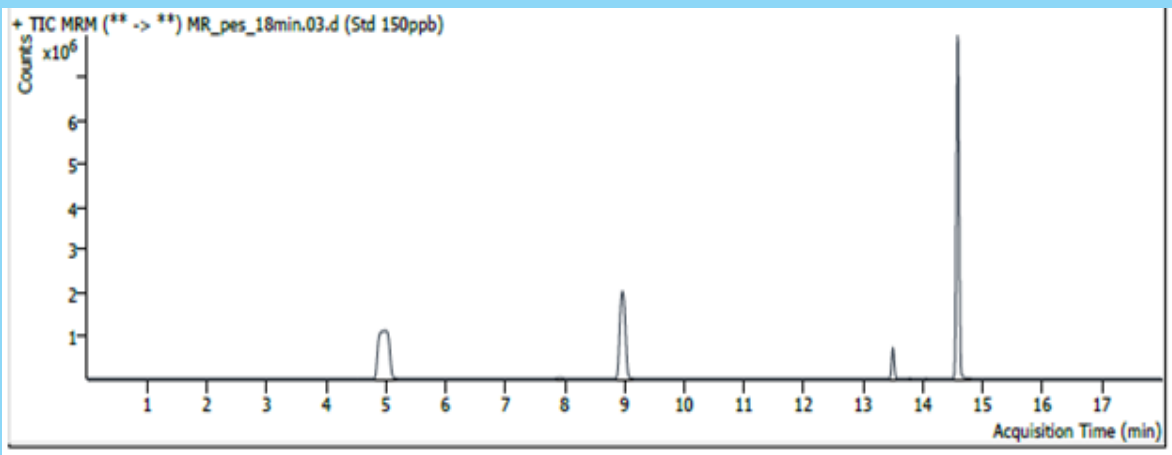
Instrument condition:

LC Parameters:

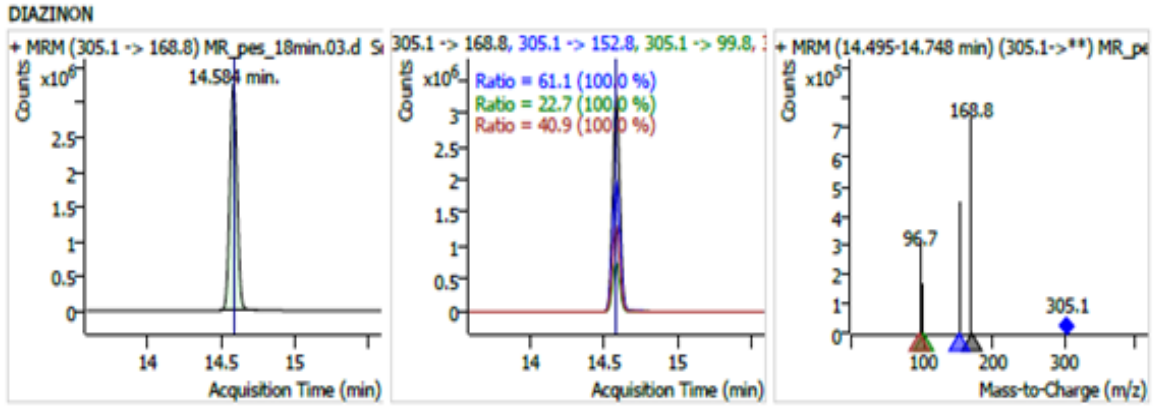
LC Parameters			
Column	Agilent ZOBRAX Eclipse Plus C18 Rapid Resolution HD 2.1*100mm 1.8 micron (P.N. 959758-902)		
Injection volume	3 µL		
Column temperature	40 °C		
Flow rate	0.5 mL/min		
Gradient	Time(min)	%A	%B
	0	98	2
	0.5	98	2
	1.8	85	15
	3.5	80	20
	6.0	75	25
	7.0	70	30
	9.0	65	35
	11.0	50	50
	14	30	70
	16	10	90
	18	2	98
Run time	18 minutes		
Post run time	1 minutes		
Mobile phase	A 0.1% Formic acid in H2O B 0.1% Formic acid in ACN		
Needle wash	1:1:1:1 ACN/MeOH/IPA/H_2O		

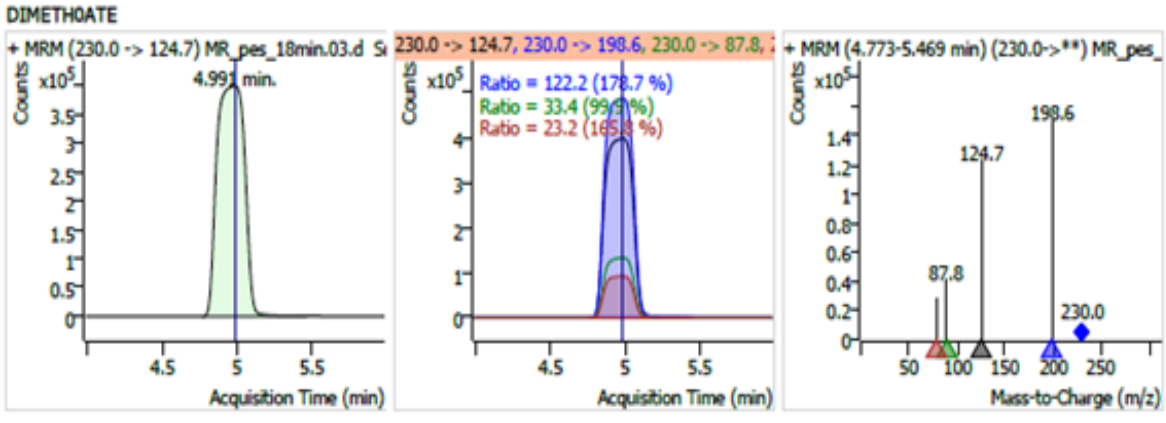
MS parameters:

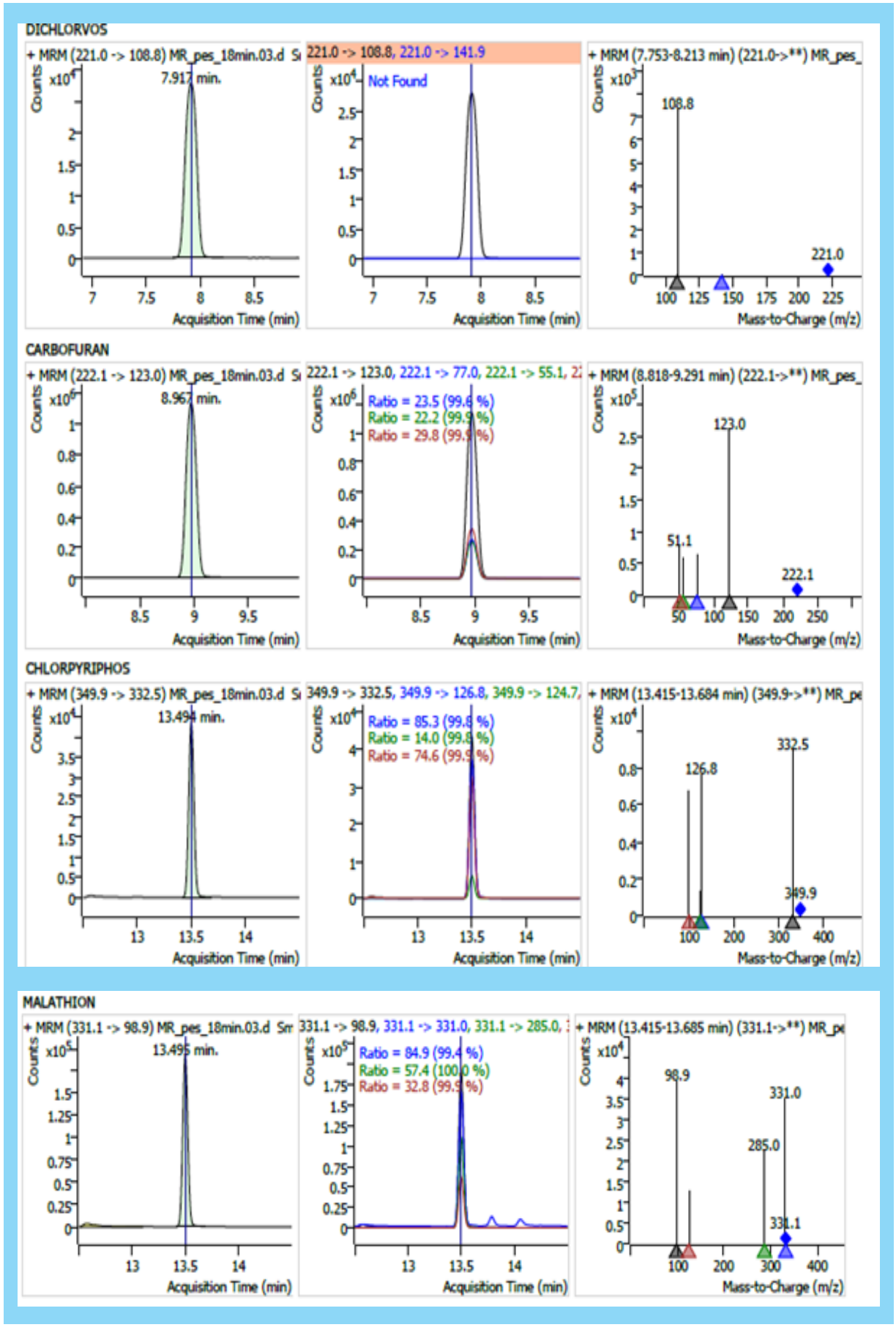
MS parameters	
Ionization mode	Positive
Gas temperature	200 °C
Gas flow	11 L/min
Nebulizer	35 psi
Sheath gas temperature	275 °C
Sheath gas flow	11 L/min
Capillary	3,000 V



Compound	Transition	RT	Resp.	Final Conc	Units
DIMETHOATE	230.0 -> 124.7	4.991	5145786	146.0753	ng/ml
DICHLORVOS	221.0 -> 108.8	7.917	202403	146.7964	ng/ml
CARBOFURAN	222.1 -> 123.0	8.967	7474874	144.7408	ng/ml
CHLORPYRIPHOS	349.9 -> 332.5	13.494	147293	147.8174	ng/ml
MALATHION	331.1 -> 98.9	13.495	647849	149.3497	ng/ml
DIAZINON	305.1 -> 168.8	14.584	11262769	147.7360	ng/ml






DICHLORVOS
+ MRM (221.0 -> 108.8) MR_pes_18min.03.d
7.917 min.
221.0 -> 108.8, 221.0 -> 141.9
Not Found
+ MRM (7.753-8.213 min) (221.0->**) MR_pes_
108.8
221.0
Counts
Acquisition Time (min)
Mass-to-Charge (m/z)
CARBOFURAN
+ MRM (222.1 -> 123.0) MR_pes_18min.03.d
8.967 min.
222.1 -> 123.0, 222.1 -> 77.0, 222.1 -> 55.1, 22
Ratio = 23.5 (99.6 %)
Ratio = 22.2 (99.9 %)
Ratio = 29.8 (99.9 %)
+ MRM (8.818-9.291 min) (222.1->**) MR_pes_
123.0
51.1
222.1
CHLORPYRIPHOS
+ MRM (349.9 -> 332.5) MR_pes_18min.03.d
13.494 min.
349.9 -> 332.5, 349.9 -> 126.8, 349.9 -> 124.7,
Ratio = 85.3 (99.8 %)
Ratio = 14.0 (99.8 %)
Ratio = 74.6 (99.9 %)
+ MRM (13.415-13.684 min) (349.9->**) MR_pe
332.5
126.8
349.9
MALATHION
+ MRM (331.1 -> 98.9) MR_pes_18min.03.d
13.495 min.
331.1 -> 98.9, 331.1 -> 331.0, 331.1 -> 285.0,
Ratio = 84.9 (99.4 %)
Ratio = 57.4 (100.0 %)
Ratio = 32.8 (99.9 %)
+ MRM (13.415-13.685 min) (331.1->**) MR_pe
98.9
331.0
285.0
331.1

MoFPI Project: Setting up of food testing laboratory

R. Thomas, Seema R. Pegu and S. Rajkhowa

The infrastructural development project was sanctioned by Ministry of Food Processing Industries with an outlay of Rs. 365.00 lakhs to set up a state of the art NABL Accredited testing laboratory for pork and pork products at ICAR-NRC on Pig. Construction of a separate building with an area of about 1900 sq. ft has already been completed for housing the sanctioned equipment. The said building has provisions for sample receiving and coding, sample processing, residue monitoring, adulteration detection and microbial analysis, of food samples especially of meat and meat products. Institute has initiated the process for applying for NABL accreditation of the laboratory. As the first step, three of the Scientific staffs, who are associated with the current project have undergone the ISO 17025:2017 training programme (Laboratory Quality Management and Internal Audit) at National Institute of Training for Standardization (NITS), BIS, Noida. Food Quality Management Database has been designed and developed for handling the analytical samples with traceability. Proficiency Testing has been completed and the process of application for NABL is in the final stage.

A total of 28 numbers of analytical and testing equipments including LC-MS/MS, Atomic Absorption Spectrophotometer and Real Time PCR were procured and installed in the Quality Control Laboratory.

APRAT Project: Technical Advisory Services for Piggery Value Chain Improvement in Assam, under the World Bank financed Assam Agribusiness and Rural Transformation Project (APART).

R. Thomas, Seem R. Pegu, K. Barman, Sunil Kumar, S. Rajkhowa

ARIAS Society, Govt. of Assam has signed a Memorandum of Understanding (MoU) with ICAR-National Research Centre on Pig, Guwahati to provide technical advisory services for piggery value chain improvement in Assam under the World Bank funded project. Institute is focusing on four thrust areas under this project viz. analysis of feed resources for ration balancing; sero-sampling for JEV to inform targeted measures to decrease mosquito transmitted virus to pigs; support in creation/up-gradation of liquid boar semen processing labs and conducting capacity building programme for master trainers. With respect to preparation of database for ration balancing, guidelines for feed sample collection, packaging and transportation is prepared and submitted to AHVD. Those AHVD staffs and Pig Bondhus so far trained at the institute were given detailed narration about the sample collection and transportation process. Institute has undertaken a background study related to the prevalence of JEV in different districts of Assam and accordingly the following districts were identified for the study viz. Jorhat, Sivasagar, Kamrup, Nalbari and Lakhimpur. The blood samples received from these districts are being analyzed for the JEV antibody. Regarding capacity building of value chain actors in the project, institute has already conducted 05 training programmes to Veterinary Doctors from 13 districts. The theme of the training programmes was "Master Training (ToT) programme for AHVD staff on Scientific Pig Farming". A total of 115 Veterinarians were trained in these programmes. All the trainees were practicing veterinary doctors and the training has provided exposure to participants on basics of selection of breed/varieties/strain and breeding strategies for profitable pig farming, principles of swine feeding, feeding of different categories of pigs and use of non-conventional feed stuffs for swine feeding, care and management of different categories of pigs, neonatal piglet mortality and its management, exposure to semen lab, semen collection, processing and evaluation of boar

semen for Artificial Insemination, housing requirement for scientific pig farming, common diseases of pigs and their management including vaccination schedule, farm cleaning, disinfection, routine farm operation practices, castration and needle teeth clipping of piglets and different methods of administration of medicines in pig, demonstration of formulation of feeds for different categories of pigs and financial avenues for augmenting backyard pig farming to homestead enterprise. Training has also imparted information on value addition and further processing of pork and the avenues available in the utilization of different by-products arising out of pig slaughter operations. Similarly, four training programmes for the *Pig Bondhus* i.e. "Master Training (ToT) programme for local service provider (Pig Bondhu)" were organized and a total of 80 pig bondhus participated in the programme. They were exposed to basics of pig farm management, feeding management, breeding management and the biosecurity measures to be followed to avoid/ reduce the incidence of disease outbreaks in pig farms. Special emphasis was given to artificial insemination in pigs and proper heat detection. Hands-on training sessions were organized on artificial insemination in female pigs using liquid semen samples.

Extension

Institute Project: Fostering the adoption of scientific pig production practices among small holders in Assam

Misha Madhavan M., Keshab Barman, Mohan N. H., Santanu Banik, R. Thomas, Seema R. Pegu and Sunil Kumar

During the period of report, two educational tools were prepared as per the first objective of the project. One is a technical bulletin on scientific pig production practices in local language (Assamese) and the other one is a video on scientific interventions for up scaling rural piggery. The video was prepared in three different languages i.e., English, Hindi and Assamese considering the end users. Then, item analysis was carried out for the prepared 30 items. Based on the item difficulty index and discrimination index, 15 items were selected for the knowledge test as shown in below. The primary data collection was continued for understanding the adoption rate of scientific pig production practices among farmers.

Table : Selected items for the knowledge test with its difficulty and discrimination indices

Sl. No	Items	Difficulty Index	Discrimination Index
1	When AI should be done in gilts?	47.50	0.27
2	Mating between close relatives should be avoided because….....	55.00	0.64
3	What should be the optimum trough space for feeding in the pig pen?	65.00	0.36
4	Silage can be prepared from….....	62.50	0.36
5	At what distance the umbilical cord of new born piglets should be cut?	30.00	0.36
6	After how many days the weaning of the piglets have to be done?	65.00	0.36
7	Castration have to be done for the male piglets grown for fattening purpose because.	32.50	0.64
8	At what time the artificial insemination should be done in guilts?	32.50	0.27
9	The practice of feeding solid diet to piglets separated from their mother, while they are suckling milk (Creep feeding) can be started from.	32.50	0.64
10	Regular deworming has to be done for pigs to control the gastro-intestinal parasites within the duration of:	77.50	0.55
11	Why the usage of boots is recommended while working in pig farms?	90.00	0.36
12	Integrated farming is one of the most important aspects for effective pig farm waste management. But what is meant by integrated farming?	47.50	0.36
13	How many lactating sows can be kept together scientifically?	90.00	0.36
14	Which of these practices falls under health management?	80.00	0.36
15	Which of the following is not a bio-security measure in pig farm?	35.00	0.45

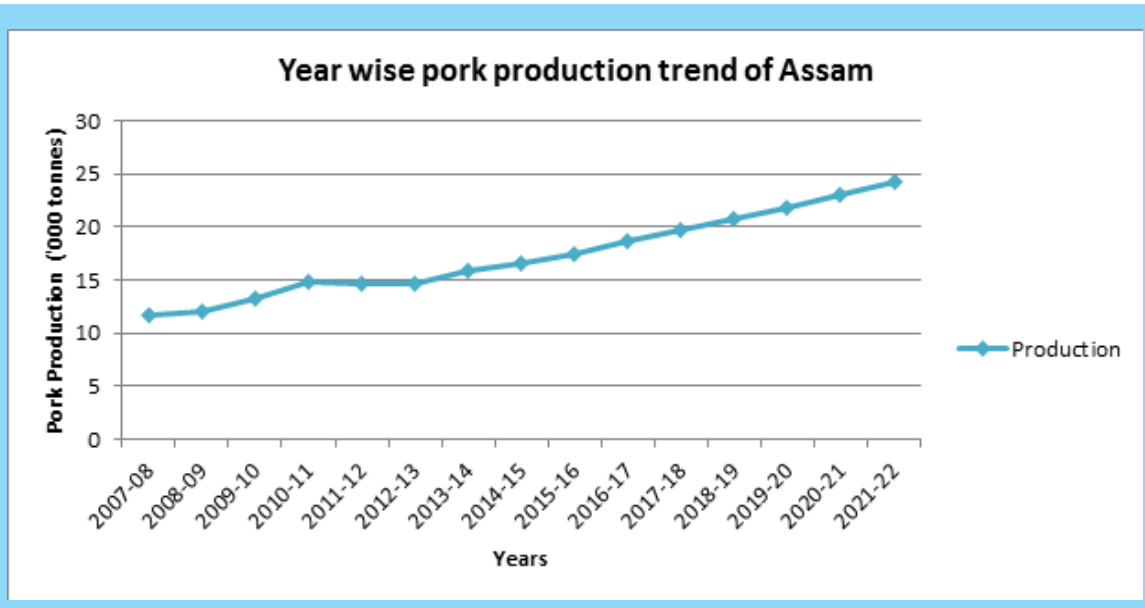
NASF project: Pork marketing chains in North East India for sustainable livelihood of tribal women (Assam, Meghalaya and Nagaland)

Misha Madhavan M. and Mohan N. H.

This project is being carried out since 1st December, 2019 with other three partnering institutes. During the reported period, secondary data collection was carried out as per the objective from the available literature, Department of Veterinary & Animal husbandry, Govt. of Assam, R & D institutes, different stakeholders in piggery sector in Assam. The data on pig population, pork production and prices were collected. The data was then analyzed for understanding the trend of pork production in Assam. Based on the available data for 10 years (2007-08 to 2016-17), the

Compound Annual Growth Rate (CAGR) for pork production in Assam was estimated as 5.3 %. That is every year there is an increase of 5.3 % in total pork production in Assam. Based on this the data was extrapolated for the next 5 years from 2016-17 as shown in the given table.

Year-wise meat production trend of Assam (in '000 tonnes) from 2007-08 to 2021-22 (Forecasting of production with CAGR)



Source: State Pig Breeding Policy Assam, 2018 and Integrated Sample Survey Report 2016-17

*Data from 2017-18 to 2021-22 is calculated by the authors based on CAGR

From the secondary data collected, the following details were also documented.

- Available pork products in Assam which include the traditionally processed and commercially processed pork products.
- The wholesaler and retailer prices of different pork products to understand the price difference along the marketing chain.
- Institutional Support Mechanism for development of pig/pork production in Assam
- Different Schemes and Credit facilities available for piggery sector in Assam.
- Different actors involved in the pork marketing chains in Assam

Based on the secondary data, we then identified six districts for the primary data collection which includes

1. Lakhimpur from the North Bank Plains Zone
2. Golaghat from the Upper Brahmaputra Valley Zone
3. Kamrup (M) from the Lower Brahmaputra Valley Zone
4. Kamrup (R) from the Lower Brahmaputra Valley Zone
5. Baksa from the Lower Brahmaputra Valley Zone
6. Karbi Anglong from the Hill Zone

Later, a semi-structured interview schedule was prepared with the lead centre for collecting the primary data. A pilot survey was conducted in which data were personally collected from 71 farmers from three districts i.e., Baksa, Golaghat and Kamrup Rural. This data was then analysed and the results are as follows.

- More than half of the male population in Assam who are into pig farming has received education till high school level.
- Farming is the pre dominant occupation. Private employee and self employed is second important occupation in Assam
- In Assam, 84% of the farmers own pig for the purpose of selling i.e. only for commercial purpose 16% of them own it for both self consumption and commercial purposes.
- State wise decision making with respect to cleaning and waste management participation of both members of the family is highest in Assam as it is almost 1/4th of the population
- In Assam the participation of women in decision making with respect to purchase of feed and other inputs is less than 5%.
- On the other hand in Assam women alone have a larger say (almost 65%) in the marketing of pig/ pork.
- Mass media is dominant source of information (44%) in Assam. Among the mass media mobile is highly used (25%) as source of information compared to other sources
- **Challenges** faced by pig farmers especially women in the state of Assam at each level-
- **a) Input-** Lack of good quality feed & other raw materials; lack of open grazing land
- **b) Production-** lack of contact with vets; lack of govt. support
- **c) Processing-** lack of awareness; lack of transportation & communication; high cost of technology
- **d) Marketing-** financial problem and improper market facilities

FOCARS Programme

Institute orientation training programme: During the year 2020, three new Scientists have joined ICAR-National Research Centre on Pig. Three newly joined scientists of ICAR-NRCP viz. Dr. Nitin Attupuram, Ms. Salam Jayachitra Devi and Dr. Sheikh Firdous Ahmad have undergone their institute orientation training at ICAR-NRCP, Rani, Guwahati from 06/04/2020 to 05/05/2020. This trainin programme has helped the new scientists to gain meaningful insights through virtual interactions regarding all the laboratories, library and farm in the institute and also interacted with the scientific, administrative and technical staff during this training period. They have gained information about the linkages of the institute.

Professional attachment training programme: As a part of FOCARS training programme the newly joined scientists have undergone 3 months professional attachment training at different institutes. The brief report of the research work carried out by each Scientist is mentioned hereunder.

Name of scientist: Dr. Sheikh Firdous Ahmad

Institute: Sher-e-Kashmir University of Agricultural Sciences and Technology of Kashmir (SKUAST-K), Srinagar, Kashmir.

Topic: Genomic and animal breeding analysis of ovine germplasm of Jammu and Kashmir.

Development of breed specific marker panel and gain genomic insights into genetic makeup of *Changthangi* sheep: SNP BeadChips are easily available for various species with different densities (from low to high through medium density chips). Genome-wide data-based studies are gaining momentum in different livestock species which is evident from enormous number of research publications coming out from different aspects of genomic analysis. This is also attributable to recent advances in bioinformatics tools. Though the cost of genotyping animals from whole-genome data has gradually come down, however, economics are still unfavourable in developing countries. Not all SNPs in BeadChip are informative, polymorphic and useful. There is an urgent need to develop low-density SNP chips/panels that are breed-specific, informative and polymorphic in a particular breed of interest. In the present study, we tried to gain genomic insights of *Changthangi* Sheep population of Ladakh based on genomic data. Genomic data, pertaining to *Changthangi*sheep and five other sheep breeds (Australian Merino, Rambouillet, Garole, Deccani and Tibetan) were retrieved from different online platforms/supplementary data of high impact papers/ online repositories. The breeds included in the data are relevant with respect to breeding policy for small ruminants in India where Australian Merino is used for crossbreeding purpose with objective of improvement in fibre traits; while Rambouillet is used for improvement of dual-purpose breeds. The data was initially pruned with quality control parameters based on genotypic rate (0.1), Mendelian errors (0.1), minor allele frequency (0.05) and Hardy Weinberg equilibrium (0.001). Only autosomal chromosome-based SNP markers with definite mapping coordinates were considered for analysis. We used LD-based pruning individual breed-wise data to get breed specific SNPs. The data (whole genome-wide markers and breed-specific informative markers) were run for breed stratification using STRUCTURE software with a burn-in of 20000 and MCMC runs of 50000 (three iterative runs) for a *K* value range of 2-6. TRES software was used to select SNPs that help in differentiation of all breeds in the dataset based on three different criteria *i.e.,* Delta Value, Pairwise Wright's F_{ST} and informativeness for assignment (I_n). Principal component analysis stratification was undertaken after incorporation of Chinese merino and European Mouflon breeds in the dataset. Only 38351 SNP markers could qualify the quality control and threshold parameters. Genomic clustering (though non-exclusive) was achieved for all breeds at *K* value of 6. A total of 992 SNPs were scored based on LD-pruning in *Changthangi* sheep. On merging the dataset and running LD-pruning, 1196 SNP were pruned-in for all breeds. 500 SNPs were selected from TRES-software based analysis that produced exclusive breed clustering on STRUCTURE analysis. The markers evaluated and selected from the present study will be helpful in economizing the cost of genomic-based studies and these markers may be exploited on genetic basis for gaining further insights into the genetic make-up of *Changthangi*sheep of Ladakh.

Undertaking multivariate quantitative genetic analysis of body weight traits in Corriedale sheep: In the present study, an attempt was made to elucidate the genetic parameters of the body weight traits of lambs from Corriedale sheep population at different stages of life. Data were collected from 6874 lambs born to 234 rams and 2145 ewes born over a span of 49 years from 1969 to 2017. The traits under study included birth weight (BW); weight at weaning (WW); weight at 6 months of age (6MW); weight at 9 months of age (9MW) and weight at yearling stage (YW). Data were genetically analysed using restricted maximum likelihood (REML) algorithm in WOMBAT

program. A multivariate animal model was fitted to the data incorporating season, period of lambing, sex of lamb, litter size and total litter born to ewe as fixed effects. Variance and covariance components were estimated using the animal model after incorporating direct additive genetic effect of animal as random factor. Genetic and phenotypic correlation estimates with corresponding standard errors were also estimated. The heritability estimates for BW, WW, 6MW, 9MW and YW were 0.126, 0.300, 0.292 0.192 and 0.169, respectively. The genetic correlation between different traits under study was high, except between BW and 9MW for which the estimate was moderate. Phenotypic correlation ranged from low to high for different trait combinations. Among different traits under study, only two traits showed moderate heritability *i.e.,* WW and 6MW while that of other traits was low. Both these traits showed high correlation with all subsequent traits. Selection programme for Corriedale sheep should be based on WW which is expressed early in life and will lead to moderate response.

Estimation of (Co)variance components and genetic parameters of fibre traits in Rambouillet sheep using multi-trait analysis: The study aimed to estimate the genetic parameters of different fibre traits viz. greasy fleece weight, staple length and fibre diameter in Rambouillet sheep population using multi-trait animal model. Data, spanning over a period of 10 years (1998-2007) and pertaining to fibre traits at first clip, were collected for a total of 4186 Rambouillet sheep maintained at an organized farm. (Co)variance structure and genetic parameters were estimated using multi-trait animal model. The genetic analysis of data was performed based on restricted maximum likelihood (REML) procedure using WOMBAT software. The model incorporated sex of lamb (male and female), year of birth (1-10), season of birth (1-2) and litter size (1-2) as fixed effects while direct additive genetic and maternal genetic effects were included as random effects. The direct additive genetic heritability estimates were 0.120±0.034, 136±0.037 and 0.356±0.070 for greasy fleece weight, staple length and fibre diameter, respectively. The maternal genetic heritability of all fibre traits under study were very low, ranging from 0.014±0.008 (Greasy fleece weight) to 0.070±0.002 (fibre diameter). The total heritability estimate was low for greasy fleece weight (0.0907±0.027) and staple length (0.156±0.034) traits while it was moderate for fibre diameter (0.342±0.051). Additive genetic correlation was positive and low between greasy fleece weight and staple length and between staple length and fibre diameter. However, the additive correlation estimate was high but negative between greasy fleece weight and fibre diameter. In conclusion, low heritability estimates were recorded for greasy fleece weight and staple length which may not be highly responsive to selection. However, fibre diameter was moderately heritable which implies that selection may lead to moderate improvement in this trait. The results from the present study will help in formulating optimal breeding plans for improvement in fibre traits in Rambouillet.

Name of the Scientist: Nitin M. Attupuram

Institute: Rajiv Gandhi Center for Biotechnology, Thiruvananthapuram, Kerala

Topic: Research entitled "Study on expression Non Structural 3 (NS3) protein on transfected HepG2 cell lines" was done to understand molecular dynamics involved in immunological changes associated with viral infections. Dengue virus (DENV) contains a positive single-stranded RNA genome that encodes a single precursor polyprotein that is further cleaved into structural and non-structural proteins, among which the non-structural 3 (NS3) protein has C- terminal helicase domain required for RNA replication and is also involved in forming functional viral protease. Bacterial culture with recombinant gene of interest incorporated into plasmid was done. Bacterial growth was achieved in Luria-Bertani (LB) broth and plasmid extraction was performed using

plasmid extraction kit (Wizard plus SV mini preps DNA purification system). Transfection was performed on HepG2 cells, cultured in 4cm culture well plates. Lipofectamine mediated transfection of the gene of interest was done on adherentHepG2 cells and green fluorescence was observed on successfully transfected cells. Samples were collected from transfected cells. For secretary protein estimation cell supernatant was utilized, and for cellular protein and RNA analysis cell culture scrapings were utilized. Western blotting confirmed the cellular localization of NS3 protein in HepG2 cell lines.

Name of the Scientist: Salam Jayachitra Devi

Institute: National Institute of Technology, Department of Computer Science Engineering, Manipur

Topci : Research work carried out: A research work entitled "Counting pig using Marker-Controlled Watershed Segmentation" has been carried out during the professional attachment training at the National Institute of Technology, Manipur during 5th June to 4th September 2020.

The segmentation algorithm for counting pigs is a combinational algorithm that consists of an image threshold to perform foreground extraction, watershed transformation, marker-controlled watershed segmentation, bwlabelling and counting of pigs in an image. This combinational algorithm also includes morphological processing method to simplify the image pixels and remove the cracks, grille, and other noise present in the image and established a pixel array of foreground and background which is the input of marker-controlled watershed segmentation algorithm. The flow chart of this algorithm is depicted in below.

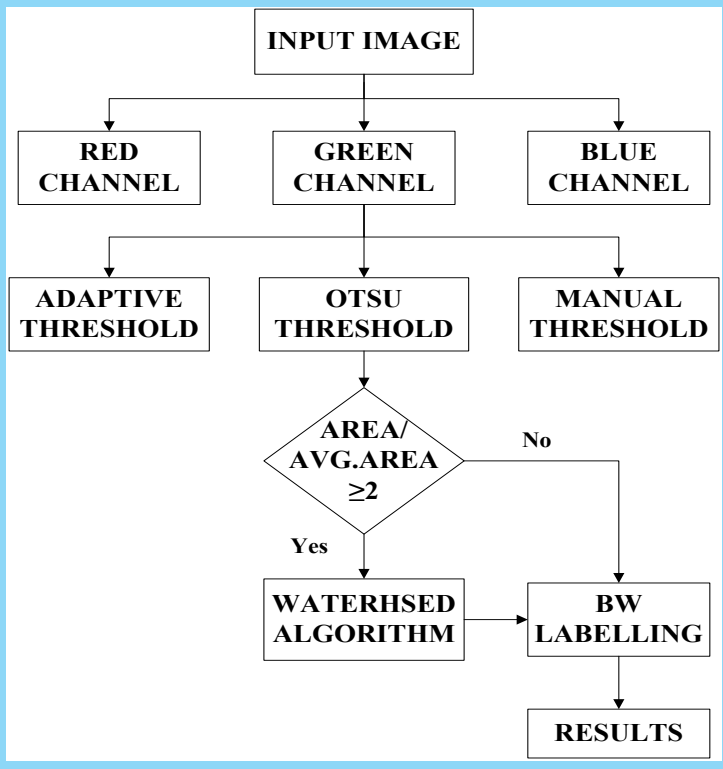


Fig. Framework of pigs counting system

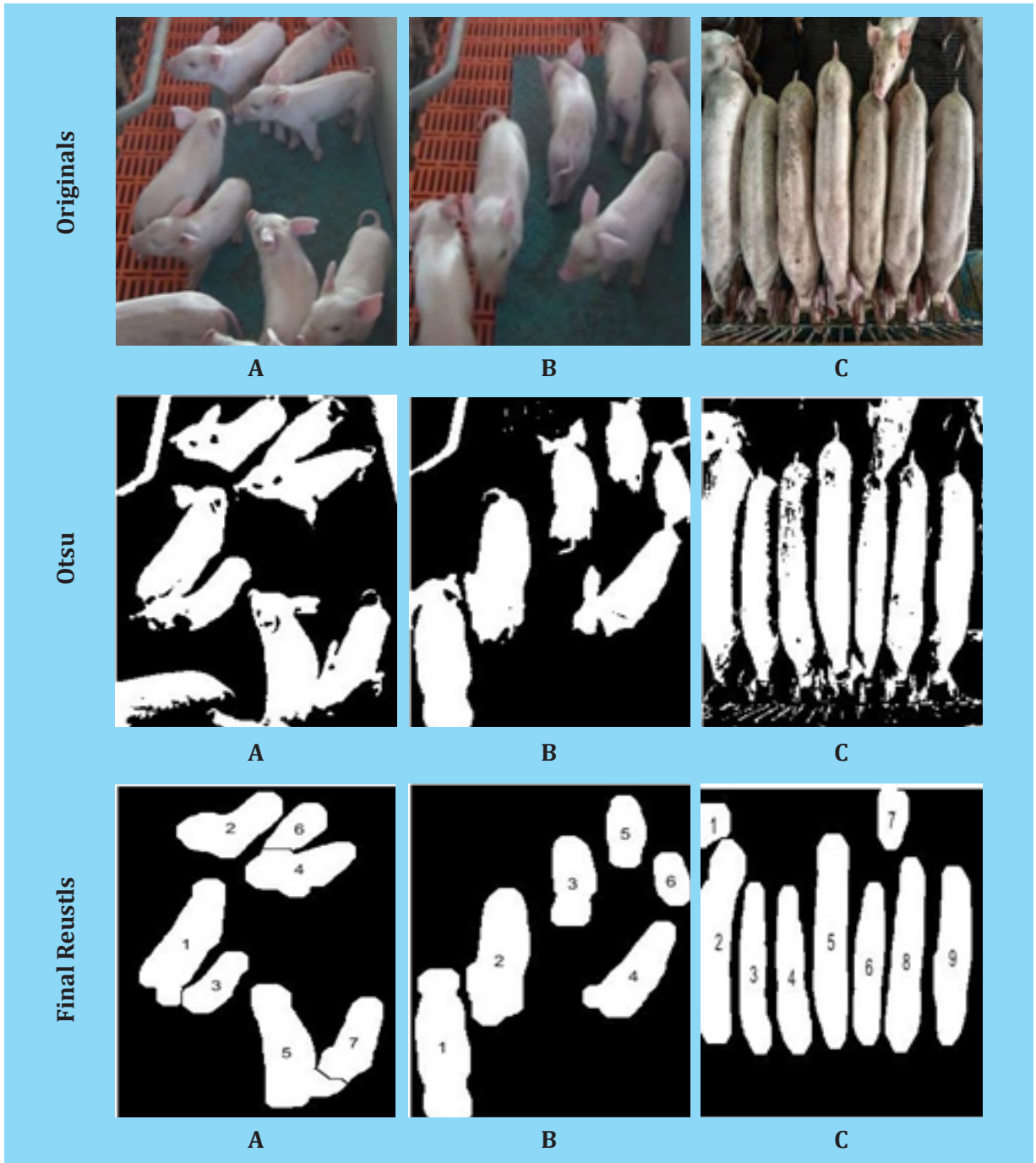


Fig. Illustration of Marker-Controlled watershed segmentation and counting process

Counting of objects in an image has been illustrated. In this, we have considered four piggery images. Then apply Otsu threshold on these images followed by morphological filtering. In all these three images, the objects (pig) are touching or overlapping with one another. To count these overlapping or touching objects individually, we considered Marker-controlled watershed segmentation process. The overlapping objects are segregated using Marker-controlled watershed segmentation and it is clearly show. Once the touching objects get segregated, all the objects are counted by giving the proper numeric label of each object. Hence, counting of pigs has been successfully carried out using Otsu threshold and Marker-controlled watershed segmentation algorithm.

OUT-REACH PROGRAMMES

TRIBAL SUB-PLAN Scheme

The Tribal Sub-Plan (TSP) is a planning concept used in NRC on Pig channelizes the flow of benefits from the ICAR/ Central government for the development of tribal populations in the state. The motivation for TSPs is to bridge the gap between tribal population and others by accelerating access to income generating opportunities through input distribution like piglets, animal feeds, minor machineries/ equipments, medicines and supplements. TSP also provides capsule training courses to tribal pig farmers to ensure employment opportunities. TSP ensures direct benefits to individual or families belonging to Scheduled Tribes.

Nodal Officer : Dr B C Das, Principal Scientist

Members: Dr Keshab Barman, Dr Seema R Pegu, Dr Juwar Doley and Dr. Jaya

Table : Distribution of piglets, pig feed, feed supplements, medicine, vaccines etc during 2020-2021

SI. No.	Description	Unit	total
1	Capacity building programme: Training/demonstration/ awareness/ orientation programmes, scientist interaction etc	Number	26
2	Technical guidance, input support and follow up on scientific pig farming practices at Kamrup, Goalpara, Udalguri, Nalbari, Nagaon, Baksa districts of Assam	Number	1500
3	Distribution of pig feed	Kg	15600
4	Distribution of mineral mixture	Kg	300
	Distribution of anthelmintic for pig	Dose	3000
	distribution of piglets	No	62
	Hand gloves	No	400
	Potash	g	2400

Table : List of awareness camp under TSP

Year	Sponsoring Institute	Name of the training	No. of Beneficiaries
2020	ICAR-NRCP under TSP	Animal Health and Awareness camp conducted on 29-12-2020 at Rani	29
	ICAR-NRCP under TSP	Animal Health and Awareness camp conducted on 07-1-2021 at Tangla Odalguri	160
	ICAR-NRCP under TSP	Animal Health and Awareness camp conducted on 22-12-2020 at Dhamdhama Nalbari	170
	ICAR-NRCP under TSP	Animal Health and Awareness camp conducted on 01-09-2020 at Rani	50
	ICAR-NRCP under TSP	Animal Health and Awareness camp conducted on 02-09-2020 at Ratanpur, Boko, Kamrup Assam	110








TSP activities at a glance

SCSP Scheme

Seema R. Pegu, Keshab Barman, Rafiqul Islam, Juwar Doley, Kalyan Dey and Sunil Kumar

The SCSP (Scheduled Caste Sub Plan) has been started by the Government of India to benefit the farmers of scheduled caste (SC) communities of the country. The institute implemented the SCSP plan to benefit the pig farmers of the SC community. Superior quality crossbred Pig along with pig feed and medicines and essential feed supplements were distribution to approximately 200 farmers in different SC villages of Kamrup and Nalbari District of Assam under the SCSP plan during the year 2020.

Glimpses of SCSP program conducted under Scheduled caste sub plan of the Institute

AICRP AND MEGA SEED PROJECTS

AICRP and MEGA Seed Projects on Pig

ALL INDIA COORDINATED RESEARCH PROJECT ON PIG

The main objective of AICRP on pig, which launched in IVth Five Year Plan (1970-1971), was to study the performance of pigs in different agro-climatic condition of the country. Subsequently the project was mandated to develop region-specific package of practices including quality germplasm. Few centers are mandated for conservation of indigenous germplasm. Presently the programme is continuing in fifteen different centers across the country.

ICAR-National Research Centre on Pig is regularly monitoring the progress of AICRP on Pig project through technical and financial monitoring in consultation with the Council and conduction of review meet. The last AICRP review meet was conducted at ICAR-RCNEH, Barapani on 27-28th September, 2019.

Assam Agricultural University, Khanapara, Guwahati

The ICAR-AICRP on pig, AAU, Khanapara has played an important role since its inception for development of pig production in the state and neighboring states through various ways like attending training, awareness program, exhibition, demonstration, distribution of leaflet /booklet. The centre has conducted several training programme and extension activities to popularize piggery in the state of Assam and adjoining states. This centre has played a significant role in developing piggery sector by selling of quality piglets, elite gilts/ sows and boars at nominal price to the interested farmers of the state. The center is maintaining HD-K75 crossbred germplasm developed by crossing of Hampshire (75%) and local pig (25%) of Assam. The total herd strength of the HD-K75 crossbred germplasm was 116 at the end of 2019-20 financial year. During 2019-20, total 334 piglets were born and 288 piglets were sold and 20 death occurs at the Centre. The average Litter size at birth and weaning was 7.42 ± 0.85 and 7.17 ± 0.55 respectively.

HD-K75 Sow with Piglets

Kerala Veterinary and Animal Science University, Mannuthy Centre, Kerala

KVASU, Mannuthy Center is maintaining Large White Yorkshire, Desi and Mannuthy White crossbred variety developed by crossing of LWY (75%) with local pig of Kerala. The Centre could impart scientific knowledge to the progressive pig farmers in establishing the piggery units with respect to health care, feeding and breeding management, waste disposal and other problems faced on a day to day basis through telephone and by direct personal contact. Mannuthy White is well adapted to humid tropical agro-climatic conditions and suited to low input rearing system of Kerala. The centre has

Imparting training to farmers

successfully fulfilled the demand of the farmers by supplying 248 fattening piglets (75% crossbreds) and generated a total revenue of Rs 7.16 lakhs during the year 2019-20. Total 231 crossbred 50%, 114 crossbred 75% and 29 LWY was available at the end of 2019-20 financial year. The average Litter size at birth and weaning was 10.42±0.18 and 10.22±0.12 respectively in 75% crossbreds.

Sri Venkateshwara Veterinary University, Tirupati

The AICRP on Pig at SVVU Center, Tirupati is maintaining Large White Yorkshire pigs and its crosses under optimum managemental conditions. Presently performance of only 75% LWY crossbreds by inter se mating is being studied. Currently 23nd Generation is in progress. During the period under report 225 piglets were born and 204 animals were sold. On the whole 241 piglets were born from 30 farrowing. During the year under report 179 weaners and adults were sold, 22 animals were slaughtered and there were 62 deaths due to various reasons. At the end of 2019-20 total herd strength was 324. The average Litter size at birth and weaning was 8.0±0.40 and 6.84±0.39 respectively in 75% crossbreds.

Offering sweet potatoes to the pig

ICAR-Central Coastal Agricultural Research Institute, Goa

Goa being tourism hub is one of the highest consumers with more than 50% of its population consuming Pork. The crossbreed pigs developed by ICAR-CCARI, Goa are hugely popular amongst producers and consumers alike. Suitable breed, crossbreeding of local pig breed, controlled breeding using synchronization and AI, standard balanced feeding, comfortable housing of pigs will lead to improved pig production and benefit the farmers. AICRP on pig Goa centre is attempting to provide training's and demonstrations and also providing farmers with quality breeding stock. The center is maintaining Agonda Goan (Local), Large White Yorkshire and its crosses. Total herd strength at the end of financial year 2019-20 was 177. During this period total 302 piglets were born and 218 piglets were sold to farmers. The average litter size at birth and weaning was 8.38±0.433 and 7.76±0.296 of 75% crossbred population.

4th Generation Sow with Piglets

Crossbred (75 % L x 25 % D) gilts at Unit

Indian Veterinary Research Institute, Izatnagar, Barielly

ICAR-IVRI AICRP centre maintain 75% exotic blood line by inter-se mating for which minimum 30 breedable sows are maintained with a sex ratio of 1:3 with 10 sires (2 sires from each 5 unrelated lines). Total herd strength at the end of financial year 2019-20 was 114. During this period total 556 piglets were born and 550 piglets were sold/transferred to farmers. The average litter size at birth and weaning was 7.46±0.31 and 6.42±0.28 of 75% crossbred population.

Tamilnadu Veterinary and Animal Science University, Kattupakkam

TANUVAS Centre is maintaining *inter-se* population of TANUVAS KPM Gold (75% crossbred LWY x Desi) pigs. Besides regular training, the center is presently involved for characterizing the local pig population of the state. Total herd strength at the end of financial year 2019-20 was 396. During this period total 731 piglets were born and 562 piglets were sold to farmers. The average litter size at birth and weaning was 8.4±0.93 and 8.4±0.93 of 75% crossbred population.

College of Veterinary Sciences & Animal Husbandry, CAU, Aizawl, Mizoram

The C.V.Sc & A.H, CAU centre maintains Zovawk to serve as genetic improvement unit. The basic principle of the project is to start a comprehensive study at institutional level to develop a farmer's friendly package of practices creating more assets and better opportunities for cash-starved populace. Total herd strength of Zowak at the end of financial year 2019-20 was 63. During this period total 10 piglets were born and 2 piglets were sold to farmers. The average litter size at birth and weaning was 5.3±0.96 and 5.18±1.56 of zovawk.

Nagaland University School of Agricultural Sciences and Rural Development, Medziphema Campus, Nagaland

The AICRP on pig, Nagaland centre started the project maintaining local Indigenous pig (Tenyivo) and studied the performance of the local breed and up-grade the local germplasm by crossing with exotic Hampshire boar. Presently centre was maintaining Tenyivo, Hampshire and upgraded Tenyivo (75%) using Hampshire boar. The center is mandated to conserve and subsequent genetic improvement of local pigs of the state (TenyiVo). The centre is also engaged in training on improved pig production. Total herd strength of Tenyivo, Hampshire and its 75% cross at the end of financial year 2019-20 was 45, 10 and 101, respectively. During this period total 128 piglets were born and 118 piglets were sold to farmers. The average litter size at birth and weaning was 6.66±0.71 and 5.33±0.71 of Tenyivo

AICRP Field Units at Thiyagadurgam

Zovawk Sow with piglets

Sensitization on the importance of Tenyivo pig at Seithekema Village

Artificial Insemination in Pig

ICAR-Central Island Agricultural Research Institute, Port Blair

AICRP on Pig programme of this centre was initiated looking to the high demand of pork and scope of piggery in the region. Under this centre, Nicobari pig are maintained, produced and supplied to farmers. Characterization work for Andaman local pig is initiated by the center. Total herd strength of Nicobari at the end of financial year 2019-20 was 93. During this period total 51 piglets were born and 36 piglets were sold to farmers. The average litter size at birth and weaning was 7.04±0.15 and 6.44±0.90 of Nicobari.

Rani sow with piglets at center

College of Agricultural, CAU, Imphal, Manipur

AICRP on Pig at Manipur centre was sanctioned with the main objective of development of region-specific package of practices for improved pig husbandry in the state of Manipur. The center is mandated to study the various performance characteristics of the Rani breed under Manipur condition. Works on characterization of Indigenous local pigs of Manipur were also initiated during the year. Total herd strength of Rani at the end of financial year 2019-20 was 144. During this period total 198 piglets were born and 150 piglets were sold to farmers. The average litter size at birth and weaning was 9.33±0.31 and 8.81±0.30 of Rani.

Female Chambil wak

ICAR Research Complex for NEH Region, Barapani

The AICRP on Pig, ICAR Research Complex for NEH region has successfully developed and released Lumsniang crossbred variety of pig which is suitable for hilly terrine of India. Besides Lumsniang the center is also maintaining the indigenous Niang Megha pig and 50% cross of Hampshire and Niangmegha. The center conducted several training, extension activities in farm and farmers' field. Artificial Insemination (AI) has been carried out regularly at farmers door step to produce the crossbred piglets. Total herd strength of Niangmegha, Lumsniang and 50% cross of Hampshire and Niangmegha at the end of financial year 2019-20 was 52, 105 and 55, respectively. During this period total 479 piglets were born and 338 piglets were sold to farmers. The average litter size at birth and weaning was 9.02±0.55 and 8.12±0.81 of Lumsniang.

Ghungroo piglet at AICRP center

ICAR-Indian Veterinary Research Institute, Eastern Regional Station, Kolkata

ICAR-AICRP on pig in IVRI, Kolkata was established with an idea to develop an elite flock of Ghungroo germplasm through selective breeding, propagate and supply the superior germplasm to cliental which indirectly increase the pork production. Besides maintaining Ghungroo germplasm the center conducted several trainings to the farmers for popularization of the breed. Total herd strength

of Ghungroo at the end of financial year 2019-20 was 104. During this period total 175 piglets were born and 156 piglets were sold to farmers. The average litter size at birth and weaning was 8.35±0.25 and 8.05±0.18 of Ghungroo.

KVK-Goalpara, ICAR-NRC on Pig

The AICRP on pig unit of KVK Goalpara is mandated to conserve Doom pig of Assam and maintain it with selective breeding. The genetic improvement programme of the breed was carried out in the center. As conservation approach, identification of breeding tract, supply of quality germplasm at field and mass-awareness by training and demonstrations were carried out. Total herd strength of Doom pigs at the end of financial year 2019-20 was 64. During this period total 9 piglets were born and 24 animals were purchased. The average litter size at birth and weaning was 4.5±0.5 and 4.5±0.5.

Doom Pig with litter at AICRP on Pig center

LWY Pig with litter at AICRP on Pig center

Guru Angad Dev Veterinary and Animal Science University, Ludhiana

Looking to the scope and importance of piggery sector in the state of Punjab the Council sanctioned one centre of AICRP on Pig at GADVASU, Ludhiana during 2017. The AICRP on Pig center of GADVASU, Ludhiana is maintaining Large White Yorkshire pigs. The center is engaged in training and demonstration to the farmers of Punjab. Total herd strength at the end of financial year 2019-20 was 52. The average litter size at birth and weaning was 9.7±0.7 and 7.25±1.1.

Krantisinh Nana Patil College of Veterinary Science, Shirval

Looking to the scope and importance of piggery sector in the state of Maharashtra the Council sanctioned AICRP on Pig center at Krantisinh Nana Patil College of Veterinary Science, Maharashtra Animal and Fishery Sciences University, Shirval during 2017. The center is maintaining Large White Yorkshire pigs. The center has initiated work on characterization and documentation of local pigs of Maharashtra. Total herd strength of LWY and native pigs at the end of financial year 2019-20 was 17 and 24, respectively. During this period total 74 piglets were born and 41 piglets were sold to farmers. The average litter size at birth and weaning was 10.0±0.26 and 8.67±0.61 of LWY, respectively.

Indigenous native pigs of Maharashtra

MEGA-Seed Project on Pig

Increased population pressure and rapid urbanization has resulted in increased demand for quality pork production. However, the growth and development of piggery sector has been hampered due to various major constraints like non-availability of superior quality seed stock, low cost feed ingredient, imbalanced ration at reasonable price, unscientific management, lack of financial support and marketing channel, etc. To mitigate the demand of quality pig germplasm among the farmer's field, an attempt was made by launching Mega Seed Project on Pig in 2008 which consists of eight different centres. Under this project improved variety of piglets were produced and distributed to the farmers.

Assam Agricultural University, Khanapara, Guwahati

The center is maintaining HD-K75 and 50% Hampshire crossbred pigs developed under AICRP on Pig unit of this center. These animals are well adapted and acceptable to the farmers of different states of northeastern region. During 2019-20 total 903 piglets were produced and 791 piglets were sold.

Birsa Agricultural University, Ranchi, Jharkhand

The rural people of Jharkhand have widely accepted the piggery sector as remunerative enterprises with great enthusiasm which in turn has provided tremendous employment opportunities to the local people. Mega Seed Project on pig supplying Jharsuk pig variety to the farmers. The center is developing second line breeder for further propagation of the variety. During 2019-20 total 1053 piglets were produced and 718 piglets were sold.

ICAR RC for NEH Centre, Nagaland

Pig is one of the most important livestock which plays an important livestock in improving the socio-economic status of the tribal and weaker section of the society of Nagaland. Mega Seed Project has made an approach to propagate quality pig germplasm at to farmer's field. The center is maintaining and distributing Rani crossbred pig variety to the stake-holders of the state. The center also popularized artificial insemination in pig in the state of Nagaland to enhance the production of piglets from superior breeding stock. During 2019-20 total 402 piglets were produced and 221piglets were sold.

Crossbred sow with piglet at Mega Seed Center

Visit of DDG (AS)

Visit of Animal Husbandry Minister, Central Government

Veterinary Department, Govt. of Mizoram, Aizwal

Mega Seed Project on Pig of Aizawl centre is mandated to supply quality Large White Yorkshire germplasm in the state. The production performance of the center was greatly affected by outbreak of PRRS in the state. The centre has also supported a few farmers in the state for scientific pig production and management. During 2019-20 total 276 piglets were produced and 181 piglets were sold. The centre has also supported a few farmers in the state for scientific pig production and management.

Suckling LWY piglets

Kerala Veterinary and Animal Sciences University, Mannuthy Centre, Kerala

The mandate of the centre is producing and supplying Mannuthy White crossbred germplasm developed under AICRP on Pig project. Artificial insemination is being regularly practised to avoid inbreeding depression and proper utilisation of genetic potential of superior males. During 2019-20 total 725 piglets were produced and 422 piglets were sold.

Crossbred pigs at Mega Seed centre of Mannuthy

Animal Resources Development Department, Tripura

The centre was started in 2014 and maintaining Landrace, LWY X Desi crossbred. The center was actively involved in characterization of local pig of Tripura. During 2019-20 total 596 piglets were produced and 417 piglets were sold.

Animal Husbandry and Veterinary Services, Sikkim

Looking to the scope and importance of piggery sector in the state of Sikkim the Mega Seed Project on Pig was sanctioned at Animal Husbandry and Veterinary Services, Govt. of Sikkim. The center is maintaining HDK75 and Rani crossbred variety. During 2019-20 total 424 piglets were produced and 289 piglets were sold.

3rd Farrowing HDK75

KRISHI VIGYAN KENDRA ACTIVITIES

KVK Goalpara carried out different mandated activities through On Farm Testing (OFT) for identifying technologies in terms of location specific sustainable land use system; to organize training to update the extension personnel with emerging advances in agricultural research on regular basis; to organize short term and long term training courses in agriculture and allied vocations for the farmers and rural youths with emphasis on "Learning by doing" for higher production on farms and generating self employment, and organising front line demonstrations (FLDs) on various crops and livestock for large adoption by the farmers. In addition, KVK produces quality technological products (seed, planting material, bio-agents, livestock) and make it available to farmers, organize frontline extension activities, identify and document selected farm innovations and converge with ongoing schemes and programmes within the mandate of KVK. During the reported period from January to December, 2020 the following activities were carried out by the KVK.

Capacity development and training programme

For capacity building of farmers, rural youth and extension functionaries, a total of 99 training programmes were conducted covering 2858 number of participants during the year. The training programmes included training for farmers and farm women-52 nos. covering 1540 participants; training for rural youth-31 nos. covering 938 participants; training for extension functionaries-8 nos. covering 150 participants; 8 long duration sponsored trainings covering 230 participants.

Fig. Glimpses of trainings conducted

Technology Assessment through on farm testing (OFT):

The On farm Testing conducted by Krishi Vigyan Kendra Goalpara on different agricultural technologies are as follows:

OFT on Performance of Rice variety "Numuli" under rain-fed condition

The rice variety Numuli is developed by Assam Agricultural University, Jorahat in the year 2019-20. The variety is 100 to 110 days long duration with potential yield of 5-6 t/ha. The grain quality of this variety is medium fine. The short duration rice variety like Nululi is the need of the hour for the farmer of Goalpara district to incorporate more number of crops in same piece of land for multiple cropping and farmers doubling income. The following are the yield and yield attributing character of rice variety Numuli has been recorded in famer's field.

- Average tiller No : 15-17
- Effective tillers: 12-14
- Plant height : 110-115 cm
- Duration of the crop : 135 -140 days

- Grain Yield recorded : 4.85 t/ha
- Stover yield : 12.4 t/ha
- HI : 0.39
- C:B : 1.58

Fig. Rice variety Numuli at Dhontola Village Rangjuli Block Latitude 25^{0}58′14″ & Longitude 90^{0}55′7″

OFT on Potato var "Kufri jyoti" under zero tillage in rice fallow

Almost 80-90 percent cultivable area of Goalpara district is grown rice during the kharif growing season (June–October), followed by a fallow during the rabi season (November–February). Targeting *Rice Fallow* Areas in this district an OFT on Potato under zero tillage in rice fallow was taken for efficient utilization of residual resources in farmer's field. The potato Kufri Jyoti is suitable for agro-ecological situation of Goalpara district which carries moderate resistance to early and late blight. The average yield potential of this variety is 300 – 350 q/ha

Fig. Potato variety Kufri Jyoti under zero tillage

OFT on Rice Variety Disang under Irrigated Condition

Flood and hailstorms are a frequent problem of the Goalpara district which causes major damages both Ahu and Sali rice productivity. It occurs during the onset and recession of the monsoon during May–June and September–October. To solve this problem an OFT on evaluation of rice variety Disang under Irrigated Condition was introduced during early ahu (pre flood) situation. Disang is a short duration (95-100 days) rice variety which can be cultivated as early Ahu (Pre flood) and post flood situation to escape flood and developed by AAU Jorhat during 2010. The OFT has shown very good performance in yield as well as income of farmer.

- Average tiller No : 15
- Effective tillers: 12-14
- Plant height : 110-115 cm
- Duration of the crop : 100 days
- Grain Yield recorded : 5.2 t/ha
- Stover yield : 12.4 t/ha
- HI : 0.45
- C:B : 1.60

Fig. Early Ahu variety Disang

OFT on Integrated management of late blight disease in potato

An OFT programme on "Integrated management of late blight disease in potato" was taken. Five multi-location farmer's field were selected for the trials.

Details of Technology: Use of healthy planting materials; clean cultivation; disease monitoring; spray of Mancozeb 75% 2); spray of Cymoxanil 8% + Mancozeb 64%. Significant results observed in all the trials plots.

Fig. OFT on Integrated management of late blight disease in potato

OFT on Cultivation practices of milky mushroom

An OFT programme on Cultivation practices of milky mushroom (*Calocybe indica*) introduced in summer season of 2020. Spawns were collected from ICAR-DMR, Solan Himachal Pradesh. Growing season of Milky mushroom in Assam is during May-August (25-35^{0}C). Substrate: rice straw. Casing material: pasteurized soil (75%) + sand (25%). Five farmers from different villages of Goalpara district were chosen for the programme. Farmers found very much suitable for growing milky mushroom during the summer season.

Fig. OFT on Cultivation practices of milky mushroom

OFT on Evaluation of Tractor drawn Ridge Former

Bed and furrow system of cultivation is good alternative for growing summer vegetables in medium land condition. Bed making is a time consuming and laborious process which restricts summer vegetable production in medium lands. Evaluation of Tractor drawn Ridge former was done in rainy as well as dry weather condition in Goalpara condition. The ridge was not stable while making at rainy weather, but stable while making at dry weather condition. Field capacity of the ridge former was recorded 0.41 ha/hr, with clear height of 0.20m. The implement may be used prior to onset of monsoon.

Fig. OFT on Evaluation of Tractor drawn Ridge Former

OFT on Ready to cook green jackfruit (Minimally processed)

Jackfruit (Artocarpus heterophyllus) is widely found in Goalpara district of Assam. The ripe fruits are nutritious and rich in vitamins and minerals. The immature fruits are used as vegetable. As jackfruit is a seasonal fruit, so to make it available all year round preparation of value added products like ready to cook minimally processed jack fruit is a good option, thereby enhancing farm income and nutritional security of the farmers. Keeping this in view, an OFT was carried out to prepare ready to cook minimally processed jack fruit. The Source of the Technology is Horticulture Division, ICAR Research Complex for NEH Region, Umiam. In this technology mature fruits (45-60 days after fruit set) were harvested, peeled and sliced into pieces. This was followed by blanching of the slices for 10 minutes. The blanched pieces are then filled into sterilized glass bottles with brine solution (8% NaCl) and (8% NaCl + 0.2% KMS). The slices were evaluated at 30 days interval for six months for its shelf life. Longest shelf life with no cloudiness and microbial growth was recorded at 8% NaCl + 0.2% KMS during storage at ambient temperature.

Fig. OFT on Ready to cook green jackfruit (Minimally processed)

OFT on Varietal evaluation of gerbera hybrids

Floriculture is a sunrise area in Goalpara district of Assam. In the recent years, it has been observed that farmers of the district are willing to enter into commercial floriculture sector out of which gerbera cultivation is one of the most popular area. Gerbera (*Gerbera jamesonii*) is an attractive cut flower crop belonging to the Asteraceae family. The availability of wide range of exotic varieties and their adaptability to grow on wide range of climate makes it a profitable cut flower crop for the growers. But the major problem identified is non availability of good quality planting material in the region. Keeping this in view, an OFT was conducted to characterize the performance of hybrids of gerbera namely RCGH-22, RCGH-114, RCGH-12, RCGH-117 grown under open conditions in KVK farm and farmer's field in Matia block. Among the varieties RCGH 12 recorded with highest no. of flower/plant/month (4.59). On the other hand RCGH 22 recorded highest flower diameter with 09.93 cm with highest no. of suckers/plant (10.12).

Fig. OFT on Varietal evaluation of gerbera hybrids

OFT on Assessment of micronutrients for better reproductive health in cattle

There are 497 dairy farms in Goalpara district covering near about 12000 crossbred/improved cattle population, although there are 288494 nos. of cattle population including indigenous cattle in the district. From survey/direct contact and even from the information from Vety. & A.H. deptt. it was found that some of the established dairy farms were in decreasing trend of milk yield. The reason was some of the high yielding cows were not in lactating condition because they did not conceive even after 2-3 insemination. Several physical and laboratory tests were conducted and finally found that the cows were in good reproductive health. From interrogation with the owner, it has been found that the feeds supplied to the cows were in deficient of micronutrients. Keeping the problems in view, an OFT was conducted on "Assessment of micronutrients for better reproductive health in cattle" to 20 dairy farms for a period of 6 months @ 3 kg/100 kg of feed. Surprisingly during the period of 6 months and after completion of the period 87% of the problematic cows came into the estrus.

OFT on Assessment of Kadaknath bird in Goalpara district

Distributed 800 nos. of 10 days Kadaknath chicks to 40 female farmers @ 20 nos./ farmer. 200 Kadaknath chicks kept for demonstration at KVK farm. Recording of body weight, egg production, feed conversion efficiency and disease occurrence of the birds at one month interval up-to one year had been done. The following observations have been recorded during the study period.

a. The birds are of higher productivity in respect to egg yield than Assam desi-chicken i.e. yield 150-160 eggs per annum

b. Age at first egg: 168 days

c. Fertility of the eggs: 90 – 95%

d. The birds can be propagated further by natural hatching with the help of desi chicken.

e. Body weight at Eight weeks (restricted feeding): 1.1 -1.3 kg

f. Body weight at Forty weeks (restricted feeding): 1.8 – 2.0 Kg

g. Vaccination schedule has been followed against the possible diseases. The Kadaknath were found to be resistant against many diseases than other birds in the geo-climatic condition of Goalpara district.

h. Cost benefit ratio is 1:7.

OFT on Standardization of black rice cake recipes

An OFT was conducted to standardize the methods of black rice cake preparation. Black rice cake prepared by farmers varied in taste and texture and shelf life is also low. Inclusion of flavor and different ingredients is also done. Thus to maintain a similar taste, portion and yield control and incorporation of different flavours, the programme is conducted. Products prepared by farmers under the programme were Black rice cake, Black rice eggless cake and Chocolate black rice cake.

Results:

- Portioning of the recipe is done so as to maintain a similar taste & texture
- Incorporation of new ingredients provides more characteristics to the recipe and helps in more marketing and profitability to the farmers
- New desirable taste received by farmers and consumers
- Need to popularize more for benefit of the farming community

Fig. OFT on Standardization of black rice cake recipes

OFT on Preparation of Jackfruit chips

An OFT was conducted to prevent wastage of Jackfruit during surplus season. To prevent wastage and to provide economic benefits to farmers, Jackfruit chips are prepared with technology from CAU, Tura. Recovery of finished product, assessment of shelf life, palatability test, acceptance by farmers etc. were evaluated.

Results:

- Jackfruit chips can emerge as an important potential Jackfruit product.
- Easily saleable snack food in the market
- For longer shelf life and crispiness, moisture content is the most important factor as far as storage quality is concerned.

- Chips were stored at room temperature (28°C - 32°C) for storage studies in food grade sealed plastic packets.
- Product well accepted by farmers.
- Contributes to generation of income and employment besides reducing loss during seasonal glut.

Fig. OFT on Preparation of Jackfruit chips

OFT on Improved spreading tool (Lakhimi) for sun drying of paddy grains

An OFT was conducted on Improved Spreading tool "Lakhimi" to reduce the drudgery of women during sun drying of paddy grains. The traditional spreading tool was modified on the basis of anthropometric measurement of farm women. The physical parameters considered while developing improved spreading tool were weight of the tool, length and width of the blade, length and circumference of the handle and angle between handle and blade. Use of modified spreading tool reduces the physiological workload of farm women thus results in reduction of drudgery. The programme is in progress.

Demonstration of newly proven technology for large scale adoption through frontline demonstration (FLD) and Cluster frontline demonstration (CFLD) Programme

The FLDs undertaken by KVK are as follows.

FLD on Front Line Demonstration on Lentil Var WBL-77 (In progress)

Front Line Demonstrations on lentil using improved varieties WBL-77 were conducted during rabi seasons in three adopted villages of KVK, Goalpara to show the higher production potentiality. The demonstrations were carried out in 18 farmers' fields of 10 ha area in rainfed medium land situation. The variety WBL-77 has developed by the Indian Institute of Pulses Research which potential yield is 18 q/ha. The variety is good for that area where there is late sowing of paddy.

Fig. Lentil var WBL-77

FLD on maize var. QPM 9 (In progress)

FLD on maize var QPM-9 is conducted during rabi seasons of the year and in 10 ha of land to show the higher production potentiality. The maize variety QPM 9 is an early maturing (85-90 days), high yielding (50-55 q/ha) hybrids. Plant height is 160-170 cm. Its grain is yellow in colour and semi-flint in texture.

Fig. Maize var QPM-9

FLD on Toria var. Uttara

FLDs on toria var Uttara was conducted in farmer's fields in an area of 10 ha at different locations of the district.

Fig. Toria var. Uttara

Community nursery of Rice var. Ranjit Sub 1

Flood is the most common during kharif season in Goalpara district of Assam. Because of the unpredictable nature of rainfall, farmers often get difficulty in raising rice seedling. Keeping this point in view, a community nursery of rice seedling was established covering 2 ha of land in KVK farm as a contingency plan. The programme was conducted with full support of District Agricultural Office, Golapara. The Ranjit Sub 1 variety was selected for the programme due its resistant capacity to water submergence up to 15 days. A total of 132 farmers were benefited with the programme by transplanting this seedling in their field after damage their seedling due to flood.

Fig. Rice var. Ranjit Sub 1

FLD on Integrated management of bacterial wilt of tomato

FLD programme on "Integrated management of bacterial wilt of tomato" has undertaken in different farmer's field. Bacterial wilt (*Ralstonia solanacearum*) is a major yield reduction cause in slanaceaous crops namely tomato, brinjal, potato.

Details of technology: Use of healthy seeds; application of bleaching powder @ 1.5 Kg /bigha mixed with furrows at the time of ploughing at least one month before planting; application of lime @ 3 kg/bigha; and drench 100 ml solution per plant of Ashafoetida (Hing) 5 gm + 50 gm turmeric powder + 50 liter water mixture.

Fig. FLD on Integrated management of bacterial wilt of tomato

FLD on Year Round Cultivation of Oyster Mushroom

FLD programme on "*Year round cultivation of oyster mushroom*" has been undertaken in multi-location in Goalpara district of Assam. Normally oyster mushroom (*Pleurotus spp*) (10-28^{0}C) can be grown during September to April (8 months) of a year. Pink oyster mushroom) (*Pleurotus djamor*) (20-30^{0}C) grows really fast, producing fruits in as little as 3-4 weeks. They can be cultivated during March to August of a year. Thus year round oyster mushroom can be grown commercially.

Fig. FLD on Year Round Cultivation of Oyster Mushroom

Crop Enterprise	Demonstration Yield (kg/5 Kg bag)			Yield of local Check	% increase/ over local	Gross Cost (Rs/unit	Gross Return (Rs/unit	Net Return (Rs/unit)	B:C
	H	L	A	(kg/5 Kg bag)	%				
Oyster Mushroom	1.6	1.2	1.4	0.8	175	20,000	80,000	60,000	3:1

FLD on Use of Pheromone for integrated management of fruit flies in vegetables

A FLD programme on "Use of Pheromone for integrated management of fruit flies in vegetables" has been undertaken for the year 2020-21 in different farmer's fields. Fruit fly (*Bactrocera cucurbitae / B. dorsalis*) is a major insect pest causing heavy yield loss in different cucurbits crops viz. cucumber, pumpkin, ridge gourd, sponge gourd and pointed gourd. We suggested using pheromone block fruit fly in cucurbits (Lure). Installation of pheromone traps at 30 days after planting @ 10 traps/ ha to trap adult flies.

Fig. FLD on Use of Pheremone for integrated management of fruit flies in vegetables

FLD on Scientific cultivation practices of okra var. Arka Anamika

Yellow vein mosaic virus is one of the major problems faced by the okra farmers of Goalpara district. Arka Anamika is an interspecific hybrid of okra developed by ICAR-IIHR, Bangalore resistant to Yellow vein mosaic virus. Keeping this in view, a FLD on Scientific cultivation practices of okra var. Arka Anamika was carried out in farmer's fields in Rangjuli and Kuchdhowa blocks of the district as well as in the KVK farm. No yellow Vein Mosaic Virus symptom was observed. Average yield recorded was 138.25 q/ha with B:C ratio of 2.7:1

FLD on Use of Tractor operated Multicrop Thresher

Threshing of Paddy is a time consuming and labourious job. Cost involvement is also high and there is shortage of hired labourer during peak harvesting season. multicrop thresher has been demonstrated in farmer's field for awareness and popularization of mechanised threshing in Goalpara condition. Threshing capacity recorded was 8.0 Qtl/hr with threshing efficiency of 97%. Winnowing efficiency was recorded 100%. Breakage of grains was nil at 1200 RPM. Threshing capacity of 3 pairs was 1.13 Qtl/hr. of The technology was readily accepted by the farmers.

Fig. FLD on Use of Tractor operated Multicrop Thresher

FLD on Development of shelf stable products from Tapioca

To prevent seasonal wastage of Tapioca, one FLD was conducted on Tapioca chips preparation with technology from CTCRI, Thruvananthapuram. There is lack of awareness among farmwomen for preservation of Tapioca. Thus a programme on Tapioca chips is undertaken where method of Tapioca chips preparation is shown to farmers. Processing time, shelf life, palatability test and acceptability by farmers were evaluated.

Results:

- Important source of Carbohydrate
- Easily saleable snack food in the market
- Well accepted by farmers due to desirable flavour and crispy texture
- Introduction of spices makes the chips tastier.

Fig. FLD on Development of shelf stable products from Tapioca

FLD on Scientific management of pig farm for better livelihood and income generation

57 nos. of pig farms following all scientific norms have been established in Goalpara district during the period of 2020. Out of that 39 farms have been established in collaboration with SRLM which has been sponsored by NABARD. Rest 18 farms were established by the farmer's own contribution. This is one of the major steps for self employment and livelihood promotion of rural unemployed youth. All the farms are running well and generated income as desired.

CLUSTER FRONTLINE DEMONSTRATION

Under ICAR-IARI NEH component cluster demonstration on improved varieties of potato *Kufri Jyoti* was conducted. Seeds of 100 quintal *Kufri Jyoti* were collected from KVK Kamrup, Kahikuchi, Guwahati (AAU) and distributed as cluster among different farmers in four blocks namely Dudhnoi, Krishnai, Matia and Rangjuli for the season 2020-21. The cluster demonstration cover 4.05 ha areas of more than 30 farmers. Farmers have found both the varieties very suitable for Goalpara district agro-climatic situation. Both the varieties found to be immune to late blight fungus (*Phytophthora infestans*) and bacterial wilt (*Ralstonia solanacearum*). No major infestation late blight and bacterial wilt and insect pest observed in the cluster demonstration programme.

Fig. Clustered Front Line Demonstration on Oilseed and Pulse crops

CFLD on Sesamum variety ST1683

Sesamum is the most the most important kharif oilseed crop grown in Goalpara district. It is cultivated in 442 hectare area in the district with average productivity of 409 kg/ha. The lower productivity of the crop is attributed to cultivation of locally available varieties, poor adoption of improved management practices. Keeping above reasons for low productivity and poor expansion of area under HYV of this crop, KVK, Goalpara organized CFLD on Sesamum during 2020 -21 in 23 numbers of farmers' field. Farmers cultivated Sesamum in 20.0 ha area with assistance from KVK Goalpara under ICAR Cluster Frontline Demonstration on Oilseeds under NMOOP. High Yielding Variety 'ST1683', with package of practices is followed for this demonstration. Periodic field visits were made to record crop yield and yield attributing characters, pest and disease incidence and given necessary advice to the farmers.

Crop	Technology Demonstrated	Demonstrated Plot				Farmers plots (Local Var)			
		Gross Cost (Rs/ha)	Gross Return (Rs/ha)	Net Return (Rs/ha)	B:C Ratio	Gross Cost (Rs/ha)	Gross Return (Rs/ha)	Net Return (Rs/ha)	B:C Ratio
Sesamum	Var. ST1683	19800	49600	29800	1.7	18600	36800	18200	1.4

Fig. Sesamum Var. ST1683

CFLD on Black Gram variety UP-31

Black gram is an important kharif pulse crop in Goalpara district of Assam but due to unavailability of improved variety and non adoption of improved cultivation practices in the district, its productivity (650 kg/ha) is below the average national productivity (970 kg/ha) and state yield of 850 kg/ha. Considering all this conditions the Department of Agriculture, Cooperation and Farmers Welfare had sanctioned the project "Cluster Frontline Demonstrations on kharif pulses during 2020 to ICAR-ATARI, Guwahati through National Food Security Mission. The basic strategy of the Mission is to promote and extend improved technologies along with capacity building of farmers. The programme has been carried out by KVK, Goalpara covering 20 ha of land and involved 83 numbers of farmers.

Crop	Technology Demonstrated	Demonstrated Plot				Farmers plots (local var)			
		Gross Cost (Rs/ha)	Gross Return (Rs./ha.)	Net Return (Rs/ha)	B:C Ratio	Gross Cost (Rs/ha)	Gross Return (Rs/ha)	Net Return (Rs/ha)	B:C Ratio
Black gram	Var. PU-31	19000	45600	26600	1.6	18700	31550	12850	1.4

Fig. Black gram Var. PU-31

CFLD on Green gram Var. IPM 2-14

Green gram is one of the important kharif season pulse grown in Assam in general and Goalpara district in particular. The improved variety IPM-02-14 (Shreya) being a short duration (75 days) variety, helped the farmers to plan third crop even in summer season and which in turn helped

in improving the economy of the farming community. Also being resistant to Mungbean Yellow Mosaic Virus and crinkling disease led to less cost of cultivation compared to local variety. The positive attribute of IPM 02-14 (Shreya) variety helped in the dissemination of technology in and around the villages of Goalpara district. A total of 20 ha area was demonstrated with this variety along with full package of practices. The followings are the data on yield and income recorded in farm itself.

Crop	Technology Demonstrated	Demonstrated Plot				Farmers plots (Local Var)			
		Gross Cost (Rs/ha)	Gross Return (Rs/ha)	Net Return (Rs/ha)	B:C Ratio	Gross Cost (Rs/ha)	Gross Return (Rs/ha)	Net Return (Rs./ha.)	B:C Ratio
Green gram	Var. IPM-02-14	22240	44200	21960	1.98	19500	32000	12500	1.64

Fig. Green gram Var. IPM-02-14

Other programmes implemented by KVK

i. NARI (Nutrition Sensitive Agriculture Resources and innovations) programme

Nutrition- sensitive agriculture is a food-based approach to agricultural development that puts nutritionally rich foods, dietary diversity, and food fortification at the heart of overcoming malnutrition and micronutrient deficiencies.

NARI programme was implemented at KVK Goalpara to make the rural people aware about the nutrition sensitive agriculture through cultivation of high yielding nutritional crops, nutrition and human health. Under the NARI flagship programme, 100 nos of Anganwadi workers from 03 development blocks of Goalpara district were given training on nutri thali, fortified crops, nutrition garden and fortification of traditional recipes. A nutrition garden is established in the KVK farm.

Sl.No.	Activity	No. of Participants
1.	Training on nutri thali, fortified crops and nutrition garden	100
2.	Training on processing and preservation of locally available fruits and vegetables	100
3.	Demonstration on Fortification of Traditional Recipes	100
4.	Demonstration on Development of NutriThali from locally available food.	100
5.	Establishment of Nutritional Garden in KVK farm. Size: 200 sq meter	-

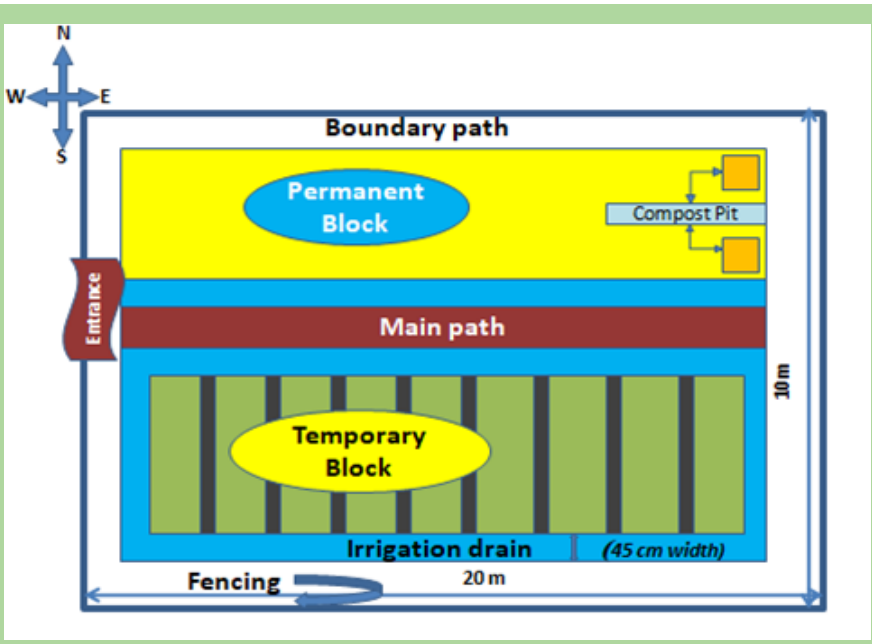


Fig. Lay out of the nutrition garden established at KVK Goalpara under NARI

Fig. Training under NARI

Fig. Nutrition garden under NARI

ii. Gramin Krishi Mausam Sewa/DAMU Programme

Agro-meteorological service rendered by IMD, Ministry of Earth Sciences is an innovative step to contribute to weather information based crop/livestock management strategies and operations dedicated to enhancing crop production by providing real time crop and location specific agromet services with outreach to village level. This indeed has a potential to change the face of India in terms of food security and poverty alleviation.

Farmers need both weather and climate services for better crop production. Agromet Advisory services are the provision of accurate and locally-appropriate climate and weather information play a vital on risk mitigation in agriculture. At the district level, AAS is underway to extend up to sub-district/block level with dissemination up to village level to meet the end user's requirements in both the irrigated and rain-fed systems. Establishment of 660 DAMUs in each district of India at KVK is under pipeline which includes 130 existing AMFUs till 2019 for the weather forecast. So that small and marginal farmers will be benefitted by these services.

Preparation of agromet advisory bulletin and dissemination is the main objective of Gramin Krishi Mausam Sewa (GKMS).The Agromet Advisory Service (AAS) bulletins is being prepared and issued in both English as well as in local languages. For preparation of agro advisory bulletin it consists of scientists belonging to various disciplines of Krishi Vigyan Kendra (KVK) and Agricultural Officers of the District. The AAS bulletins are prepared twice in a week i.e. Tuesday and Friday and are being disseminated through whatsapp as well as via DSS portal for 8 blocks of Goalpara district.

- **No. of Farmers enrolled**: 300 Farmers.
- **No of message sent / week**: 2 messages per week (Bi-weekly).
- **No of farmers used/ respond**: Quite good respond received
- **Helps in**: Expert panel has been constituted from the different sector and effective advisories in these sectors *viz.* agriculture, livestock, Poultry, fisheries, floriculture etc. were disseminated timely to farmers based on its real time importance.
- **Reduction in Cost:** 10-15% of the production cost has been reduced who ever have followed the advisories.

Numbers of district level as well as block level advisories prepared till date and are disseminated the same to the end user are presented in tabular form.

Session (2020-21)	Nos. of District level bulletins issued	Nos of block level bulletins issued(For 8 blocks)	Total bulletin issued
April	7	56	63
May	9	72	81
June	9	72	81
July	9	72	81
Aug	8	64	72
Sept.	9	72	81
Oct	9	72	81
Nov	8	64	72
Dec	9	72	81
Jan	7	56	63
Total Nos. of bulletin issued till date			**756**

Fig. Awareness programme under DAMU

iii. Formation of Farmer Producers Organisation (FPO):

Four nos. of FPOs were formed during the year 2020 namely Siroheuji Krikhi homobay homiti and Agia Adarsh Agro Producers Limited.

CELEBRATION OF IMPORTANT DAYS

i. Celebration of International Women's Day

International Women's Day was celebrated by KVK Goalpara on 08th March 2020 with the theme "Each for equal" with a small gathering of 30 nos. of women farmers and anganwadi workers.


Fig. International Women's Day celebration at KVK Goalpara

ii. Celebration of World Environment Day

World Environment Day was celebrated on 05th June, 2020 at KVK Goalpara by distributing 1000 no. of seedlings of fruit plants and avenue trees to local peoples for creating awareness about the importance of natural ecosystem and its diversity. On account of COVID – 19, face masks prepared by KVK Goalpara were also distributed along with seedlings among the farmers.


Fig. Celebration of World Environment Day & Distribution of mask

iii. Celebration of Rashtriya Poshan Maah during September 2020

Rashtriya Poshan Maah was celebrated during the month of September, 2020 under POSHAN Abhiyaan (PM's Overarching Scheme for Holistic Nourishment), which was launched in 2018. In this regard, KVK Goalpara also celebrated the *Poshan Maah* in convergence with social welfare department (ICDS Scheme) at different Anganwadi centres, schools and villages of Goalpara district.

The main aims of the programme were to raise awareness on importance of nutrition among people to ensure health and nutrition for everyone. It was an initiative to address the problem of malnutrition or under nutrition among young children and women especially in rural areas, as essential nutrition is very crucial at critical stages in the life cycle of children and women. Training on capacity development of Anganwadi workers, establishment of Nutrition Garden, development and formulation of Nutri-thali, demonstration on weaning food for children, value addition of locally available fruits and vegetables etc. were various programmes conducted throughout the month.

Under this programme, 100 packets of seeds provided by IFFCO were distributed among Anganwadi workers. Apart from this, rally on nutrition, quiz competition, receipe contest, display on nutritious receipes of Goalpara district, counselling on nutrition, etc were organised. More than 60 nos. of Anganwadi workers and 100 farmers were benefitted from this programme.

Fig. Celebration of Rashtriya Poshan Maah during September 2020

Extension Activities carried out by KVK:

A number of extension activities were carried out for dissemination of agricultural technologies and information by the KVK during this period which is presented in table 1.

Table 1: Extension activities carried out by KVK

Sl. No.	Name of programme	No. Of Programme	No. of participants								
			Male				Female				
			SC/ ST	OBC	Gen	Total	SC/ ST	OBC	Gen	Total	G. Total
1	Diagnostic visits	362	1152	242	23	1417	612	104	89	805	2222
2	Advisory Services	1596	568	122	56	746	323	72	23	418	1164
3	Animal Health Camp	04	58	-	-	58	160	-	-	160	218
4	Celebration of important days	16	325	140	-	465	52	-	-	52	517

5	Exhibition	07									50000
6	Exposure visits	03	96				63				159
7	Farmers Seminar/ workshop	67	1273				1072				2345
8	Farmers Visit to KVK	112	785	112	19	915	1248	-	-	1248	2164
9	Field Day	12	252				384				636
10	Group meetings/ Discussion	62	511				421				932
11	Awareness Camp	5	165				121				
12	Kisan Gosthi	5	83				95				178
13	Kisan Mela	2									20000
14	Method Demonstrations	135	1755				2565				
15	Scientists visit to farmers field	325	383	-	-	383	252	-	-	252	635
16	Film show	85	1141				1547				

Success Story

During the implementation of KVK activities a number of interventions are emerging out as success stories. One of the important success stories is highlighted below:

Md. Abdul Halim is known to be an innovative and dedicated farmer not only in Goalpara district but whole state of Assam. He started his professional journey as a small agricultural vendor and as time passed by he was interested in agricultural farming. Initially, he was involved in cultivation of different horticultural crops however income was not at par as he expected. Then he contacted KVK Goalpara for new scientific guidelines for different farmings. As per his requirement the experts of different subjects of KVK Goalpara had given many suitable suggestions on different crop cultivation based on his choice. At present he is having 4 ha of land which has been fully utilised around the year by cultivating many high value crops like Capsicum, chilly, apple ber, etc. He is also involved in maize, pulses and oilseeds, vermicompost unit, nursery, aromatic medicinal plants and vetivar cultivation.

He is also known as an innovative livestock farmer. He has started Emu and Kadaknath bird farming for the first time in North East India. Right now he is having 6 nos. of Totapuri and Jamunapuri breeds of Goat, 4 nos. of crossbreed cow and 100 nos. of Kadaknath birds. Besides this, he is having a pond of 0.75 bigha which is utilising for fish farming and as a Jalkund. He is considered as one of the progressive farmers for ushering of new technologies. As a progressive farmer he always tries to improve his skill and eager to know every aspects of farming. His success has influenced the other farmers of the nearby villages. As a reorganisation of his efforts, he was awarded the Best Farmer of Assam in the year 2013-14 and Best Farmer of India in the year 2009-10.

Now he is the owner of a nursery where many newer varieties of fruit plants and mother plants are available. He may be considered as one of the resourceful farmer for other farmers.

Fig. Glimpses of different activities

External funded project

AICRP on Pig: The AICRP pig farm was established in 26th March, 2014 under the administrative control of the ICAR – National Research Centre on Pig, Rani, Guwahati, Assam. Amongst the guidelines, the major point was conservation of doom pigs as the total population of this pig is gradually decreasing day by day because of its migratory nature at farmer's field and unscientific management. This pig is staying in herd and moving from one place to another. This may be the reason for more infestation of many dreaded diseases resulting into death of many doom pigs. Keeping this problem in view, 30 nos of doom pigs purchased from the aforesaid doom pig herd and managed scientifically at the AICRP pig farm, ICAR – KVK Goalpara. All the guidelines of scientific management viz. space requirement at different ages, balanced nutrition, scientific breeding, deworming, vaccination against some diseases, treatment as and when necessary and biosecurity measures are strictly followed.

The main idea was to increase the population of Doom pigs and to deliver the healthy adult doom pig (both male and female) in the breeding tract of Doom pig. Unlike other breeds of pig, Doom pig is difficult to maintain in the intensive system because of its migratory nature. Hence, some of the modification has been made to rear this animal satisfactorily in intensive system for farmer's benefit. Record of herd strength of the pig are being regularly maintained and currently according to the record data the overall herd strength is 42 (fourty two numbers).

In addition to that the following operations are being carried out in the AICRP pig farm on a regular basis:

- Routine deworming is being judiciously carried out using broad spectrum anthelmentic.
- New born piglets are being administered with Iron dextran injection on 4th and 14th day of their lives.
- Routine health check up in every week is being carried out to determine their overall health conditions.
- Quarantine shed in the premises of the farm is being regularly and hygienically maintained.

- Regular use of bleaching powder inside and outside the farm premises along with mandatory use of foot dip disinfectant is being regularly monitored.
- Aseptic ear tagging of all the animals have been done properly and recorded for easy identifications and performance records.

Fig. Aseptic ear tagging of individual doom pigs

Krishak Samridhi Project: This is a NABARD sponsored project in association with Ajgarh Social circle and KVK Goalpara. This project is running only in 5 states of India viz. Assam, Bihar, Haryana, Gujarat and Orissa. One district of every state is allowed to implement the project. Goalpara district is the only district in North Eastern India for this project in which 9 nos. of villages were selected covering 1200 farmers.

The success of this project till date is as follows:

(i) 650 beneficiaries started pig farming after JLG (Joint Liability Group) formation

(ii) 15 beneficiaries have started dairy farming. Sahiwal breed of cattle has been introduced for A2 milk production.

Activities carried out during lockdown period

Following activities were carried out during lockdown period:

(i) 9 nos. of advisories prepared and issued during lockdown.

(ii) For installation of Aarogya Setu app, messages have been given to 6743 nos. of farmers and so far information 3867 farmers downloaded the app.

(iii) Bulletins for agro advisory service under DAMU prepared and distributed to the farmers.

(iv) 450 number of masks were provided to farmers during lockdown period.

Farmer Award: A farmer of KVK Goalpara Md Abdul Halim, received Progressive Farmer Award-2020 in biennial conference of Assam Veterinary Association, Deptt. Of Animal Husbandry and Veterinary Science, Govt. of Assam

Newspaper and TV Coverage:

KVK is regularly publishing the important activities of KVK in daily news papers and TV channels for dissemination of information to the each and every farmer of the district.

গোৱালপাৰা জিলাত কৃষক ৰাইজৰ বাবে 'গ্ৰামীণ কৃষি মৌচম সেৱা'

ভৱেশ চন্দ্ৰ ভাগৱতী,দুধনৈঃ অসমত কোভিড-১৯ৰ ভয়াবহতা আৰু সংহাৰী ৰানপানীৰ কৰাল গ্ৰাসৰ সময়তো গোৱালপাৰা জিলাত দুধনৈস্থিত গোৱালপাৰা কৃষি বিজ্ঞান কেন্দ্ৰই জিলাখনৰ কৃষক ৰাইজৰ সুবিধা হোৱাকৈ ইণ্টাৰনেটৰ মাধ্যমত গ্ৰামীণ কৃষক মৌচম সেৱা আৰম্ভ কৰিছে। ভাৰতৰ কৃষিজীবি ৰাইজ মূলত বতৰ আৰু মৌচুমী বায়ুৰ ওপৰত নিৰ্ভৰশীল। বৰ্তমান সময়ত বতৰ আৰু জলবায়ুৰ পৰিবৰ্তনে কৃষিখণ্ডত ভাবুকিৰ সৃষ্টি কৰা পৰিলক্ষিত হৈছে। অত্যন্ত ৰবষুণ, ধুমুহা, শিলাবৃষ্টি, খৰাং, শীতল আৰু গৰম বতাহৰ ফলত প্ৰত্যেক বছৰে কৃষক ৰাইজে শস্য উৎপাদনৰ ক্ষেত্ৰত ব্যাপক ক্ষতিৰ সম্মুখীন হৈছে। ৬ পৃষ্ঠাত

এহেজাৰ কৃষকক জৈৱিক সাৰ প্ৰয়োগৰ প্ৰশিক্ষণৰ লক্ষ্য

পৰিষদীয় এলেকাৰ কৃষিখণ্ডক জৈৱিক খণ্ডলৈ ৰূপান্তৰিত কৰাৰ সংকল্প ৰাভা হাছুঙৰ ঃ টংকেশ্বৰ ৰাভা

বাণী দাসৰ নেতৃত্বত অগপৰ ২২খন আঞ্চলিকৰ দুই সহস্ৰাধিকৰ এজেপিত যোগদান

ভৱেশ চন্দ্ৰ ভাগৱতী, দুধনৈঃ আগন্তুক দহ বছৰৰ ভিতৰত পৰিষদীয় এলেকাৰ কৃষি খণ্ডক "জৈৱিক জ'ন"লৈ ৰূপান্তৰ কৰাৰ লক্ষ্য স্থিৰ কৰি লৈছে ৰাভা হাছুং পৰিষদে। ২ পৃষ্ঠাত

নিজৰ পেট লঘোণে ৰাখি কুকুৰৰ বাবে ডীম বিস্কুট ক্ৰ

এসাঁজৰ সন্ধানত মানৱদৰদী বুলুৰ

ৰ পৰা

Sunday, 13th December 2020

পৰিষদীয় এলেকাৰ কৃষিখণ্ডক জৈৱিক...

বিশেষকৈ উদ্যান শস্যত জৈৱিক সাৰৰ প্ৰয়োগৰ জৰিয়তে সু-স্বাস্থবান নিৰোগী ৰাভা হাছং গঢ়াত গুৰুত্ব প্ৰদান কৰিব বুলি কয় ৰাভা হাছং চীফ টংকেশ্বৰ ৰাভাই। ৰাভা হাছং স্বায়ত্ত শাসিত পৰিষদৰ সৌজন্যত আৰু দুধনৈস্থিত গোৱালপাৰা কৃষি বিজ্ঞান কেন্দ্ৰৰ উদ্যোগত ১১ ডিচেম্বৰত নিখিল ৰাভা মহিলা পৰিষদৰ মুখ্য কাৰ্যালয়ত আয়োজিত 'উদ্যান শস্যত জৈৱিক সাৰ প্ৰয়োগ' সম্পৰ্কীয় সাত দিনীয়া প্ৰশিক্ষণ কৰ্মশালাত মুখ্য অতিথি হিচাবে উপস্থিত থাকি কৃষক সকলক উদ্যান শস্যত জৈৱিক সাৰ প্ৰয়োগৰ প্ৰশিক্ষণ প্ৰদান কৰাৰ বাবেও লক্ষ্য স্থিৰ কৰি লোৱা বুলি সংবাদ মাধ্যমক কয়। কৃষি বিজ্ঞান কেন্দ্ৰৰ মুখ্য সমন্বয়ক তথা জেষ্ঠ কৃষি বিজ্ঞানী ড° হিতু চৌধুৰীয়ে পৌৰোহিত্য কৰাৰ লগতে আদৰণি ভাষণ পাঠ কৰে। আদৰণি ভাষণত ড° চৌধুৰীয়ে ৰাভা হাছং পৰিষদে উদ্যান শস্যত জৈৱিক সাৰ প্ৰয়োগৰ জৰিয়তে সমাজখনক কিদৰে সুস্বাস্থবান আৰু নিৰোগী কৰি তুলিব পাৰি তাৰ বাবে অৰ্থ সাহায্যৰে বিশেষ উদ্যোগ লোৱা বাবে পৰিষদলৈ ধন্যবাদ জ্ঞাপন কৰে। উদ্যান শস্য বিভাগৰ বিশেষজ্ঞা মীনাক্ষী ৰবা কামানে আঁত ধৰা অনুষ্ঠানত কৃষি বিজ্ঞান কেন্দ্ৰৰ বিজ্ঞানী ডঃ উৎপল ভট্টাচার্য, ডঃ হৰিচৰণ কলিতা, ডঃ বিশ্বজিৎ দে, মৌচুমী ৰবা, পলী শইকীয়া বেঞ্জামিন কামানে কৃষক সকলক জৈৱিক সাৰ প্ৰয়োগৰ উপকাৰিতা আৰু লাভালাভৰ বিষয়ে বিতংভাবে বুজাই দিয়াৰ লগতে সোমবাৰৰ পৰা অন্তিম দিনলৈ কৃষক সকলক প্ৰশিক্ষণ প্ৰদান কৰিব। প্ৰশিক্ষণৰ প্ৰথম দিনটোতে পঞ্চাশৰো অধিক কৃষকে কৰ্মশালাত উপস্থিত থাকে। ইয়াৰ উপৰিও সাতদিনীয়া প্ৰশিক্ষণ কৰ্মশালাত পৰিষদৰ উপাধ্যক্ষ ৰমাকান্ত ৰাভা সহ পৰিষদৰ কেবাগৰাকী কাৰ্যবাহী সদস্য, সাধাৰণ সদস্য উপস্থিত থাকে।

দুধনৈত উদ্যান শস্যত জৈৱিক সাৰ প্ৰয়োগ শীৰ্ষক সপ্তাহজোৰা কৰ্মশালাৰ সামৰণি

ভৱেশ চন্দ্ৰ ভাগৱতী, দুধনৈ ঃ দুধনৈস্থিত গোৱালপাৰা জিলা কৃষি বিজ্ঞান কেন্দ্ৰৰ উদ্যোগত আৰু ৰাভা হাছং স্বায়ত্ব শাসিত পৰিষদৰ সহযোগত উদ্যান শস্যত জৈৱিক সাৰ প্ৰয়োগ শীৰ্ষক সপ্তাহজোৰা প্ৰশিক্ষণ কৰ্মশালাৰ আজি সফল সমৰণি পৰে। দুধনৈ উদয়পুৰস্থিত নিখিল ৰাভা মহিলা পৰিষদৰ মুখ্য কাৰ্যালয়ত অনুষ্ঠিত সামৰণি সভাত দুধনৈস্থিত গোৱালপাৰা কৃষি বিজ্ঞান কেন্দ্ৰৰ মুখ্য সমন্বয়ক তথা জেষ্ঠ বিজ্ঞানী ড° হিতু চৌধুৰীয়ে পৌৰোহিত্য কৰে। সভাত মুখ্য অতিথি হিচাবে ৰাভা হাছং পৰিষদৰ মুখ্য কাৰ্যবাহী সদস্য টংকেশ্বৰ ৰাভাই উপস্থিত থাকি কয় যে, আগন্তুক দহ বছৰৰ ভিতৰত পৰিষদীয় এলেকাৰ কৃষি খণ্ডক "জৈৱিক এলেকা"লৈ ৰূপান্তৰ কৰাৰ লক্ষ্য স্থিৰ কৰি লৈছে ৰাভা হাছং পৰিষদে। বিশেষকৈ উদ্যান শস্যত জৈৱিক সাৰৰ প্ৰয়োগৰ জৰিয়তে সু-স্বাস্থবান নিৰোগী ৰাভা হাছং গঢ়াত গুৰুত্ব প্ৰদান কৰিব বুলি কয় ৰাভা হাছং চিফ গৰাকীয়ে। তেওঁ পুনৰ কয় যে, ৰাসায়নিক সাৰৰ প্ৰয়োগৰ ফলত মাটিৰ গুণাগুণ কমি যোৱাৰ লগতে তাৰ পৰা উৎপাদিত শস্যই স্বাস্থ্যৰ ক্ষতি কৰে। সেয়েহে প্ৰাকৃতিক ভাবে খাদ্য-শস্য উৎপাদন কৰিবলৈ প্ৰাকৃতিক সাৰ যেনে গোবৰ সাৰ, কেচুঁ সাৰ, পচন সাৰ ইত্যাদি জৈৱিক সাৰ প্ৰয়োগেৰে কৃষিভূমিৰ মান উন্নত কৰাৰ লগতে জৈৱিক শস্য তথা পাঁচলি উৎপাদন আৰু কৃষকক জৈৱিক সাৰ প্ৰয়োগৰ প্ৰশিক্ষণ দিবলৈ মনোনিবেশ কৰা বুলিও সংবাদ মাধ্যমৰ আগত কয়। আনহাতে উদ্যান শস্য বিভাগৰ বিশেষজ্ঞা মীনাক্ষী ৰবা কামানে আঁত ধৰা অনুষ্ঠানত সভাত পৌৰোহিত্য কৰা ড° হিতু চৌধুৰীয়ে ৰাভা হাছং পৰিষদে আৰ্থিক সাহায্যৰে কৃষকক জৈৱিক সাৰ প্ৰয়োগৰ প্ৰশিক্ষণ দিবলৈ লোৱা পদক্ষেপক ভূয়সী প্ৰশংসা কৰাৰ লগতে প্ৰশিক্ষাৰ্থী সকলে প্ৰশিক্ষণ কালত লাভ কৰা জ্ঞান ব্যবহাৰিক ৰূপত প্ৰয়োগ কৰিবলৈ আহ্বান জনায়। কৰ্মশালাত প্ৰশিক্ষণ গ্ৰহণ কৰা ৩৫ গৰাকী কৃষকে এই প্ৰশিক্ষণৰ পৰা যথেষ্ট উপকৃত হোৱা বুলি কয়। প্ৰশিক্ষণ কৰ্মশালাৰ সামৰণি সভাতে প্ৰশিক্ষণ গ্ৰহণ কৰা প্ৰশিক্ষাৰ্থী সকলক একোটাকৈ উন্নত কৃষি সঁজুলিৰ টোপোলা, ২১০০ টকাৰ মাননি আৰু একোখনকৈ মানপত্ৰৰে সম্বৰ্ধনা জনায়। সামৰণি অনুষ্ঠানত কৃষি বিজ্ঞান কেন্দ্ৰৰ ড° হৰিচৰণ কলিতা, বিশ্বজিৎ দে, মৌচুমী ৰবা, পলী শইকীয়া, বেঞ্জামিন কামানে উপস্থিত থকাৰ উপৰিও ৰাভা হাছং অধ্যক্ষ চাৰুমোহন ৰাভা, পৰিষদৰ কেইবাগৰাকী কাৰ্যবাহী সদস্য, সাধাৰণ সদস্য উপস্থিত থাকে। সভাৰ শেষত শলাগৰ শৰাই আগৰঢ়াই কৃষি বিজ্ঞানী ড° উৎপল ভট্টাচাৰ্যীয়ে।

Video Links of TV Telecasts:

https:youtu.be/MnhJRgrlsXo – Training on organic horticulture

https://public.app/s/4vF3S - Training on organic horticulture

https://www.facebook.com/109252330876705/videos/3423073187753394/?sfnsn=wiwspwa&extid=wc45S2z5zWQB4w&d=w&vh=e – Celebration of Poshan month 2020

https://asombartamajuli.com/dudhnoisthito-Krishi -Bigyan/ - Celebration of Swatchata Pakhwada 2020

https://www.facebook.com/198584745131/posts/10158872629340132/?sfnsn=wiwspwa&d=w&vh=e – Bonsai cultivation at Goalpara

NAIF SCHEMES

Institute Technology Management Unit (ITMU)

In-Charge : Dr. Pranab J. Das, Principal Scientist

In the year 2020, Institute Technology Management Unit (ITMU) of ICAR-National Research Centre on Pig (NRCP) has taken several innovative steps for the technologies developed by the Institute and providing a platform for the pig stakeholders for economically sustainable pig husbandry as well as the development of entrepreneurship. The National Agriculture Innovation Fund under ITMU has also taken many forward steps for transfer of technology and commercialization of different technology. The future potential of the pig industry is tremendous. It cannot be underestimated, not just in terms of a profitable business, but also as a means of permanent employment for unemployed youth. This year will be remembered as a breakthrough year for innovative research on diagnostic kits, pork products and low-cost feed formulation. The Institute Technology Management Unit of National Research Centre on Pig trained numbers of Pig farmers, stakeholders and Pork processors for scientific pig rearing and value addition of pork and pork products. These efforts were intended to nurture and support unemployed youth who would be future piggery entrepreneur and thereby boosts the economy of the sector. The Institute also taking initiative in making hygienic pork and pork products with good taste and flavour to popularize supply of "Clean Pork" also helps in getting rid of zoonotic diseases that may arise from pork and pork product. With the continuation of its effort to develop and transfer of technologies, the ITMU-NAIF, NRCP is also published couple leaflet and newsletter on ITMU activities and different technology developed by the institute. Overall ITMU-NAIF of this centre involved in protection, management and commercialization of innovative technologies and overreaches to the overall need. It acts as an interface between R & D, knowledge revolution and stakeholders. The diversity of tasks performed by ITMU-NAIF also include IPR management, technology licensing, developing public-private-partnership, organizing field demonstration and training programme to expand and establish pig husbandry as economically viable husbandry. The newly developed technologies under different aspects will further strengthen the intellectual property management and transfer the regime of ICAR and make a significant contribution to the upliftment of the economic status of pig farmers. Institute Technology Management Committee Meetings were conducted 03 times during the year 2020.

Institute Technology Management Committee:

Chairman	:	Director, ICAR-NRC on Pig
Member	**:**	Dr. Santanu Banik, Principal Scientist
		Dr. Keshab Barman, Principal Scientist
		Dr. R. Thomas, Sr. Scientist
		Dr. Sunil Kumar, Scientist
		Mr. P. Nayak, AFAO/AO
		Mr. Uttam Prakash, AAO
External Member	**:**	Dr. Alpana Das, Pr. Scientist
Member Secretary	**:**	Dr. Pranab J. Das, Pr. Scientist

Management of IP portfolio

IPRs	Name of Institute	Application/ Registration No.	Name of Innovation/ Technology/ Product/ Variety	Date of Filing/ Registration	Application Granted/ Registered
Patent	ICAR-NRCP	202011052348	Antimicrobial activity of piggery waste medicinal maggots	10.12.2020	Application filed
	ICAR-NRCP	201631026604	Pig hair based bio-composite and a method for its preparation	04.08.2016	Patent No. 319634 Granted-31.08.2019 (Renewal of the patent 29.12. 2020)
	ICAR-NRCP	202011004699	NRCP-Nucleic acid based diagnosis of porcine reproductive and respiratory syndrome (PRRS) virus infection in pigs	03.02.2020	Application filed
Trademarks	ICAR	Luit Pork	16.12.2020	Processed	Applied
Copyrights	ICAR	SwineApp	Nov. 2020	Processed	Applied
	ICAR	African Swine Fever App	Nov. 2020	Processed	Applied
	ICAR	Swine Summer Stress Checker App	Nov. 2020	Processed	Applied
	ICAR-NRCP; KALYANI GOVT. ENGINEERING COLLEGE; UTTAR BANGA KRISHI VISWAVIDYALAYA; ICAR-RESEARCH COMPLEX NEH	SW-13248/2020	ePIG RECOGNIZATION	15.11.2019	Registered on 11.02.2020
	ICAR-NRCP; KALYANI GOVT. ENGINEERING COLLEGE; UTTAR BANGA KRISHI VISWAVIDYALAYA; ICAR-RESEARCH COMPLEX NEH	SW-13247/2020	iGOAT RECOGNIZATION	15.11.2019	Registered on 11.02.2020
	ICAR-NRCP	L-91586/2020	TRAINING MODULE FOR LOW AND MEDIUM INPUT PIG PRODUCTION SYSTEMS	22.02.2020	Registered on 05.06.2020
	ICAR-NRCP	L-91906/2020	Piglet Diarrhoea: Associated *E. coli* Pathotypes in North-Eeast India and their Molecular detection	23.02.2020	Registered on 05.06.2020

	ICAR-NRCP	L-92197/2020	MAAMS PRASANSKARAN AVAM MULYAVARDHAN	22.02.2020	Registered on 18.06.2020
	ICAR-NRCP	L-91902/2020	TECHNIQUES & TECHNOLOGIES COMMERIALIZED/ READY FOR COMMERCIALIZATION	22.02.2020	Registered on 05.06.2020
	ICAR-NRCP	L-92237/2020	Technology for Swine Health	22.02.2020	Registered on 19.06.2020
	ICAR-NRCP	L-92923/2020	Integrated Pig Production and Pork Processing as Business Model-An Entrepreneurial Guide	22.02.2020	Registered on 17.07.2020
	ICAR-NRCP	L-92968/2020	Porcine Pasteurellosis	22.02.2020	Registered on 21.07.2020
	ICAR-NRCP	CF-4650/2020	CLEAN PORK PRODUCTION AND VALUE ADDITION	23.02.2020	Registered on 14.09.2020
	ICAR-NRCP	CF-4631/2020	Scientific Pig Production Practices	23.02.2020	Registered on 31.07.2020
Design	NIL	NIL	NIL	NIL	NA
Plant Variety	NIL	NIL	NIL	NIL	NA
Biological Material/ Strains/ Resources	NIL	NIL	NIL	NIL	NA
Any Other	ICAR-NRCP	Mobile App	African Swine Fever App (English)	31.05.2020	31.05.2020
	ICAR-NRCP	Mobile App	African Swine Fever App (Hindi)	07.07.2020	07.07.2020
	ICAR-NRCP	Mobile App	Swine Summer Stress Checker (English)	24.12.2020	24.12.2020

Commercialization of Technologies

S No	Name of Institute	Name of Technology/ Know-How	IP Protection (Yes/ No)	Name of Contracting Party	Mode of Partnership	Date of Licensing	Revenue Earned (in Rs.)
1	ICAR-NRCP	New improved region-specific crossbred pig varieties for doubling farmers' income	No	Progressive pig Farmers	POP	NA	15,51,210.00
2	ICAR-NRCP	Artificial Insemination of Pigs	No	Progressive pig Farmers	POP	NA	40,000.00

Capacity Building in IP Management

Training/workshop/Seminar etc. Attended

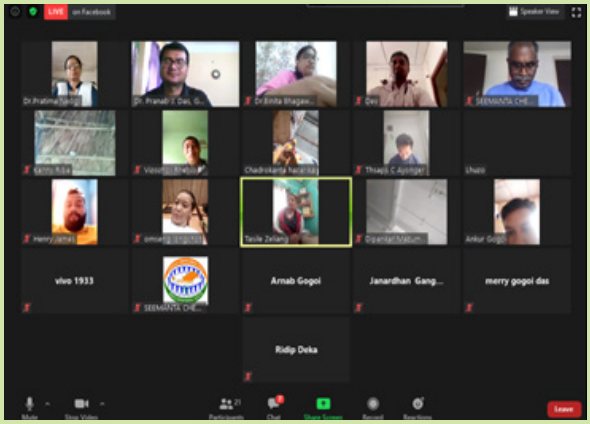
Sl. No.	*Name of Programme (Training/ workshop/ Seminar etc.) attended*	*Organized By (Name of Institute)*	*Days of Programme (Date from - to)*	*Participant (Name)*
1.	Farmers' Innovation Expo-2020 held at College of Agriculture Kyedemkulai, Meghalaya-793105, on 5th March 2020 **Topic:** Pig farming a potential bio-entrepreneurship in NEH region for doubling farmers' income	College of Agriculture Kyedemkulai, Meghalaya-793105	5th-6th March, 2020	Dr.P.J.Das
2.	Workshop on Prospects of commercialization of yak products	ITMU, ICAR-NRC on Yak	12th -14th Feb, 2020	Dr. P.J. Das
3.	State Level Farmers Fair	ICAR-ATARI	26th-27th February, 2020	All the Scientific and Technical Staff of the institute
4.	Workshop cum Training Programme on "INTELLECTUAL PROPERTY RIGHTS IN AGRICULTURAL RESEARCH & EDUCATION IN INDIA"	NAHEP and IP&TM Unit, ICAR Hqrs, Pusa Campus, New Delhi-110012	12th -28th September, 2020	Dr. P.J.Das Dr. R. Thomas

Training/workshop/Seminar etc. Organized

Sl. No.	*Name of Programme (Training/ workshop/ Seminar etc.) Organized*	*Days of Programme (Date from - to)*	*Participants (No.)*	*Participant category*
1.	Workshop on Sensitization of Institute Technologies available for Economic Pig Farming and its commercialization Prospect	7th March 2020	55	Scientist/ Faculty/ stakeholders
2.	Webinar on "African Swine Fever Sensitization Program"	8th June 2020	26	Pig farmer and pig farmers and stakeholder
3.	VIRTUAL CONTEST ON PORK DISHES (Theme: Food safety, everyone's business)	16th Oct. 2020	45	Pork processor and Pork lover
4.	Entrepreneurship Development Programme (Virtual) on Scientific Pig Production Practices and Value Addition of Pork.	10th November 2020	45	Scientist/ Faculty/ stakeholders

State Level Farmers Fair organized by ICAR-ATARI, Guwahati on 26th-27th February, 2020

Workshop on Sensitization of Institute Technologies available for Economic Pig Farming and its commercialization Prospect organized by ITMU, ICAR-NRC on Pig on 7th March, 2020.



Outreach Activities by participating webinar on "Scientific and low cost Pig Husbandry organize by ***Simanata Chetana Manch Purvorttar,*** *North East on* 16th August 2020 by Dr.P.J.Das (Incharge ITMU)

Workshop cum online Training Programme on "INTELLECTUAL PROPERTY RIGHTS IN AGRICULTURAL RESEARCH & EDUCATION IN INDIA organized on 12-16th Sept. 2020 by NAHEP and IP&TM Unit, ICAR Hqrs, Pusa Campus, New Delhi-110012

Agri-Business Incubation Centre (ABI)

In-Charge: Dr. R. Thomas, Senior Scientist

The ABI Centre at ICAR-National Research Centre on Pig is intended to help prospective entrepreneurs, by providing pro-active and value-added business support in terms of technical consultancy, infrastructure facility, experts' guidance and training to develop technology based business ideas and establish sustainable enterprises. It will act as a platform for the speedy commercialization of the ICAR-NRCP technologies, through an interfacing and networking mechanism between research institution and industries.

Induction of ABI Entrepreneurs

ABI centre of ICAR-National Research Centre on Pig is intended to help and promote piggery based enterprises by developing agi-business incubator networks in North East region and other parts of India to create a value chain in commercial piggery sector. ICAR-National Research centre on Pig inducted twelve numbers of Entrepreneurs/Start ups under ABI during 2020 to 2021; who sought for the possible support from ABI centre for streamlining their business prospectives. A total of fifteen numbers of technology transfer agreements has been signed with the entrepreneurs. The technology transfer agreement focuses on incubation and business development programme including entrepreneurship skill development activities in the areas of commercial piggery, allied service sectors and value addition in pork.

Support extended to the Incubatees

ABI centre of ICAR-National Research Centre on Pig through its mentorship connects to guide the entrepreneurs in the right direction for a better resolution and to become more agile, lean and mature as a start up company. The ABI unit also provided a more structured way to the start ups by extending the support by commercializing institute's technologies and infrastructure facility to its entrepreneurs, which has opened up new entry points in the piggery value chains for the start ups, which in turn help them to access the new potential markets. The ABI unit of ICAR-National Research Centre on Pig also extended its valuable support to its entrepreneurs in processing value added pork products and quality control. The ABI Unit is also helping the entrepreneurs by providing them pro-active and value added business support in terms of technical consultancy and mentor connections, guidance and trainings to develop modern technology based business ideas and models in business domains in order to scale their start-ups effectively.

Organized Entrepreneurship Development Programmes (EDP)

Agri-Business Incubation Centre of ICAR-National Research Centre on Pig has organized an Entrepreneurship Development Programme (virtually on Google meet application) on "Scientific Pig Production Practices and Value Addition on Pork" on 10th November 2020. The training programme was envisaged to impart the valuable knowledge and skills pertaining to scientific pig production as well as value addition of pork to the prospective individuals or entrepreneurs. A total number of 14 participants had attended both the programmes from different states of India such as from Assam, Karnataka, Telengana, Tripura, Uttar Pradesh and Andaman & Nicobar Islands. The training focused on topics related to commercial pig farming; pork processing; artificial insemination; care and management of different categories of pigs; bio-security aspects; waste management; to tackle the challenges with respect to new and emerging diseases associated with pigs and value addition of pork value chain in piggery sector.

Organized a virtual contest on pork dishes

A virtual contest on preparation of pork dishes was organized jointly ABI unit of ICAR-National Research Centre on Pig to commemorate the 'World Food Day'on 16th of October, 2020. The

institute has received over 25 entries from across the country. On this occasion, the Director of the Institute has declared the results of the winner of the virtual contest on pork dishes, and the top three winners of the contest were awarded with cash prize of Rs. 5000 for 1st Prize, Rs 3000 for the 2nd prize and Rs 2000 for the 3rd prize, respectively. The respective winners of the virtual contest are Orchid Borah, Ananya Borah and Violina Gogoi secured for the first position whereas, Bikash Jyoti Boruah secured for the second position and Monika Changmai secured for the third position.

List of Entrepreneurs under ABI as of today

Sl No.	Name	Location of Business Enterprise	Areas specific for Institutional Support	Staus of the Incubatee
1.	Arohan Foods Pvt Ltd	Guwahati, Assam	I. Technology for establishing commercial pig breeding farm. II. Technology for establishing rural pig slaughter house. III. Technology for establishing Pork Processing Units.	Graduated
2.	Amora Foods Pvt Ltd	Guwahati, Assam	I. Technology for Establishing Pork Processing Unit	Early Stage
3.	Sayuri Farms	Guwahati, Assam	I. Technology for Establishing commercial pig breeding farm, II. Technology for Establishing Pork Processing Units.	Graduated
4.	Symbiotic Foods Pvt Ltd	Sonitpur, Assam	I. Technology for establishing Artificial Insemination support, II. Technology for establishing pork processing units.	Early Stage
5.	Borluit Farms	Guwahati, Assam	I. Technology for establishing a small processing unit, II. Technology for Establishing a small Slaughter House	Early Stage
6.	G.N Nagesh	Bangalore, Karnataka	I. Technology for establishing Rural Pig Slaughter house.	Early Stage
7.	Paras Farm	Ranchi, Jharkhand	I. Technology for establishing mini pig abattoir.	Early Stage
8.	Rubul Deka	Dibrugarh, Assam	I. Technology for establishing Artificial Insemination support.	Early Stage
9.	Emergent Dream Works Infra Developers	Hyderabad, Telengana	I. Technology for establishing commercial pig breeding farm. II. Technology for establishing a micro Pig Abattoir and III. Technology for establishing Processing of common value added pork products.	Early Stage
10.	Directorate of Animal Resources Development Department	Agartala, Tripura	I. Technology for establishing a micro Pig Abattoir. II. Technology for establishing pork processing Units.	Early Stage

Transfer of Technology to one of our entrepreneur under ABI on 27.06.2020.

Signing Of MoA with the two new Entrepreneurs under ABI on 07.12.2020

SWACHH BHARAT MISSION

In-Charge: Dr. Kalyan De, Scientist

Swachh Bharat Programme has been organized in the ICAR-National Research Centre on Pig, Rani, Assam-781131 to celebrate the "World Environment Day" on 5th June 2020 during Unlock 1 period. The senior-most scientist of the institute Dr. B.C Das, PS briefly summarised the importance and link between our surrounding environment and cleanliness (Swachhata) of that. All the scientific, technical, administrative staff of the institute actively participated in this programme at 4:00 pm by maintaining social distance and cleaned the road (at the farm side) towards the Directors quarter and planted new saplings in the roadside.

A week-long celebration was undertaken to mark the 150th Birth Anniversary of the "Father of Nation" at ICAR- NRC on Pig, Rani.

Various programmes like cleaning and plantation drive, quiz on Gandhian ideology, drawing and painting depicting life and principles of Gandhi Ji, Essay writing. On the concluding day of the ceremony, 2nd October 2020 a Workshop on Gandhian philosophy was organized in which all categories of employees participated with great fervor and enthusiasm. The various participants were suitable awarded for their participation in different events. Dr. N. H. Mohan emphasized various aspects of life and the teachings of Gandhi Ji, Dr. B.C. Das highlighted various 'mantras' of Gandhi Ji's philosophy and their importance in today's perspective. Dr. Swaraj Rajkhowa, Director of the institute distributed certificates to successful participants and urged them to uphold the values of Mahatma and instill the same in our daily lives. The workshop ended with a vote of thanks to the session by Dr. Juwar Doley, the coordinator of the programme.

Campus cleaning

Quiz Competition

Painting competition

The ICAR-National Research Centre on Pig, Guwahati, Assam has celebrated "Swachhta Pakhwada" from 16th-31st December 2020. During this period, each day different action plan has been taken and reports have been submitted to the ICAR on daily basis. During this programme different activities have been undertaken to promote the Swachhta and establish a clean and green India. The activities include; display of banner at prominent places, taking Swachhta pledge, cleanliness drive including cleaning of offices, corridors and premises, cleanliness and sanitation drive within campuses and surroundings including residential colonies, e-office implementation, promoting clean & green technologies and organic farming practices in kitchen gardens of residential colonies, cleaning of sewerage & water lines, awareness on recycling of wastewater, water harvesting for agriculture, the celebration of Special Day- Kisan Diwas Swachhta Mission with farmworkers and farmers, a workshop on Swachhta Mission for students at nearby Rani High School, essay writing, quiz and painting competition among the students on swachhta mission to make them ware about swachhta and cleanliness, lectures on farm cleanliness, sanitation and biosecurity measures on farms by the scientist and tree plantation.

Swachhta Pledge

Cleaning of Campus, office, rooms, laboratory and library

To promote clean and green technologies and organic farming practices in kitchen gardens, the employee resides inside the institute campus started cultivating green vegetables for them. They are cultivating broccoli, cabbage, cauliflower, kohlrabi, spinach, etc. organically as a kitchen gardening.

Kitchen Gardening

Garden Cleaning

Farm complex cleaning

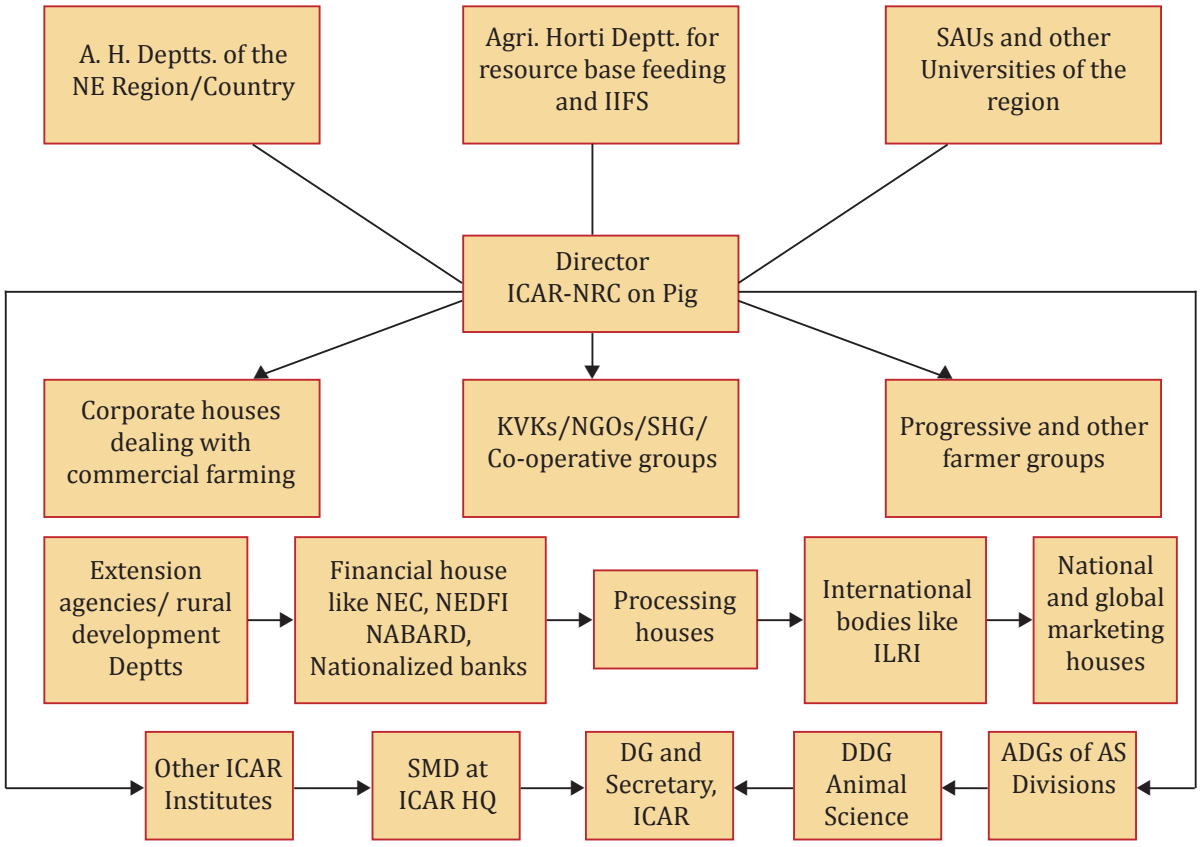


Workshop, quiz, essay writing, painting competition at local Rani High School to creaete awareness of cleanliness



Tree plantation in Swachhta pakhwada

LINKAGE AND COLLABORATION OF ICAR-NRC ON PIG



Meetings and Other Activities

Research Advisory Committee Meeting (RAC)

Members	Position in RAC
Dr. N. Balaraman, Former Vice- Chancellor, TANUVAS	Chairman
Dr. R. S. Gandhi Assistant Director General (AP & B), ICAR, New Delhi	Member
Dr. R.N. Goswami Former Dean, College of Veterinary Science, AAU Khanapara, Guwahati-781022	Member
Dr. C. Rajkhowa Former Director ICAR, NRC on Mithun, Nagaland	Member
Dr. J. Abraham Former Director, Centre for Excellence in Meat processing, KAU Mannuthy/Sharon, Mannuthy, Thrissur, Kerala-680651	Member
Dr. R.C. Upadhyay Former Head, Dairy Cattle Physiology Division ICAR-NDRI, Karnal-132001, Haryana	Member
Dr. (Mrs) Jancy Gupta Former Head, Dairy Extension Division ICAR-NDRI, Karnal-132001, Haryana	Member
Dr. Swaraj Rajkhowa Director, ICAR-NRC on Pig	Member
Nominated member by Hon'ble AM (a) Sh. Dhaneswar Deka, Bhunukuchi, Nalbari, Assam (b) Sh. Prema Datta, Dhemaji, Assam	Member
Dr. K. Barman Principal Scientist, ICAR-NRC on Pig	Member Secretary

The 14th Research Advisory Committee Meeting of ICAR-NRC on Pig was held virtually on 26-08-2020 under the Charimanship of Dr. N. Balaraman, Former ViceChanchellor, TANUVAS. Dr.SwarajRajkhowa, Director (Acting), ICAR-NRC on Pig welcome chairman, all the members and scientific staffs and made appraisal about salient achievements and future research plan of the Instuitute. Dr.Keshab Barman, Member Secretary made a brief presentation on the research programmes of the Institute and action taken report on the recommendations of previous RAC meeting. Each research project was presented as per programme followed by comments of the house. The committee critically evaluated all the works and gave their valuable comments. The major recommendations of the XIVth RAC were as follows: Genomic selection is very important and work shall be conducted in the area. DNA sample collection from high and low litter shall be done. In this regard, proposal for external funding on studies on SNP chips, genome wide association study (GWAS) and whole genome sequencing (WGS) is desirable. Simple selection indices shall be developed; metagenomics in pigs in relation to digestion of nutrients especially lignocelluloses shall be undertaken; works on important swine diseases should be done in collaboration with NISHAD, NIVEDI, CADRAD etc.; work on metagenomics in bacteria and antimicrobial resistance for identification of resistance genes in pig genome should be conducted; work on Toxoplasmosis, Sarcocystis and cysticercosis may be undertaken; institute scientists should be involved in

conducting structured surveillance programme on emerging swine diseases to prevent further occurrence in collaboration with State Govt., KVKs as well as National institutes; surveillance programme with states shall be undertaken and a coloured atlas should be developed; work on indigenous technologies for processing and preserving pig products need to be documented. Further the processing of these products need to be validated and subsequent refinement for safe use of the consumers; work on market and value chain should be conducted; work on carcass microbiology, as mentioned in FSSAI standards, using ATCC positive standards should be done and NABL accreditation shall be taken for food testing.

Institute Research Council meeting (IRC)

The XIVth Institute Research Council (IRC) meeting of ICAR-NRC on Pig was held on 27th May, 2020, under the Chairmanship of Dr.Swaraj Rajkhowa, Director (Acting), ICAR-NRC on Pig. Each research projects presentation was followed by comments of the house. The Chairman emphasized that the scientists should be critical in undertaking basic and applied research and mentioned that the new projects must comply with the Institute mandate. He also mentioned that the scientists should make extra efforts to publish quality papers in the research journals with high impact factor. During the meeting, the outcome of completed projects, progress of ongoing Institute projects and the technical programmes of new project proposals were presented by the PIs and thoroughly reviewed.

The 14th IRC Meeting on progress

Celebrations

Institute Foundation Day

The ICAR-National Research Centre on Pig, Rani has cerebrated 19th foundation day of the institute on 4th September, 2020. The inaugural programme was organized through the online platform, in whcih Dr K. M. Bujarbaruah, Former Vice Chancellor, Assam Agriculture University; Dr B. N. Tripathi, Deputy Director General (AS), ICAR; Dr. V. K. Saxena, ADG (AP&B) and Dr. A.K. Tyagi, ADG (ANP) graced the occasion. Dr Bujarbaruah was enlightened the participants with his foundation day lecture. Dr. B. N. Tripathi, DDG (AS), in his address, emphasised the need to strengthen the surveillance and biosecurity measures to tackle the emerging diseases of the pigs, especially African Swine Fever and PRRS. During the programme, Dr Tripathi has released the new website of the ICAR-National Research Centre on Pig.

Glimpses of Institute Foundation Day activities

Vigilance Awareness Week

In pursuance of Council Letter no. 104-1/2020-Vig-I dated 13th October, 2020 and Central Vigilance Council Circular no. 09/09/2020 Vigilance Awareness Week-2020 was observed in ICAR-National research Center on Pig, Rani, Guwahati, Assam from 27.10.2020 to 02.11.2020. During the Vigilance Awareness Week-2020 a number of activities were organized starting from pledge taking ceremony to conducting of competitions, workshop, public display of banner etc. On 27.10.2020, The Pledge was taken by all the employees of the institute. Director of the institute, Dr. Swaraj Rajkhowa deliberated on issues of corruption and discussed how individual should follow the transparency in their work.

A pamphlet was prepared by the Vigilance Officer of the institute covering basis aspects of vigilance. It also covered the do's and don'ts in daily office life keeping in view of vigilance. The pamphlet was distributed among all the staffs of the institute. A sensitization programme cum workshop and talk on vigilance was delivered by Mr. Amlan Kumar Kar, Retired Senior Audit Officer of, CAG on 29.10.20. The programme included deliberation of lectures on different aspects of vigilance including group discussion.On 31.10.2020, an elocution competition on "Vigilant India, Prosperous India" was conducted among the staff members of the institute. Banners were prepared on the topic "Vigilant India, Prosperous India" and were displayed at public area for creation of awareness. Staffs of ICAR-NRC on Pig interacted with the local people about vigilance awareness. The institute observed Vigilance Awareness Week by organizing different activities with great fervor to enhance the awareness, to display honesty by all of us, at all time and at all places.

Integrity Pledge (27.10.20)

Elocution competition (31.10.20)

Organization of workshop on Vigilance Awareness on 29.10.20

Public Display of banner in market place

National Unity Day

The institute organised National Unity Day on 31th Oct., 2020 at ICAR –NRC on Pig, Rani. The director of the institute thrown light on the National Unity Day Importance and a pledge was taken by all the participants of the progrmme

Independence Day

The institute celebrated 73nd Independence Day of our country on 15th August 2020. All the staff of the institute assembled with a great zeal for the flag hosting function. The Director of the institute delivered speech on this occasion by remembering all the martyrs who shed their blood in the freedom fight.

Gandhi Jayanti

The Institute celebrated 151st birth anniversary of Mahatma Gandhi on 2nd October, 2020 to commemorate his immense contribution in freedom fight of India by following the way of non-violence. As part of the celebration, institute organized drawing competition for school children in the nearby villages and distributed certificates and prizes.

Hindi Cell

हिन्दी प्रकोष्ठ,राष्ट्रीय शूकर अनुसंधान केंद्र, राणी, गुवाहाटी
राष्ट्रीय शूकर अनुसंधान केंद्र, गुवाहाटी में निम्नलिखित राजभाषा कार्यान्वयन समिति कार्यरत है।

क्रम. सं.	समिति	नाम
1.	अध्यक्ष	निदेशक,राष्ट्रीय शूकर अनुसंधान केंद्र
2.	सदस्य	डा. शान्तनु बानिक, प्रधान वैज्ञानिक
3.	सदस्य	डा. सुनील कुमार,वैज्ञानिक
4.	सदस्य	डा. जया, वैज्ञानिक
5.	सदस्य	श्री उत्तम प्रकाश, सहायक प्रशासनिक अधिकारी
6.	सदस्य सचिव	डा. सतीश कुमार,वैज्ञानिक एवं प्रभारी, हिन्दी अनुभाग

राजभाषा कार्यन्वयन समिति की बैठक कार्यालय मे प्रत्येक तिमाही को होती है। समिति हिंदी के प्रचार व प्रसार के लिए सुझाव देती है एवं विगत तिमाही की प्रगति रिपोर्ट की समीक्षा करती है। कार्यालय उपयुक्त समय पर राजभाषा विभाग को तिमाही रिपोर्ट प्रस्तुत करता है। इस वर्ष राजभाषा कार्यान्वयन समिति की चार बैठक का आयोजन संस्थान के समिति कक्ष मे किया गया। इन बैठकों का आयोजन दिनांक 18.02.2020 को अपराह्न 3:00 बजे, 16.06.2020 को पूर्वाह्न 11:30 बजे, 15.09.2020 को अपराह्न 3:00 बजे एवं 21.12.2020 को अपराह्न 12:30 बजे किया गया एवं बैठक की कार्यवृत को आवश्यक कार्यवाई के लिए संस्थान के सभी कर्मियों के साथ साथ परिषद को प्रेषित किया गया।
राष्ट्रीय शूकर अनुसंधान केंद्र, गुवाहाटी नगर राजभाषा कार्यान्वयन समिति का सदस्य है एवं संस्थान ने नगर राजभाषा कार्यान्वयन समिति की सभी बैठकों में भाग लिया ।

राजभाषा विभाग के निर्देशानुसार वार्षिक कार्यक्रमों, राजभाषा अधिनियमो एवं अन्य सभी आदेशों/अनुदेशों का अनुपालन कार्यालय द्वारा सफलतापूर्वक किया गया।

राष्ट्रीय शूकर अनुसंधान केंद्र में हिंदी पखवाड़ा का आयोजन

राष्ट्रीय शूकर अनुसंधान केंद्र में हिंदी पखवाड़ा का सफलतापूर्वक आयोजन दिनांक 14 सितंबर 2020 से 28 सितंबर तक किया गया। हिंदी पखवाडा का शुभारंभ डा. स्वराज राजखोवा, निदेशक,राष्ट्रीय शूकर अनुसंधान केंद्र, राणी, द्वारा हिंदी दिवस के शुभ अवसर पर किया गया। निदेशक महोदय ने हिंदी भाषा का महत्व और सरकारी कार्यालयों में इसकी उपयोगिता के बारे में बताया तथा कार्यालय के सभी कर्मचारियों को अधिक से अधिक कार्य हिंदी भाषा में करने का आह्वान किया। तत्पश्चात प्रभारी राजभाषा अधिकारी एवं वैज्ञानिक, डॉ सतीश कुमार ने राजभाषा के उद्भव एवं इसके इतिहास के बारे में जानकारी दी। उन्होंने हिंदी पखवाड़ा के दौरान होने वाली विभिन्न प्रतियोगितायों एवं कार्यक्रमों के बार में सभी को जानकारी दी। उद्घाटन कार्यक्रम के दौरान माननीय कृषि एवं किसान कल्याण मंत्री भारत सरकार, श्री नरेन्द्र सिंह तोमर, माननीय कृषि एवं किसान कल्याण राज्यमंत्री, भारत सरकार, श्री कैलाश चौधरी के साथ माननीय सचिव एवं महानिदेशक, भारतीय कृषि अनुसन्धान परिषद्, त्रिलोचन महापात्र जी का शुभकामना सन्देश पढ़ कर सुनाया गया ।

हिंदी पखवाड़ा के दौरान निम्नलिखित कार्यक्रमों का आयोजन किया गया

दिनांक	कार्यक्रम
14.09.2020,3.30 बजे	उद्घाटन सत्र,निदेशक, राष्ट्रीय शूकर अनुसंधान केंद्र, राणी, गुवाहाटी के द्वारा
16.09.2020,3.30 बजे	निबंध एवं श्रुतिलेखन प्रतियोगिता
17.09.2020,3.30 बजे	हिंदी कार्यशाला-01(डा.सुनील कुमार)
18.09.2020,3.30 बजे	वाद-विवाद प्रतियोगिता
19.09.2020, 3.30 बजे	हिंदी कार्यशाला-02(श्री उत्तम प्रकाश)
21.09.2020, 3.30 बजे	हिंदी कार्यशाला-03(डा. अजय कुमार यादव)
23.09.2020, 3.30 बजे	हिंदी गायन प्रतियोगिता
25.09.2020, 3.30 बजे	हिंदी कार्यशाला-04(डा. जया)
28.09.2020, 2.00 बजे	सामान्य ज्ञान प्रतियोगिता
28.09.2020, 3.00 बजे	समापन सत्र

इसके अलावा चार हिंदी कार्यशाला का आयोजन किया गया जिसमें हिंदी वर्णमाला, हिन्दी बोलचाल में पुल्लिंग एवं स्त्रीलिंग का सही प्रयोग एवं कार्यालय आवेदन पत्रों के प्रारूप की जानकारी दी गई। हिंदी पखवाड़ा का सफलतापूर्वक समापन दिनांक 28.09.2020 को हुआ। इस समारोह के मुख्य अतिथि क्षेत्रीय कार्यान्वयन कार्यालय, गुवाहाटी के कार्यलय प्रमुख श्री बद्री यादव थे। उन्होंने हिंदी भाषा के अधिक से अधिक प्रयोग पर बल दिया। संस्थान के निदेशक डा. स्वराज राजखोवा ने हिंदी पखवाड़ा का आयोजन सिर्फ हिंदी दिवस तक सीमित न रखकर उसे वर्ष में दो बार करने का सुझाव दिया, जिससे हिंदी भाषा का अधिक से अधिक प्रसार एवं प्रचार हो सके। उन्होने प्रतियोगिता के विजेताओं को प्रमाण-पत्र एवं पारितोषिक राशि देकर सम्मानित किया। संस्थान के प्रभारी राजभाषा अधिकारी एवं वैज्ञानिक डा. सतीश कुमार ने हिंदी पखवाड़ा के आयोजन का उद्देश्य हिंदी का अधिक उपयोग कर राजभाषा का विकास करना बताया। उन्होंने हिंदी पखवाड़ा में बढ़-चढ़ कर भाग लेने के लिए संस्थान के सभी कर्मचारियों एवं वैज्ञानिकों का आभार प्रकट किया एवं राजभाषा के विकास में योगदान देने के लिए सभी को प्रेरित किया।


उद्घाटन सत्र

श्रुतिलेखन प्रतियोगिता

निबंध प्रतियोगिता

वाद-विवाद प्रतियोगिता

गायन प्रतियोगिता

हिंदी कार्यशाला का आयोजन

हिंदी कार्यशाला

प्रश्नोतरी प्रतियोगिता

समापन समारोह

विशेष अतिथि का संबोधन

विजेताओं के साथ निदेशक एवं अतिथि

पुरस्कार वितरण कार्यक्रम

राष्ट्रीय शूकर अनुसंधान केंद्र में हिंदी पखवाड़े का समापन

गुवाहाटी: राष्ट्रीय शूकर अनुसंधान केंद्र में विगत 15 दिनों से चल रहे हिंदी पखवाड़े का सफलतापूर्वक समापन दिनांक 28-09-2020 को गया। इस समारोह के मुख्य अतिथि क्षेत्रीय कार्यान्वयन कार्यालय, गुवाहाटी के कार्यालय प्रमुख बद्री यादव ने हिंदी भाषा के अधिक से अधिक प्रयोग पर बल दिया। संस्थान के निदेशक डॉ. स्वराज राजखोवा ने हिंदी पखवाड़े का आयोजन सिर्फ हिंदी दिवस तक सीमित न रखकर उसे वर्ष में दो

कार्यक्रम का समाचार पत्र दैनिक पूर्वोदय मे प्रकाशन

राष्ट्रीय शूकर अनुसंधान केंद्र में हिंदी पखवाड़ा का सफलतापूर्वक समापन

गुवाहाटी, 29 सितंबर (पू.सं.)। विगत 15 दिनों से राष्ट्रीय शूकर अनुसंधान केंद्र में चल रहे हिंदी पखवाड़ा का सोमवार को सफलतापूर्वक समापन हुआ। इस समारोह के मुख्य अतिथि क्षेत्रीय कार्यान्वयन कार्यालय, गुवाहाटी के कार्यालय प्रमुख श्री बद्री यादव ने हिंदी भाषा के अधिक से अधिक प्रयोग पर बल दिया।

संस्थान के निदेशक डा. स्वराज राजखोवा ने हिंदी पखवाड़ा का आयोजन सिर्फ हिंदी दिवस तक सीमित न रखकर उसे वर्ष में दो बार करने का सुझाव दिया। जिससे हिंदी भाषा का अधिक से अधिक प्रसार एवं प्रचार हो सके। संस्थान के प्रभारी राजभाषा अधिकारी एवं वैज्ञानिक डा. सतीश कुमार ने हिंदी पखवाड़ा के आयोजन का उद्देश्य हिंदी का अधिक उपयोग कर राजभाषा का विकास करना बताया। उन्होंने हिंदी पखवाड़ा में बढ़-चढ़ कर भाग लेने के लिए संस्थान के सभी कर्मचारियों एवं वैज्ञानिकों का आभार प्रकट किया एवं राजभाषा के विकास में योगदान देने के लिए सभी को प्रेरित किया। हिंदी पखवाड़ा में विभिन्न प्रकार के प्रतियोगिता का आयोजन किया गया जिसमें हिंदी श्रुति लेखन, निबंध प्रतियोगिता, वाद-विवाद प्रतियोगिता, हिंदी-गायन एवं हिंदी सामान्य ज्ञान प्रश्नोत्तरी शामिल थे। इसके अलावा चार हिंदी कार्यशाला का आयोजन किया गया जिसमें हिंदी वर्णमाला, हिंदी बोलचाल में पुल्लिंग एवं स्त्रीलिंग का सही प्रयोग एवं कार्यालय आवेदन पत्रों के प्रारूप की जानकारी दी गई। प्रतियोगिता के विजेताओं को प्रमाण-पत्र एवं पारितोषिक राशि देकर सम्मानित किया गया।

कार्यक्रम का समाचार पत्र पुर्वांचल प्रहरी मे प्रकाशन

Training Programmes Organized

The institute has conducted a series of training programmes in different aspects of pig production, artificial insemination, pork processing and value addition. These trainings have provided exposure to participants on the basics of selection of breed/ varieties/strain and breeding strategies for profitable pig farming, feeding of different categories of pigs and use of non-conventional feed stuffs for swine feeding, care and management of different categories of pigs, exposure to semen lab, semen collection, processing and evaluation of boar semen for Artificial Insemination, housing requirement for scientific pig farming, common diseases of pigs and their management including vaccination schedule, farm cleaning, disinfection, routine farm operation practices, castration and needle teeth clipping of piglets and different methods of administration of medicines in pig, and demonstration of formulation of feeds for different categories of pigs.

Also, these trainings have provided exposure to the participants on basics of ante & postmortem inspection, hands-on-training on scientific pig slaughter process, fabrication & packaging of pork, facilities required for hygienic slaughter, common diseases encountered during the slaughter operations and the importance of personnel hygiene. Training has also provided information on value addition and further processing of pork and the avenues available in the utilization of different by-products arising out of pig slaughter operations.

List of trainings organized and number of beneficiaries

Year	Sponsoring Institute	Name of the training	No. of Beneficiaries
2020	Rastriya Krishi Vikash Yoyona, MSDE, GOI	Agricultural Skill Training on Scientific Piggery farming w.e.f. 25th Feb 2020 to 01st March 2020	21
	Institute Agri Business Incubation	Programme for Entrepreneurship Development Programme (Virtual) on Scientific Pig Production Practices and Value Addition of Pork Date: 10th November, 2020	13
	Institute TSP	Online Training Programme on AI in Pig (21-23 Oct., 2020)	20
	Institute SCSP	Online Training Programme on AI in Pig (27-29 Oct., 2020)	9
	Individually Paid training	Online Training Programme on AI in Pig (23-25 Nov., 2020)	13
	Individually Paid training	Online Training Programme on AI in Pig (29th June-01st July., 2020)	8
	Individually Paid training	Training Programme on AI in Pig (27-29 Jan., 2020)	9
	KISAN BIOTECH Project	Training Programme on AI in Pig (6-8 Jan., 2020)	6
	Individually Paid training	Online training programme on 'Scientific Pig Production in intensive system for sustainable livelihood'(6-10th July 2020)	12

List of Pig Health and Awareness camp

Year	Sponsoring Institute	Name of the training	No. of Beneficiaries
2020	ICAR-NRCP under TSP	Animal Health and Awareness camp conducted on 29-12-2020 at Rani	29
	ICAR-NRCP under TSP	Animal Health and Awareness camp conducted on 07-1-2021 at Tangla Odalguri	160
	ICAR-NRCP under TSP	Animal Health and Awareness camp conducted on 22-12-2020 at Dhamdhama Nalbari	170
	ICAR-NRCP under TSP	Animal Health and Awareness camp conducted on 01-09-2020 at Rani	50
	ICAR-NRCP under TSP	Animal Health and Awareness camp conducted on 02-09-2020 at Ratanpur, Boko, Kamrup Assam	110

Photo Training and animal health camp







Awards and Recognitions

पूर्वोत्तर क्षेत्र के लिए क्षेत्रीय राजभाषा पुरस्कार

- राजभाषा विभाग, गृह मंत्रालय, भारत सरकार के द्वारा वर्ष 2019–20 का 'पूर्वोत्तर क्षेत्र के लिए क्षेत्रीय राजभाषा पुरस्कार' में राष्ट्रीय शूकर अनुसंधान केंद्र, राणी, गुवाहाटी को द्वितीय पुरस्कार के लिए चयनित किया गया। भारत सरकार का राजभाषा विभाग प्रत्येक वर्ष हिन्दी के विकास में योगदान के लिए पूर्व, पश्चिम, पूर्वोतर, उत्तर तथा दक्षिण क्षेत्र के केंद्रीय कार्यालयों को पुरस्कृत करती है। इस वर्ष पूर्वोत्तर क्षेत्र में '11 से 50 कार्मिकों वाले कार्यालय' की श्रेणी में राष्ट्रीय शूकर अनुसंधान केंद्र, राणी, गुवाहाटी, कार्यालय कोड ofas9151 को द्वितीय पुरस्कार दिया गया ।

Sri Prabhat Kumar Nayak, Assistant finance and Accounts officer

Sri Prabhat Kumar Nayak has been awarded ICAR Cash Award 2019 under Administrative Category for his dedication towards achieving the goals of the Institute.


Indian Council of Agricultural Research

Certificate

ICAR CASH AWARD SCHEME–2019

(For Administrative Category)

is presented to

Sh. Prabhat Kumar Nayak

AF&AO, NRC on Pig, Guwahati

16 July, 2020
New Delhi

(T. Mohapatra)
Secretary (DARE) &
Director General (ICAR)

(Narendra Singh Tomar)
Agriculture & Farmers Welfare Minister, GoI
& President, ICAR Society

Dr. Santanu Banik

- Acted as co-chairman of the session "Livestock and Fisheries Sector" during State level farmers fair cum Farmers-Scientists' Interaction on "Farmers' prosperity through doubling farmers' income" organized by ATARI Zone-IV, Guwahati during 26-27th February, 2020.
- Acted as Co-convener and Joint organizing Secretary of State level farmers fair cum Farmers-Scientists' Interaction on "Farmers' prosperity through doubling farmers' income" organized by ATARI Zone-IV, Guwahati during 26-27th February, 2020.
- Acted as external thesis evaluator of M.V.Sc. Dissertation (Animal Genetics Breeding) of College of Vety. Sciences and Animal Husbandry of Assam Agricultural University.

Dr. Rafiqul Islam

- Dr. Rafiqul Islam, Principal Scientist has acted as External Thesis evaluator for two theses (one Ph.D. and one M.V.Sc) of Assam Agricultural University, Khanapara, Guwahati for the discipline of Animal Reproduction, Gynaecology and Obstetrics.
- Dr. Rafiqul Islam, Principal Scientist has acted as External Examiner to conduct a Thesis viva-voce examination of Ph.D. student in the department of Animal Reproduction, Gynaecology and Obstetrics, Assam Agricultural University, Khanapara, Guwahati.
- Reviewed three manuscripts as reviewer of Indian Journal of Animal Research, https://www.arccjournals.com, Karnal, Haryana.

- Reviewed one manuscript as Reviewer for the Journal- Animal Reproduction, Publisher: Brazilian College of Animal Reproduction.
- Editor, Animal Reproduction, Gynaecology & Obstetric Section for "Journal of Advanced Veterinary and Animal Research, https://bdvets.org/JAVAR/editorial-board.html
- Editorial Board Member for "Asian Pacific Journal of Reproduction", https://www.apjr.net/editorialboard.asp, Official Publication of Hainan Medical University, Hainan -571100,China

Dr. Keshab Barman

- Received certificate of Excellency in Reviewing Journal of Pharmaceutical Research International for the year 2020.
- Received Reviewer excellence Award as reviewer of Asian Journal of Dairy and Food Research for the year 2020.
- Received Reviewer excellence Award as reviewer of International Livestock Research for the year 2020.
- Received Reviewer excellence Award as reviewer of Indian Journal of Animal Research for the year 2020.
- Certificate of appreciation received as member of the Scientific Advisory Board in recognition of outstanding contribution to the quality of the journal of International journal of Livestock Research for the year 2020.
- Editor of EC Veterinary Science Journal, United Kingdom for the year 2020
- Member of the Scientific Advisory Board of International Foundation for Science, Sweden
- Appointed as External Examiner for M.V.Sc. thesis evaluation of Division of Animal Nutrition, Faculty of Vety. Sciences & A.H, SKUAST-Jammu vide order no AUJ/DE/19-20/F-12/931 dtd 22-09-2020 on the topic ' Utilization of spent marigold flower mealin the ration of goats.
- Appointed as External Examiner for M.V.Sc. thesis evaluation Dr. Diptanu Das, Central Agricultural University (Registration No. U-18-MZ-01-003-M-V-013) vide order no 8/CAU/CVAH/Acad/PG-RW/2020/5926 dtd. 20-11-2020. The thesis title: "Effect of Feeding rubber Seed (I{evea brasilitrisis) Meal on Grolvth, Nutrient Utilization & Blood Biochemical Parameters in Growing Pigs"
- Appointed as external examiner for evaluation of MVSc thesis of Dr. Pallab Borah, Roll No.2018-VMK-09 for M.V.Sc. Degree in Animal Nutrition of AAU vide order no AAU/DPGS/PF/2020-21/1720 dtd 06-01-2021..
- Appointed as Question Setter for M.V.Sc. Comprehensive Qualifying Written Examination of post graduate programme for subject Animal Nutrition of CAU, Aizawl, 2020.
- Acted as Reviewer for evaluation of research articles published in *Indian Journal of Animal Nutrition* for the period from 2020.
- Acted as Reviewer for evaluation of research articles published in *Animal Nutrition and Feed Technology* Journal for the period 2020.
- Acted as Reviewer for evaluation of research articles published in *Indian Journal of Animal Science* Journal for the period 2020.
- Acted as Reviewer for evaluation of research articles published in *Indian Journal of Animal Research* for the period 2020.
- Nominated as Member of FAD 5 of BIS

- Nominated as member of advisory committee of Ph.D. student of Dr. Jyoti Dubey of CVSc, Khanapara.
- Appointed as PhD Co-Supervisor of Tapu Ghosh, Life Science (Biotechnology) of Assam Don Bosco University, Assam.
- Nominated as member of advisory committee of M.V.Sc. student of Dr. Jyoti Dubey of CVSc, Khanapara.
- Nominated as member of advisory committee of Ph.D. student of Dr. Kanak Barman of ICAR-IVRI Bareilly.
- Invited to deliver online lecture on 'Scientific feeding practices for pig' in a Three days training programme on scientific pig husbandry practices organized by ICAR-RC for NEH region, Umiam under Biotech KISAN Hub on 12-02-2021.
- Invited to act as Rapporteur in a National e-Workshop cum Webinar on "Current Perspective of Swine Diseases in India and its Management Practices" w.e.f. 11-12 January, 2021 organized by ICAR-NRC on Pig, Guwahati.
- Invited to deliver online lecture on 'Economic feeding practices for pig' by letter no PGIVAS/AD/TO/1292/2020 dtd 10-12-2020 on 17-12-2020 in the online training programme organized by Post Graduate Institute of Veterinary and Animal Sciences, Akola, Maharashtra w.e.f.15-12-2020 to 19-12-2020.

Dr. P. J. Das

- Invited reviewer for Theriogenology is an open access, peer-reviewed high impact international journal published by Elsevier.(2020-21)
- Act as Editorial Board member for the Journal of Veterinary Science and Animal Medicine - Gnome Publications. (2020).
- Invited reviewer for BMC genomics, is an open access, peer-reviewed high impact international journal published by Springer Nature.(2019)-20
- Invited reviewer for Annals of Reproductive Medicine and Treatment open access, peer-reviewed international journal published by SciMedcentral. (2020)
- Invited reviewer for Asian Food Science Journal open access, peer-reviewed international journal published by SCIENCEDOMAIN international.(2020)
- Invited reviewer for Basic Research Journal (BRJ) open access, peer-reviewed high impact international journal.
- Invited reviewer for Research Square a web based scientific article editor from language editing, to formatting, to figure preparation. Research Square and developed in partnership with Springer Nature, In Review aims to open up the submission and peer review system to authors and others in the scientific community. The first service of its kind, *In Review* provides authors with on-demand access to the status of their manuscript and allows them to showcase their work to the wider community for comment while their manuscript is under review.(2020)
- Invited proposal reviewer of Department of Biotechnology, Govt. of India. (2020).
- Certificate of Excellence in Reviewing (2020), Asian Food Science Journal

Dr. R. Thomas

- Empanelled as Expert in Meat Plant Inspection Committee by APEDA vide letter no. MPD/ MT/38/ 2018/124 dated 16-04-2018.
- Empanelled as member in FAD 18/P-5 and FAD 18/P-3 panels to review Indian Standards under FAD 18 of BIS to align the same with the corresponding Codex standards and FSSAI regulations and to review the Indian standards older than 20 years in FAD-18 sectional committee.
- Empanelled as member in "Meat and meat products" under FSSAI.
- Associate Editor for Journal of Meat Science
- Member (External) of ITMC of ICAR-National Research Centre on Yak
- Participated and delivered lecture in the National level online workshop on "Mentoring and handholding support on model gram pancahyat/village for NE states" organized by NIRD &PR, Guwahati during 28-30th September, 2020.
- Performed duties as Member, Implementation Committee on Bio-Security in Govt. Nucleus Pig Breeding Farms under APART, Assam from 16th October, 2020.
- Evaluated the MVSc Thesis entitled 'Quality evaluation of ready-to-eat low fat pork sausage incorporated with olive oil, dried apple pulp powder and pomegranate seed powder' by Dr. KeshabDebnath, College of Veterinary Science, CAU, Aizwal in October, 2020.

Dr. Souvik Paul

- 2nd Prize in Hindi Quiz during the celebration of Hindi Pakhwara- 2020, at ICAR-NRC on Pig
- 1st Prize in Hindi Essay Writing during the celebration of Hindi Pakhwara- 2020, at ICAR-NRC on Pig
- 2nd prize in Hindi Debate during the celebration of Hindi Pakhwara- 2020, at ICAR-NRC on Pig
- 2nd prize in Hindi Translation during the celebration of Hindi Pakhwara- 2020, at ICAR-NRC on Pig
- 2nd Prize in Seminar/Lecture during the celebration of 150th birth anniversary of Mahatma Gandhi under SWACCHH BHARAT ABHIYAN at ICAR- NRC on Pig during 26.09.2020 to 02.10.2020
- 2nd Prize in quiz competition during the celebration of 150th birth anniversary of Mahatma Gandhi under SWACCHH BHARAT ABHIYAN at ICAR- NRC on Pig during 26.09.2020 to 02.10.2020
- Acted as reviewer for two journals viz. Small Ruminant Research and Journal of Parasitic Diseases.

Dr. Sunil Kumar

- Acted as a resource person for a lecture delivery on Prospects and potentiality of improving pig farming in NEH region on 9th September, 2020 organized by IDP-NAHEP, College of Veterinary Sciences & Animal Husbandry, Central Agricultural University, Selesih, Aizawl, Mizoram.
- Acted as a eminent speaker for a lecture delivery on Boar semen collection & preservation "on 9th September, 2020 for a short term training course on "Frozen semen technology in domestic animals" organized by Department of Gynaecology & Obstetrics, College of Veterinary Science & A. H., SDAU., Sardarkrushinagar during 7th – 16th July, 2020.

- Acted as a resource person for lecture delivery on Process of collection, processing and evaluation of Boar semen for Artificial Insemination in pigs on 10th November, 2020 in Programme for Entrepreneurship Development Programme (Virtual) on Scientific Pig Production Practices and Value Addition of Pork organized by ICAR- NRC on Pig.
- Acted as a resource person for lecture delivery on 10th November, 2020 in Programme for Entrepreneurship Development Programme (Virtual) on Scientific Pig Production Practices and Value Addition of Pork orgaised by ICAR- NRC on Pig.
- Invited as reviewer for publications by the Journal, The Haryana Veterinarian

Dr. Jaya

- Awarded third prize in Quiz competition in Hindi Pakhwada-2020 organized at ICAR-National Research Centre on Pig, Rani, Guwahati
- Awarded second prize in Hindi Assay competition (Hindi Category) in Hindi Pakhwada-2020 organized at ICAR-National Research Centre on Pig, Rani, Guwahati
- Awarded second prize in Hindi Shruti Lekhan competition (Hindi Category) in Hindi Pakhwada-2020 organized at ICAR-National Research Centre on Pig, Rani, Guwahati
- Awarded first prize in Quiz competition organized on the occasion of 150th birth anniversary of Mahatma Gandhi under Swachh Bharat Abhiyan at ICAR-National Research Centre on Pig, Rani, Guwahati
- Awarded first prize in Drawing and Painting competition organized on the occasion of 150th birth anniversary of Mahatma Gandhi under Swachh Bharat Abhiyan at ICAR-National Research Centre on Pig, Rani, Guwahati
- Awarded first prize in Essay writing competition organized on the occasion of 150th birth anniversary of Mahatma Gandhi under Swachh Bharat Abhiyan at ICAR-National Research Centre on Pig, Rani, Guwahati
- Awarded third prize in the elocution competition on "Vigilant India, Prosperous India" during Vigilance Awareness Week 2020 at at ICAR-National Research Centre on Pig, Rani, Guwahati
- Obtained 100% score in Quiz competition in "National Level Awareness Programme on Biodiversity" organized by PG and Research Department of Zoology, Arulmigu Palaniandavar College of Arts and Culture, Palani.
- Earned "A" Grade for Overall performance in the Foundation Course for ARS probationers.
- Invited for a lecture in the Young Science Leadership Virtual Series Program, Central University of Punjab, Bhatinda
- Awarded with "Publons Academy Mentor" by PUBLONS and Web of Science.

Dr. Satish

- Recognised as "Member of Scientific Advisory Board" of International Journal of Livestock Research on 30th April 2020.
- Awarded with "Graduate of the Publons Academy" and "Certified Publons Academy Peer Reviewer" on15th June 2020

Dr. Ajay Kumar Yadav

- Appreciation award as second best trainee in workshop for Diagnostic approaches in Virology, organized by Indian Institute of Technology, Guwahati from 04-03-2010 to 06-03-2020.
- Nominated as internal expert in Institute Biosafety Committee (IBSC) of ICAR-NRC on Pig by DBT

Dr. Rajib Deb

- Appointed as Associate Editor (Cell and Tissue Engineering Section) in BMC Biotechnology Journal Impact Factor-2.303; NAAS Rating: 8.30)
- Received ICAR-Post Doctoral Fellowship Award 2020 at ICAR-NDRI, Karnal
- Received Young Scientist Award 2020 by National Academy of Environmental Sciences,India
- Membership obtained from International Society of Biometrology, USA on 16—09-2020
- Certified Trainer as animal Health worker (ARG/Q4804)-v1.0 conforming to National Skill qualification framework level-3 under Skill India, National Skill Development Corporation, GOI
- Nominated as external expert for techno-commercial assessment and expert committee meeting for four technologies developed by ICAR-NINAP,Bangalore at Agriinovate India Limited, New Delhi on 17-12-2020
- Received Ram Singh Memorial Animal Welfare National Excellence Award 2020 felicitated by PahudhanPrahareeJournal(ISSN-2319-6971) on 29thJuly, 2020
- Received Elsevier recognition certificate for inclusion in Mendeley advisor community on 15-07-2020
- Acted as nodal officer for Skill India Portal of ICAR- NRC on Pig, Guwahati w.e.f. 01-02-2020 vide office order F.No.357/NRCP/2019-20-3307, dated 31.01.2020.
- Acted as External expert for evaluation of a project submitted under Intensification of Research in High Priority Areas (IRHPA) scheme of Science and Engineering Research Board (SERB), DST, GOI (17-04-2020)

Dr. Salam Jayachitra Devi

- Reviewed an article as a reviewer of the journal – Peer J Computer Science.

Dr. Nitin M. Attupuram

- Secured Third position in Seminar, Essay Writing, Drawing & Painting and Quiz competitions organized at ICAR-NRC on Pig on the occasion of 150th birth anniversary of Mahatma Gandhi.

Dr. Sheikh Firdous Ahmad

- Received Best Research Paper award for publishing two research publications entitled "Revelation of genomic breed composition in a crossbred cattle of India with the help of Bovine50K BeadChip" and "Ancestry informative markers derived from discriminant analysis of principal components provide important insights into the composition of crossbred cattle" published in Genomics journal having Impact factor of 6.205.
- Acted as the resource person in the remedial course on "Evaluation and Conservation of Native Genetic Resources" under IDP-NAHEP, SKUAST-K during Spring Semester, 2020 in the Division of Animal Genetics and Breeding, FVSc& AH, SKUAST-K.

Human Resource Development

Dr. Swaraj Rajkhowa

- Attended the Review Meet of All India Network Project on neonatal mortality (AINP-NM) in farm animals held on 6th January, 2020 at NASC, New Delhi.
- Attended the 3rd Biennial General Conference of AH and Vety. Service Association, Goalpara district Branch held at Goalpara from 18-20th January, 2020. Also acted as Co-Chairman of Technical session on "Äntimicrobial resistance trend: Current and future challenges.
- Attended the meeting of Breed Registration Committee at Krishi Bhawan, New Delhi on 24th January, 2020.
- Attended a brain storming session on Development of pig sector in Assam through breed improvement at Khanapara, Guwahati organized by AH & Vety. Dept., Govt of Assam and ILRI on 30th January, 2020.
- Attended the XXXIII Annual Convention of IAVMI held at IVRI, Izatnagar from 6-7 February, 2020.
- Attended the meeting of DDG (AS) with the Directors of Animal Science Institutes of ICAR at Krishi Bhawan, New Delhi on 6th March, 2020.
- Participated in discussion (with Hon'ble Minister, A.H. & Veterinary, Govt. of Assam) on Preparedness, Control and Containment of African Swine Fever (ASF) suspected in 6(six) districts of the state held in Conference Room , College of Veterinary Science, Khanapara on 26th April, 2020.
- Attended discussion on ASF with the Hon'ble Minister of Agriculture and Veterinary, Govt. of Assam on 2nd May, 2020
- Attended VC (with DADF) on First meeting of Expert Committee on ASF, held on 18th May, 2020.
- Attended VC (with DADF) on 2nd meeting of Expert Committee on ASF, held on 22nd May, 2020.
- Video conference on ASF epidemiology and control with FAO expert through USDA office in New Delhi on 3rd June, 2020.
- Attended VC (on 16th June 2020) to discuss on guidelines and Action plan for control and containment of ASF conducted by Commissioner & Secy, Govt. of Assam, AH & Vety. Department.
- Attended (VC) Preliminary meeting on One Health Approach conducted by the Director, NIAB, Hyderabad.
- Presented EFC of the institute (2020-2025) through VC on 11th June, 2020.
- Attended RCRC Coalitions V open house discussion on Agriculture Extension Priorities during covid time on 3rd July, 2020.
- Participated in Web Conference held on 4th July 2020 at 5-15 PM (held at Animal Health Centre, Khanapara) to discuss on Culling and Disposal Procedure of Pigs along with OIE guideline as Annexure-1, NAP for Control and Containment of ASF issued by the Ministry of Fisheries, Animal Husbandry and Dairying Department of Animal Husbandry and Dairying Government of India, Krishi Bhavan, New Delhi in June 2020.
- Attended review meeting on ASF at Conference hall , C block Janata Bhawan, on 14th July, 2020 in presence of Hon'ble Agri Minister, Govt. of Assam.

- Attended the web meeting (on 7th July, 2020) of the Scientific and Technical Appraisal and Advisory Group (STAG) formed to review the project entitled "Establishment of a Consortium for One Health for addressing Zoonoses, Phase I: towards detection and control of select transboundary and zoonotic diseases" under the Chairmanship of Dr. V.M. Katoch, Ex-DG, ICMR.
- Attended and delivered a lecture (virtual mode) on launching of India's largest piggery development project in Meghalaya by CM, Meghalaya and MoS, Ministry of Agriculture & Farmers Welfare at NCDC, New Delhi.
- Consultative meeting on transportation of live pigs through Assam under the Chairman of Minister, Agriculture and Vety, Govt. of Assam at Dispur on 30th September, 2020.
- Attended Review meeting of Meghalaya Piggery mission (organised by NCDC , New Delhi & Meghalaya Govt.) on 20th October, 2020.
- Attended virtual Interface meeting with Directorate of Animal Husbandry & Veterinary, Govt. of Assam Organized by ICAR-ATARI, Zone-VI, Guwahati on 28thOctober, 2020.
- Attended meeting of the Core Group of Expert formed to aid and advise the Government of Assam in control and containment of ASF will be held on **21st of November, 2020** at 3.00 PM in the Conference Hall of Animal Health Centre (AHC), Khanapara, Guwahati-22 to discuss about some important issues relating to African Swine Fever (ASF).
- Attended Director's and VC conference on 5th December, 2020.
- Attended Strategy Workshop on Emergency Preparedness for Prevention of Transboundary Infectious Disease in Indian Livestock and Poultry organized by NAAS on 19th December, 2020.
- Attended Urgent Meeting of the Core Group of Experts for Control and Containment of ASF at Janata Bhawan, in presence of Agriculture Minister, Govt. of Assam on 18th December, 2020.

Dr. Santanu Banik

- Attended Online Training Workshop for "Vigilance Officers of ICAR Institutes" Organized by ICAR NAARM, Hyderabad during 5-7th August, 2020
- State level farmers fair cum Farmers-Scientists' Interaction on "Farmers' prosperity through doubling farmers' income" organized by ATARI Zone-IV, Guwahati during 26-27th February, 2020.
- Attended National e-Workshop cum Webinar on "Current Perspective of Swine Diseases in India and its Management Practices" held from 11-12 Jan., 2021, at ICAR-NRC on Pig. (Acted as Organizing Secretary & rapporteur).
- Attended the third QRT meeting of ICAR Research Complex for Eastern Region, Patna at ICAR-ATARI, Kolkata on 28th January, 2020.
- Attended meeting with officials of Assam State Veterinary Department for finalization of state pig breeding policy of Assam on 30th January, 2020 at ILRI, Guwahati.
- Attended online meeting for preparation of Mithun breeding policy organized by ICAR-NRC on Mithun, Medziphema, Nagaland on 24th September, 2020.
- International Webinar on "Recent Challenges and Opportunities in Swine Production" on 3rd December, 2020 organized by Tamil Nadu Veterinary and Animal Sciences University, Chennai.
- EFC/SFC meeting of ICAR-NRC on Yak, Dirang through VC was organized on 12th June 2020 under the Chairmanship of Dr. B.N. Tripathi, Deputy Director General (Animal Science).
- EFC/SFC meeting of ICAR-NRC on Pig, Rani, Guwahati through VC was organized on 11th June 2020 under the Chairmanship of Dr. B.N. Tripathi, Deputy Director General (Animal Science).

- IMC meeting of ICAR-NRC on Yak held at ICAR-NRC on Pig, Guwahati on 2nd March, 2020
- Meeting with Hon'ble Agriculture Minister of Assam for development of pig improving policies in the state 20th February, 2020.
- Meeting with officials from British Pig Association and NE Sate Govt. for import of exotic pig at Guwahati 31st January, 2020.

Dr. Mohan N. H.

- Attended Management Development Programme on Leadership Development (Pre-RMP 2020) from 08-19 December 2020organised by ICAR-NAARM, Hyderabad.
- Attended Webinar on Introducing Upconversion Nanoparticles for Fluorescence Microscopy by Dr. Yiqing Lu, ARC Centre for Nanoscale BioPhotonics (CNBP)School of Engineering Macquarie University, Sydney, Australia 0n 08.07. 2020
- Attended Webinar on African Swine Fever: Its Socio-Economic Impact. Organised by College of Veterinary Science, Assam Agricultural University on 20.06.2020.
- Attended Webinar on flow cytometry on on flow cytometry, jointly organised by DIHAR, DRDO and Beckman Coulter on 14-15 Sept 2020.
- Attended Webinar on Prospect of animal husbandry sector in milieu of AtmnirbharBharat organised by ANDUAT, Faizbad on 27.06.2020
- Online workshop on KRISHI portal of ICAR for Scientists of ICAR-NRC on Pig on 21-8-2020
- Biosafety awareness programme for Scientists and staff of ICAR-NRC on Pig on 30-8-2020
- Fourth Institutional Biosafety Committee (IBSC) meeting of ICAR-NRC on Pig and first meeting of newly constituted committee was held on 31st August 2020.

Dr. P. J. Das

- Participated& deliver invited lecture webinar Lecture Series on "Strategies to improve pig production at present arena "organized by Institute Technology Management Unit (ITMU), ICAR-Central Island Agricultural Research Institute, Port Blair, A&N Islands, India to be held from 26th on 7th December 2020.
- Attended Webinar on International Conference on Innovations in Biotechnology and Life Sciences" has been scheduled from 18th -28th December, 2020, organized by Department of Biotechnology, Delhi Technological University, Delhi, India.
- Attended interactive session on virtual conversation entitled "'Management Rules, Rather No Rules, for Successful Enterprises" on 18th December 2020 organized by Netflix India (INVESTINDIA.GOV.CO.IN).
- Participated and act as Panellist for webinar on "Evidential Online News Content: An integral part of Research and Library e-Resources" organized by Webinar on International Resources with Experts (WIRE), a digital webinar based interaction, an initiative of Balani Infotech to encourage and engage knowledge on 19th November 2020.
- Attended & deliver lecture Entrepreneurship Development Programme (Virtual) on Scientific Pig Production Practices and Value Addition of Pork, held 10th November, 2020, organized by ICAR-NRC on Pig.
- Attended National Webinar on 'Present Challenges and Future Prospects of Dairy Sector in Eastern India' organized on 17th October 2020 by ERS of ICAR-NDRI.

- Participated in 14 days webinar series on "Intellectual Property Rights in Agricultural Research & Education in India" jointly organizing by National Agricultural Higher Education Project & Intellectual Property and Technology Management Unit, ICAR, from 12-28th September 2020 by online platform.
- Attended "Webinar on the Response of the DBT's Autonomous Institutes to COVID-19 - Part-I, Part-II & Part-III". Organized by India Alliance on Aug 21, 2020, Oct 16, 2020.
- Deliver invited lecture online lecture on "Scientific and low cost Pig Husbandry" for the tribal pig farmers/stakeholders of boarder areas organized by Seemanta Chetana Mancha Purvottar on 16th August 2020, from 11.00-12.00 Noon.
- Organized & Participated webinar on "African Swine Fever Sensitization Program" for pig farmers & stakeholders by ITMU, ICAR-National Research Centre on Pig on 10th June 2020. A total of 26 nos. of pig farmers and stakeholders were attended the webinar (Coordinator).
- Act as organizing Secretary for the one day workshop on "Sensitization of Institute Technologies available for Economic Pig Farming and its commercialization Prospect" organized by Institute Technology Management Unit of ICAR-National Research Centre on Pig on 7th March 2020.
- Participate & deliver invited lecture in Farmers' Innovation Expo-2020 held at College of Agriculture Kyedemkulai, Meghalaya-793105, on 5th March 2020.
- Participated in the Exhibition as core-committee member in the STATE LEVEL FARMERS FAIR on the theme "Farmers Prosperity through Doubling Farmers' Income" organized by ICAR-ATARI held on 26th and 27th Feb. 2020 at playground of Horticulture Research Station, AAU, Kahikuchi, and Guwahati Assam.
- Participated& deliver invited lecture in 5TH *UTTAR PRADESH AGRICULTURAL SCIENCE CONGRESS*. Focusing on Enhancing Farmer's Income and Water Conservation: Opportunities and Challenges held from February 22-24, 2020 at Institute of Agricultural Sciences, Banaras Hindu University, Varanasi, UP.
- Attended & deliver invited lecture ITMU workshop at ICAR-NRC on Yak. Two days workshop held at ICAR-National Research Centre on Yak from 12-14th Feb. 2020.

Dr. R. Thomas

- National workshop on 'Quality and safety challenges in foods of animal origin' on 28th January, 2020 organized by NetSCoFAN, FSSAI and ICAR-National Research Centre on Meat.
- Delivered lecture in the webinar on 'Pig farming- An emerging opportunity for livestock diversification and income augmentation' organized by College of Veterinary Science, GADVASU, Ludhiana.
- Attended the ITMC meeting of ICAR-NRC on Yak as Member (External) on 19-08-2020.
- Attended the FSSAI's FAG meeting (virtual) under NetSCoFAN organized by ICAR-NRC on Meat.
- Attended 35th GB meeting of the ARIAS Society on 25th August, 2020 at Administrative Staff College, Guwahati.
- Attended 14th meeting (virtual) of FSSAI's Scientific Panel on meat and meat products on 18th September, 2020.
- Participated in CHIFSS e-stakeholder meeting on 'Building resilient food systems for the future' on 26th August, 2020.
- Participated in the 8th meeting of State Project Coordination Committee of World Bank funded APART project on 8th June, 2020 at Agriculture Complex, Guwahati.

- Participated in the 14 days virtual workshop-cum-training on "Intellectual property rights in Agricultural Research & Education in India" organized by NAHEP cell of ICAR during 12-28 September, 2020.
- Participated and presented abstract in the International e-conference on 'Recent Advances and Status of Wildlife Forensics' organized by LaCONES, CSIR-Centre for Cellular and Molecular Biology, Hyderabad during 3-5th November, 2020.
- Represented the institute and provided the required inputs in the 40th Meeting of "Scientific Panel on Meat and Meat Products" under FSSAI on 18-09-2020 held through virtual mode.
- Represented the Institute in FAD -18 Sectional Committee meeting of Bureau of Indian Standards (BIS) to review Indian Standards under FAD 18 to align the same with the corresponding Codex Standards and FSSAI regulations.
- Sincere efforts were taken in the past and still continuing with Agricultural and Processed Food Products Export Development Authority to enhance export of fresh pork and pork products from India.
- Represented the institute in FAD 18/P-5 and FAD 18/P-3 panels to review Indian Standards under FAD 18 to align the same with the corresponding Codex standards and FSSAI regulations and to review the Indian standards older than 20 years in FAD-18 sectional committee.
- Represented the institute as member of inspection team of APEDA to assess the infrastructure developed at Export Oriented Pork Processing Unit at Nazira, Sivasagar, Assam.
- Delivered lecture in the International e-conference on 'Recent Advances and Status of Wildlife Forensics' organized by LaCONES, CSIR-Centre for Cellular and Molecular Biology, Hyderabad during 3-5th November, 2020 (Virtual mode).
- Delivered lecture as key speaker to the participants in the 'Skill development training programme on pig production and pork processing' under NAHEP scheme of ICAR organized by CVSc, Khanapara on 20th November, 2020.
- Delivered lecture as key speaker in the National level online workshop on "Mentoring and handholding support on model gram pancahyat/village for NE states" organized by NIRD &PR, Guwahati during 28-30th September, 2020 (Virtual mode).
- Delivered lecture as key speaker in the webinar on 'Pig farming- An emerging opportunity for livestock diversification and income augmentation' organized by College of Veterinary Science, GADVASU, Ludhiana.

Dr. J. Doley

- Attended International Virtual Workshop Series on Regulatory Approaches for Animal Biotechnology w.e.f. Sept 23, 24 -2020 on Genome editing regulatory approaches organized by the International Service for the Acquisition of Agri-biotech Applications (ISAAA).

Dr. Rajib Deb

- Training of Trainers (TOT) programme for KVK/SAUs/ICAR Institutes organized by Agriculture Skill council (ASCI) of India in collaboration with ICAR-ATARI, Kanpur nominated by ICAR-NRCP, Guwahati vide letter no. File No.79/NRCP/2018-19 3188, dated 05.02.2020(13-15th Feb, 2020)
- Intellectual Property Rights in Agricultural Research & Education in Indiaduring 12-28 September, 2020 organized by IP&TM Unit, ICAR,KAB - I, Pusa,New Delhi - 110 012

- Organised Nodal officer & Coordinator- Agriculture Skill development training program on "Scientific Pig Farming" under the RKVY Scheme, Ministry of Skill Development & Entrepreneurship, Government of India from 25th Feb-31st March, 2020 at ICAR-NRC on Pig, Rani, Guwahati, Assam (36 days)

Dr. Kalyan De

- Participated in "Webinar on ASF: Its Socio-Economic Scenario" organized by CoVSc, AAU, Khanapara on 20.06.2020
- Paricipated in webinar on "Post Pandemic challenges and opportunities in Animal Health" organized by CoVSc, SVPUAT, Meerut on 14.08.2020
- Participated on "Interactive Workshop – ICAR Research data repository for knowledge management- KRISHI PORTAL Virtual Workshop" organized by ICAR on 21.08.2020
- Participated in webinar on "Climate-smart Livestock Production in India" organized by WBUAFS, Kolkata on 05.08.2020-07.08.2020
- Participated in webinar on "Impact of COVID-19 on Dairying, Poultry and Fisheries: National Perspective" organized by Indian Journal of Animal Health, Kolkata on 29.08.2020
- Participated and delivered lecture in "African Swine Fever Sensitization Program" with pig farmers and stakeholders" organized by ICAR NRC on Pig on 09.06.2020
- Participated and delivered lecture in "Online training Program on A.I in Pig for Nalbari and Baksa" organized by ICAR NRC on Pig on 29.06.2020 to 01.07.2020.
- Participated and delivered lecture in "Scientific Pig Production in intensive system for Sustainable Livelihood" organized by ICAR NRC on Pig during 06.07.2020 to 10.07.2020
- Participated and delivered lecture in "Online awareness program on A.I in Pig farmers" organized by ICAR NRC on Pig during 17.10.2020 for Majuli; 20.10.202 for Kukurmara.
- Participated and delivered lecture in "Online Training program on A.I in Pig" organized by ICAR NRC on Pig during 21.10.2020 – 23.10.2020.

Dr. Sunil Kumar

- Clinical use of antibacterial in Veterinary Practices: an Overview organized by WBUA&FS in collaboration with Alembic Pharmaceuticals Ltd. On 25th July, 2020.
- Attended National webinar on "Applications of Flow cytometry in Semen Analysis" from 21-22 July, 2020 organized by SRS, ICAR-NDRI, Bengalore.
- Participated as delegate in the National Webinar on Advanced Technologies for the Study of Testis Function and Male Germ Line Stem Cells organized by Indian Society for the Study of Animal Reproduction on 11-07-2020
- Participated in webinar "Basic to Recent Advances in Veterinary Andrology organized by Lakhimpur College of Veterinary Science, Assam Agricultural University, Joyhing, North Lakhimpur – 787051 on 19-20 Sept., 2020.
- Participated in National Webinar on "Mitigating the Challenges in Animal Reproduction Sector" held on December 13, 2020 organized by Dept. of Animal Reproduction, Gynaecology & Obstetrics, College of Veterinary Science & Animal Husbandry, Odisha University of Agriculture & Technology.
- Participated in online workshop on Flow Cytometry Techniques & Applications on 21-22 December, 2020 organized by NECBH

- Participated in online workshop on "Flow Cytometry Techniques & Applications" on 21st -22nd December 2020 jointly organized by NECBH, IIT Guwahati and BD (Becton, Dickinson and Company).
- Participated in ICAR Research Data Repository for Knowledge Management: KRISHI Portal Virtual Workshop organized by NRC on Pig on August 21, 2020
- Participated in a 5 - Day Online National Training on Entrepreneurship Development held from 7th - 11th September, 2020 organized by IDP – NAHEP, College of Veterinary Sciences & Animal Husbandry, Central Agricultural University, Selesih, Aizawl, Mizoram
- Attended National training on Design Thinking in Research Project Formulation and Implementation (Online Training) organized by NAARM from 25-29.08.2020

Dr. Jaya

- Attended Online training programme on "Climate change: Challenges and Response" for women scientists organised by Centre for Disaster Management, Lal Bahadur Shastri National Academy of Administration, Mussoorie in collaboration with DST (5-10-2020 to 09-10-2020)
- Attended "International Virtual Workshop Series on Regulatory Approaches for Animal Biotechnology" 2020 organized by International Organizing Commitee of ISAAA and Virginia Tech, USA.
- Attended Online training programme on "Analysis of experimental data using SAS" conducted by ICAR-NAARM, Hyderabad (9-11-2020 to 14-11-2020)
- Attended Online training programme on "Advanced bioinformatics tools and its applications in agriculture" conducted by ICAR-NAARM, Hyderabad (07-12-2020 to 11-12-2020)

Dr. Satish Kumar

- Attended online training programme on *"Advanced Bioinformatics tools and its Applications in Agriculture"* organized by ICAR-NAARM, Hyderabad during 07-11 December, 2020.
- Participated in Online National Seminar on *"Big Data Analytics in Agriculture"* organized by ICAR-NAARM, Hyderabad during 10-11 December, 2020.
- Attended online training programme on *"Analysis of Experimental Data using SAS"* organized by ICAR-NAARM, Hyderabad during 09-17 November, 2020.
- Certificate of Excellence by Researcher Academy, Elsevier, for completing every module within "Certified Peer Reviewer Course" on 18th May 2020.
- Completed the Self-learning Online Course on "Understanding Open Educational Resources" offered by Commonwealth of Learning, Canada on 2nd May 2020
- Participated in the online National Workshop on "Footprint of Ideal Research Methodology" conducted by College of Veterinary Science & A.H., Rewa (M.P.) during 11th to 14th August, 2020.
- Participated in 10 days webinar lecture series on "Bioinformatics and Statistical tools in Livestock research" organized by ITMU, ICAR-Central Island Agricultural Research Institute, Port Blair, India from 16th – 25th November 2020.
- Attended the Science Leadership Workshop organised by the central University of Punjab, Bathinda, India from 22nd to 28th June 2020.
- Participated in National Webinar on "Lesser-Known Animal Genetic Resources of India: An Overview" held at ICAR-NBAGR, Karnal on 05/10/2020.

- Participated in the Two Day's National Webinar on "Concepts of Statistical Methodologies in Animal Sciences" organised by Department of Animal Genetics and Breeding, LCVSc, AAU, Joyhing, North Lakhimpur, Assam on 26th and 27th September 2020.
- Attended the Online Workshop on "Scientific Writing and Research Ethics" for Veterinary and Animal Science Community, organized by DBT/Wellcome Trust India Alliance on 14 August 2020.
- Attended Wiley Author Webinar Series on "Learn to Publish" conducted by Wiley during June-July 2020.
- Attended the virtual global summit on "Artificial Intelligence: Responsible AI for Social Empowerment (RAISE2020)" organised by Ministry of Electronics & Information Technology, India during 5-9 October, 2020.
- Attended International e-Conference on "Expanding Horizons in Physio-Biochemical and Molecular Approaches for Improving livestock health and production" organised by the Department of Veterinary Physiology and Biochemistry, Veterinary College and Research Institute, Orathanadu, Thanjavur, Tamil Nadu, India during 19th – 20th October, 2020.
- Participated in the International Webinar on "Present and future trends in conservation and breeding technologies to enhance production in indigenous animals" organised by the Department of Animal Genetics and Breeding, Veterinary College and Research Institute, Tirunelveli, Tamil Nadu, India on 15.12.2020
- Participated in the National web conference on "Enhancing Livestock Productivity for Food Security through Advance Genetics and Reproductive Techniques" organized by Bihar Agricultural University, Sabour, Bhagalpur held on September 30, 2020.
- Participated in Webinar on "African Swine Fever: Its Socio-Economic Impact" organised by College of Veterinary Science, Assam Agricultural University Khanapara, under the aegis of NAHEP on 20th June 2020.

Dr. Misha Madhavan M

- Participated in the International Webinar Series on "Emerging Trends in Extension and Social Sciences Research" jointly organized by Multi-Technology Testing Centre & Vocational Training Centre, College of Fisheries, Central Agricultural University (Imphal), ICAR-NAARM, Hyderabad and ICAR-CTCRI, Kerala, India, during 10 to 16 June 2020.
- Participated in Webinar series on "Quantitative Methods for Social Sciences" from June 1-20, 2020 organized by ICAR-National Institute of Agricultural Economics and Policy Research
- Attended workshop on "Sensitization of institute technologies for economic pig farming and its commercialization prospect" on 7th March 2020, Organized by ITMU, ICAR-NRC on Pig

Dr. Ajay Kumar Yadav

- Attended XXXIII annual convention of Indian Association of Veterinary Microbiologists Immunologists and specialists in infectious diseases and National Conference on 'Challenges and Threats of Microbes to Animals and Humans' 6-7 February, 2020 held at ICAR-Indian Veterinary Research Institute, Izatnagar Bareilly, Uttar Pradesh.
- Attended three days workshop for Diagnostic approaches in Virology, organized by Indian Institute of Technology, Guwahati from 04/03/2020 to 06/03/2020.
- Attended National Webinar on "Laboratory Biosafety with special reference to COVID-19 Diagnosis" organized by Department of Veterinary Microbiology, College of Veterinary Science and Animal Husbandry, Jabalpur (M.P.) on 19th June 2020 through virtual platform.

- Attended online webinar on "African Swine Fever: Its Socioeconomic Impact" organized by College of Veterinary Science, Assam Agriculture University under the aegis of NAHEP on 20th June, 2020.
- Participated in online national workshop "An Insight to Research Proposals, Statistical Techniques and Intellectual Property Rights" organised by College of Veterinary Science and Animal Husbandry, Mhow from 26 to 28 June 2020.
- Attended International e-Conference on "Immunology in 21st Century for Improvising One-Health" organized by College of Biotechnology, Sardar Vallabhbhai Patel University of Agriculture & Technology (SVPUAT), Meerut, India and Department of Animal Husbandry and Dairying (DAHD), Govt. of India, New Delhi during 7th – 8th August, 2020 through virtual platform.
- Participated in the webinar on "Post Pandemic challenges and opportunities in Animal Health" organized by College of Veterinary & Animal Sciences, Meerut, Uttar Pradesh on August 14, 2020.
- Attended one day Webinar on "Wildlife and Human Conflict: A long Journey Ahead" organized by Society of Immunology and Immunopathology on 16, August, 2020.
- Attended one day webinar on "Response of the DBT's Autonomous Institutes to COVID-19-Part-I" organized by India Alliance on 21st August, 2020.
- Participated in the webinar on "Microbiome, Immunity and Vaccines" organized by Indian Association of Veterinary Microbiologists, Immunologists & Specialists in Infectious Diseases (IAVMI) on August 30, 2020.
- Attended one day webinar on "Response of the DBT's Autonomous Institutes to COVID-19-Part-II" organized by India Alliance on 10th September, 2020.

Dr. Salam Jayachitra Devi

- Attended National Webinar on Present Challenges and Future Prospects of Dairy Sector in Eastern India" dated 17th October 2020.
- Attended National Webinar on Climate Resilient Livestock Production: Opportunities and Threats organized by ICAR-National Institute of Abiotic Stress Management, Baramati, India on November 03, 2020.
- Attended online training program on "Analysis of Experimental Data Using SAS" organized by ICAR-NAARM, Hyderabad during 09-17 November, 2020. File No. 60/NRCP/2020-21.
- Attended Generic Online Training in Cyber Security dated on December 16, 2020, organized by the Ministry of Electronics and Information Technology (MeitY), Government of India.

Dr. S.F. Ahmed

- Successfully completed 5-days online training programme on "Advanced Bioinformatics tools and its Applications in Agriculture" (SKILL-BIF, ICAR-NAARM) organized by ICAR-NAARM, Hyderabad during 07-11 December, 2020.
- Participated in 10-days webinar lecture series on "Bioinformatics and Statistical tools in Livestock research" organized by Institute Technology Management Unit (ITMU), ICAR-Central Island Agricultural Research Institute, Port Blair, India from 16-25 November, 2020.
- Attended 9-days online training programme on "Analysis of Experimental Data using SAS" organized by ICAR-NAARM, Hyderabad during 09-17 November, 2020.

- Participated in 16-days workshop on "ABC of Scientific Writing" during 18th August to 2nd September, 2020 organized by Krishi Vigyan Kendra, ICAR-National Rice Research Institute, Cuttack.
- Attended ten-days training programme on "Understanding Biometrical Genetics: Statistical Maneuvering towards ensuring food security from 7th to 16th September, 2020 organized by Dryland Agriculture Research Station (DARS) under IDP-NAHEP, SKUAST-Kashmir.
- Successfully completed ten days online training programme on "Achieving zero hunger by 2030: Critical role of Agriculture and Allied Sectors" from 17-27 August, 2020 organized by FVSc& AH, SKUAST-Kashmir, Shuhama, Srinagar, J&K.
- Participated in 5-days online training programme on "Google Suite for E-learning" from September 21-25, 2020 organized by Agricultural Research Information Systems (ARIS), SKUAST-K.

Dr. Nitin M Attupuram

- ICAR- National Agricultural Higher Education Project sponsored training programme on "Science communication for smart scholars" by ICAR- CIFE, Mumbai from 26th May to 8th June, 2020
- Professional Attachment Training under the mentorship of Dr. E. Sreekumar (Scientist F) at Rajiv Gandhi Center for Biotechnology, Thiruvananthapuram from 12th June to 11th September, 2020.
- ICAR-National Agricultural Higher Education Project webinar on "Impact of COVID-19 on Dairy & Food Processing Sector" by Anand Agricultural University on 16th & 17th June, 2020
- Online training webinar on "Inferring Co-Expressing Genes and Regulatory Networks from RNA-Seq Data" by University of Cambridge on30th July, 2020
- National Webinar on "Applications of Flow Cytometry in Semen Analysis"by ICAR- NDRI, SRS-Bengaluru, from 21st to 22nd July, 2020.
- Webinar on "COVID-19 & Animal Health Industry" conducted by Kerala State Veterinary Council, Peroorkada on 1st of August, 2020
- Training on "Bio-computational Interventions to Analyze Canine & Livestock Genomes" organized by College of Animal Biotechnology, Guru AngadDev Veterinary and Animal Sciences University (GADVASU), Ludhiana, Punjab, India, from 6th to 9th October 2020.
- One year "Certified Livestock Advisor" programme jointly organized by MANAGE, Hyderabad and ICAR-CIRC, Meerut.
- Postgraduate Diploma in "Therapeutic Management of Infectious diseases" conducted by Kerala Veterinary & Animal Sciences University, Pookkode.
- Co-presented session on "Housing and management of Boars, Sows and Gilts during extreme winter and summer" for the training programme entitled "Training on artificial insemination in pig" on 14th and 22nd October 2020
- Presented session on "Scientific Management practices to be followed in pig farm" for the training programme entitled " Programme for Entrepreneurship development (Virtual) on Scientific Pig Production Practices and Value addition of Pork" on 10th November, 2020

Research Programmes & Projects

S N	Project title	Principal Investigator
Flagship programme		
1	Artificial Insemination in Pigs	Dr. Sunil Kumar
Programme-1: Conservation and genetic improvement of indigenous pigs		
2	Generation-wise genetic evaluation of rani crosses (Project code: IXX14634)	Dr. S.Banik
3	Phylogenetic analysis of pig mitochondrial genome sequences of native pigs of North East India (Project code: IXX13503)	Dr. P. J. Das
4	Characterization and expression profiling of Pig MSY (male-specific region of Y chromosome) genes for boar fertility. (Project code: IXX14211)	Dr. P. J. Das
5	Exploring Genetic Variability in different candidate genes and their association with reproduction and production traits in pigs (Project code: IXX14968)	Dr. Satish Kumar
6	Molecular characterization of indigenous pig breeds	Dr. Satish Kumar
Programme-2: Optimization of physiological and reproductive efficiency including identifying markers for early detection of fertility		
7	Preservation of boar semen using different additives in liquid and frozen state (Project code: IXX15357)	Dr. R. Islam
8	Development of early fertility markers in pigs (Project code: IXX12418)	Dr. Mohan. N. H.
9	Physic-genomic responses and MCT profiling of exotic and Indigenous pig breeds in heat stress during different seasons	Dr. B.C.Das
10	Regulation of ovarian function by locally produced immunogenic and angiogenic growth factors in pigs.	Dr. Jaya
11	Propagation of Artificial Insemination for establishment of multiplier units and optimizing reproductive efficiency in pigs at farmers' field (Project code: IXX15356)	Dr. Sunil Kumar
12	Investigations of NOTCH signaling in the regulation of porcine ovarian functions. (Project code: IXX15358)	Dr. Jaya
Programme-3: Characterization of production system, feeding practices and their optimization for enhancing pig production, especially under field conditions		
13	Development of vegetable waste/fruit waste based pig feeds (Project code: IXX14389)	Dr. Kesab Barman
14	Development of molecular diagnostic tool for rapid detection of mycotoxins in pig feeds (Project code: IXX13618)	Dr. Keshab Barman
15	Ethogram development and welfare assessment of growing Desi and crossbred pig (Project code: IXX15343)	Dr. Kalyan De

Programme-4: Continuous monitoring, recording of pig diseases and development of disease management protocol		
16	Studies on zoonotic pathogens of porcine origin with special reference to Salmonella, Campylobacter and Staphylococcus species (Project code: IXX11238)	Dr. S. Rajkhowa
17	Development of loop mediated isothermal amplification (LAMP) assay for rapid detection of important zoonotic bacterial pathogens of pigs	Dr. S. Rajkhowa
18	Development of rapid laboratory and field assays for microbiological quality assessment of pork	Dr. S. Rajkhowa
19	Prevalence study of helicobacter infection in pigs with particular reference to gastritis (Project code: IXX12312)	Dr. Seema Rani Pegu
20	Evaluation of antimicrobial efficacy of Typhonium trilobautum Schott Tuber Extract against important bacterial pathogens ssociated with respiratory tract infections in pigs	Dr. Seema Rani Pegu
21	Development of IRT image based system for examination health status of pigs.	Dr. P. J. Das
22	Expression, characterization and evaluation of diagnostic potential of Nucleocapsid/Matrix/GP5/Non-structural protein7 (nsp7) of porcine reproductive and respiratory syndrome virus (PRRS)	Dr. Ajay Kumar
23	Development of CD163 host receptor based sero-diagnostic for early detection of porcine respiratory and reproductive syndrome virus (Project code: IXX15355)	Dr. Rajib Deb
24	Molecular and Serological detection of Porcine Parvovirus (PPV) and its characterization (Project code: IXX15348)	Dr. J. Doley
25	Epidemiology of protozoan diseases with special reference to cryptosporidia and coccidia in neonatal piglets.	Dr. Souvik Paul
26	Sero-prevalence and molecular epidemiology of important porcine viral diseases in pigs in northeastern part of India with special reference to Assam (Project code: IXX15395)	Dr. S. R. Pegu
27	Epidemiology, patho-physiology and development of nucleo-diagnostics against porcine corona viruses from North-Eastern India (Project code: IXX15394)	Dr. A. K. Yadav
Programme–5: Technology upgradation of post-harvest handling, processing and value addition of pig products		
28	Development of pork based ready to serve functional products (Project code: IXX13650)	Dr. R. Thomas
29	Optimizing the processing conditions to prevent the occurrence of selected FSSAI used food born pathogens in pork and pork products and to develop mitigation strategies. (Project code: IXX15319)	Dr. R. Thomas
Programme-6: Institute-stakeholder linkages and skill development		
30	Out Reach programme under TSP	Dr. B. C. Das
31	Out Reach programme under SCSP	Dr. S. R. Pegu
32	Fostering the adoption of scientific pig production practices among small holders in Assam	Dr. M. Madhavan

LIST OF EXTERNALLY FUNDED RESEARCH PROJECTS

SN	Name of the project	Principal Investigator	Funding agency
1	Setting up of quality control laboratory	Dr. R. Thomas	MoFPI, Govt. of India
2	DBT-NER centre for Advanced Diagnostics and services on Animal Health and diseases(ADSAHD)	Dr. S. Rajkhowa	DBT, Govt. of India
3	Network Project on Neonatal Mortality	Dr. S. Rajkhowa	ICAR
4	All India Coordinated Research Project on Pig: KVK, ICAR-NRC on Pig centre	Dr. S. Banik	ICAR
5	National Mission for Sustaining the Himalayan Agriculture	Dr. K. Barman	MoEF, Govt. of India
6	Image based systems for identification of individuals, breeds and diseases of pigs and goats	Dr. S. Banik	ITRA, Govt of India
7	e-Varaha: Information System for Safe Pork Production in North Eastern India	Dr. P. J. Das	ITRA, Govt of India
8	Molecular epidemiology of Japanese Encephelitis virus in pigs and mosquitoes in Assam	Dr. Seema Rani Pegu	DBT, Govt. of India
9	Development of Rapid Laboratory and Field Based Assays for Microbiological Quality Assessment of Pork	Dr. S. Rajkhowa	DBT, Govt. of India
10	MicroRNA mediated regulation of physiological responses during heat stress in pigs	Dr. N. H. Mohan	ICAR-LBS Award Project
11	Development of thermo-tolerant pig through biomarker assisted selection	Dr. N. H. Mohan	ICAR-National Fellow Project
12	Farm-to-Fork Risk profiling of hazards associated with pork supply chain in India, developing a database on hazards and associated unique pig husbandry / processing practices, developing food safety interventions towards reducing hazards and effective risk communication strategies as guidance to the industry	Dr. R. Thomas	ICAR-LBS Award Project
13	Maize production in NEH region for sustainable livestock production	Dr. K. Barman	ICAR-Indian Institute of Maize Research
14	Technical Advisory Services for Piggery Value Chain Improvement in Assam, under the World Bank financed Assam Agribusiness and Rural Transformation Project (APART)	Dr. R. Thomas	APART, Govt. of Assam
15	Kisan Biotech Hub	Dr. S. Banik	DBT
16	Biochemical characterization of seminal gel and its application for bio-stimulation in pigs	Dr. Sunil Kumar	DBT
17	Pork marketing chains in North East India for sustainable livelihood of tribal women (Assam, Meghalaya and Nagaland)	Dr. Misha Madhavan M	NASF
18	DBT-Biotech Kisan Hub	Dr. Swaraj Rajkhowa	DBT

Personnel

ICAR-NRC ON PIG

Research Management Position

Dr. Swaraj Rajkhowa, Ph.D., Director (Acting)

Dr. Vivek Kumar Gupta, Ph.D. has joined as Director, ICAR-National Research Centre on Pig, Guwahati on 19th January, 2021.

Scientific staff

Dr. B.C Das, Ph.D., Principal Scientist (Animal Physiology)

Dr. Santanu Banik, Ph.D., Principal Scientist (Animal Genetics & Breeding)

Dr. Keshab Barman, Ph.D., Principal Scientist (Animal Nutrition)

Dr. Mohan N. H., Ph.D., Principal Scientist (Animal Physiology)

Dr. Rafiqul Islam, Ph.D., Principal Scientist (Animal Reproduction and Gynecology)

Dr. Pranab Jyoti Das, Ph.D., Senior Scientist (Animal Genetics & Breeding)

Dr. Rajendran Thomas, Ph.D., Senior Scientist (Livestock Products Technology)

Dr. Seema Rani Pegu, Ph.D., Sr. Scientist (Veterinary Pathology)

Dr. Souvik Paul, Ph.D., Scientist (Veterinary Parasitology)

Dr. Juwahar Doley, Ph.D., Scientist (AnimalBiotechnology)

Dr. Rjib Deb, Ph.D., Scientist (Animal Biotechnology)

Dr. Kalyan De, Ph.D., Scientist (Livestock Production and Management)

Dr. Sunil Kumar, Ph.D., Scientist (Animal Reproduction and Gynecology)

Dr. Satish Kumar, M.VSc., Scientist (Animal Genetics & Breeding)

Dr. Jaya, M.VSc., Scientist (Animal Physiology)

Dr. Misha Madhavan M., Ph.D., Scientist (Agricultural Extension)

Dr. Ajay Kumar Yadav, Ph.D., Scientist (Veterinary Microbiology)

Dr. Sheikh Firdous Ahmed, M.V.Sc., Scientist (Animal Genetics & Breeding)

Dr. Nitin M Attupuram, Ph.D., Scientist (Livestock Production & Management)

Dr. Salam Jayachitra Devi, M. Tech., Scientist (Computer application & Information Technology)

Technical staff

Dr. Anil Kumar Das, Senior Technical Assistant

Dr. Gagan Bhuyan, Senior Technical Assistant

Dr. Rajib Kumar Das, Senior Technical Assistant

Shri Siba Chandra Deka, Senior Technician

Shri Kailash Choudhury, Senior Technician

Shri Rana Pratap Kakati, Senior Technician

Administrative staff

Shri. P. K. Nayak, Asst. Finance and Accounts Officer

Shri. Uttam Prakash, Assistant Administrative Officer

Smt. Jonali Nath, Upper Division Clark

Ms. Hira Moni Thakuria, Jr. Stenographer cum Computer Operator

Supporting staff

Shri Naren Chandra Deka, Skilled Supporting Staff

Shri Ratul Baishya , Skilled Supporting Staff

Krishi Vigyan Kendra, Dudhnoi

Dr. Santosh Baishya, Ph.D, Principal Scientist & Head

Dr. Hitu Choudhury, Ph. D., ACTO, Animal Science

Dr. Biswajit Dey, Ph.D., ACTO, Horticulture

Dr. Utpal Kumar Bhattacharyya, Ph.D., ACTO, Plant Protection

Dr. Hari Charan Kalita, Ph.D., ACTO, Agronomy

Mrs. Poli Saikia, SMS, Home Science

Er. Benjamin Kaman, Programme Assistant, Soil and Water Conservation Engineering

Mrs. Minakshi Barah Kaman, Programme Assistant, Home Science

Mrs. Mousumi Bhuyan, Programme Assistant, Horticulture

Ms. Kabyawati Rabha, Junior Stenographer cum Computer Operator

Mr. Mrinal Baruah, Senior Technician (Driver)

Mr. Jayanta Choudhury, Technician, Tractor Driver cum Mechanic

Mr. Dhruba Lachan Rabha, Skilled Supporting Staff

Mr. Jitumani Kalita, Skilled Supporting Staff

Publications

Research papers

A. ICAR-National Research Centre on Pig

Barman, K., Banik, S., Kumar, S., Thomas, R., Konwar, D., Girish P.S., Anil Kumar Das ,D.K. Sarma and Swaraj Rajkhowa. 2020. Effect of supplementation of 'Diakur plus' on growth and nutrient utilization in crossbred (Hampshire x Ghungroo) piglets. Trends in Bioscience Journal, 13(2): 75-79.

Barman, K., Banik, S., Pegu, S.R., Kumar, S., Konwar, D., Das, P. J., , Rahman, J.I., Das, A.K., Rajkhowa, S., Jat, S.L. and Rakshit, S. 2020. Effect of supplementation of HQPM-1 maize grain on production performancesin cross bred (Hampshirex Ghungroo) grower pigs. International Journal of Curren*t Microbiology and* Applied Sciences. 9 (8): 1762-1767.

Barman, K., Banik, S., Pegu, S.R., Kumar, S., Rahman, J.I., Das, A.K., Rajkhowa, S., Jat, S.L. and Rakshit, S. 2020. Effect of Supplementation of QPM Maize Fodder on Production Performance in Large White Yorkshire Grower Pigs. EC Veterinary Science 5(8): 142-146.

Barman, K., Banik, S., Thomas, R., Das, A. K., Dutta, K. and Rajkhowa, S. 2020. Effect of replacing groundnut cake with dried *Moringa oleifera* leaves on growth and nutrient utilization in crossbred (Hampshire x Ghungroo) grower pigs. Indian Journal of Animal Science, 90(8): 1155-1158.

Barman, K., Banik, S., Thomas, R., Gokuldas, P. P, Kaushik, P., Kumar, S., Das, B. C., Das, A. K., Konwar, D. and Rajkhowa, S.2020. Effects of replacing conventional diets with brewer's rice byproducts on performance of crossbred (Hampshire X Ghungroo) grower pigs. Indian J. Anim. Health., 59(1): 62-66.

Barman, K., Banik, S., Thomas, R., Konwar, D., Das, B.C., Bora, S. and Rajkhowa, S. 2020. Effect of feeding different levels of protein and energy of Bureao of Indian Standard on production of performance of cros[s] bred (HS x GH) grower pig. Indian J. Animal. Health. 59(2): 178-188 .

Devi, J., S., & Singh, B. 2020. Link prediction model based on geodesic distance measure using various machine learning classification models. Journal of Intelligent & Fuzzy Systems, 38(5): 1-13.

Devi, S. J., & Singh, B. 2020. Link Prediction Model Based on the Topological Feature Learning for Complex Networks. Arabian Journal for Science and Engineering,. 45: 1-15.

Ghosh, T., Singha, L.I. and Barman, K. 2020. Isolation and Characterization of a Novel RIP from Trichosanthes dioica having Anticancer Activity. International Journal of Current Microbiology and Applied Sciences. 9 (9): 232-242.

Jaya B., N. H. Mohan, Satish Kumar, Jayashree Gogoi, Sai Kumar, Bosco Jose, Meeti Punetha, Sanjib Borah, Amit Kumar and Mihir Sarkar 2020. "Transcriptome profiling of different developmental stages of corpus luteum during the estrous cycle in pigs." Genomics, 113(1): 366-379.

Kumar, S. Islam, R.., Barman, K., Mohan N.H., Banik, S. and Rajkhowa S. 2020. Effect of supplementation of Vitamin E and Selenium duri*ng Transitio*n Period on Productive Performance in Sows. Veterinary Research International, 8 (3): 170-172.

Mohan NH, Ankit Nath*, R. Thomas, S. Kumar, S*. Banik, A. K. Das, R. K. Das and D. K. Sarma. 2020. Relationship between plasma, saliva, urinary and faecal cortisol levels in pigs. Indian J of Animal Sciences, 90 (5): 768–772.

Mohan, N H., M. Choudhury, L. Ammayappan, Prajwalita Pathak, Sujay Chakraborty, R. Thomas, S. Debnath, Maitry Paul and D. K. Sarma. 2020. Characterization of Secondary Structure of Pig Hair Fiber Using Fourier-transform Infrared Spectroscopy, Journal of Natural Fibers, DOI: 10.1080/15440478.2020.1856272.

Panda, S., Gaur, G.K., Sahoo, N.R., Ahmad, S.F.,Ramachandrappa, P.*D. and* Bharti, P.K.. *2020. Evaluation of animal* mo*del*s for genetic analysis of growth performance in Landlly pigs. Turkish Journal of Veterinary and Animal Sciences, 44(4): 910-918.

Satish K., Jaya Bharati, Ajay Kumar Yadav, Seema Rani Pegu, J Doley, S Paul, B C Das, N.H Mohan and R Deb. 2020. Pattern of antibiotics use in pigs of North Eastern India. Indian Journal of Animal Health, 59: 50-54.

Thomas, R., S. Singha, M.Saikia, R. Kalita, Z. Baruah and N. Saharia. 2020. Estimation of concentrat*ion of selected heavy metals in m*uscle, liver and bone of pigs. Journal of Meat Science, 15(1):56-59.

B. Krishi Vigyan Kendra, Dhudhnoi, Goalpara

Biswas, K. K.; I Bhattacharyya, U. K.; Palchoudhury, S.; Balram,N.; Kumar, A.; Arora, R.; Sain, S. K.; Kumar,P.; Khetarpal, R. K.; Sanyal, A.; & Mandal, P. K. 2020. Dominance of recombinant cotton leaf curl Multan-Rajasthan virus associated with cotton leaf curl disease outbreak in northwest India. PLOS ONE doi.org/10.1371/journal.pone.0231886 April 22, 2020.

Choudhury, H.; A. Dhali, A.; A. Mech, A.;. Choudhury, M.D.; Kumar. S. and V.K. Vidyarthi,V.K. 2020. Blood Biochemical Profile of Tho-Tho Cattle (Bos indicus) and Its Comparison to Assam Local Cattle (Bos indicus) and Mithun (Bos frontalis).Veterinary Research International, 8 (2): 160-165.

Duhan, M.; Gupta, S.; Bhattacharyya, U.K.; Palchoudhury, S.; & Biswas, K. K. 2020. Appearance of Cotton leaf curl disease begomovirus avirulent strains associated with a lower disease incidence in Delhi. Ann. Pl. Protec. Sci. (2020) 28 (1) : 67-71

Rahman, M.; Phookan A.; Zaman, G.U.; Das, A.; Akhtar, F.; Hussain, J and Choud*hury*, H. 2020. *Growth a*nd Reproductive Performances of Doom Pigs under Field Condition. Veterinary Research International, 8 (2):73-77.

Patents

A. Granted

Pig hair based biocomposite and a method for its preparation (patent no. 354534) on 28.12.2020 (Inventors: Mohan N.H. et al.)

B. Filed

Antimicrobial activity of piggery waste medicinal maggots Patent filed Reference number: An Indian patent filed with application number 202011052348, Dated Dec 01, 2020 (Inventors: Deb R, Rajkhowa S, Pegu S R, Yadav A K, Paul S,Ramesh D, Choudhary M).

Review articles

Jose, B., Punetha, M., Jaya, B., Konda, P. K., Chris, E., Tripati, M. K. and Sarkar, M. (2020). A Defensive Shield: Strategies to Tackle Global Coronavirus Outbreak in Future. Int. J. Curr. Microbiol. App. Sci, 9(8), 3768-3780.

Malik, Y. S., Bhat, S., Kumar, O. R., Yadav, A. K., Sircar, S., Ansari, M. I. & Dhama, K. (2020). Classical swine fever virus biology, clinicopathology, diagnosis, vaccines and a meta-analysis of *prevalence: A* review from the Indian Perspective. Pathogens, 9(6), 500. 10.3390/pathogens9060500.

Punetha, M., Jose, B., Jaya, B. and Sarkar, M.(2020). Pathogenesis of SARS-CoV-2 and Important Insights on its Potent Inhibitors Remdesivir and Chloroquine -A Review. Int. J. Curr. Microbiol. App. Sci, 9(6), 2217-2227.

Technical/popular articles

Jaya B.*, Satish Kumar, Mohan, N.H. and B.C. Das 2020. Basic Conc*epts on Animal Welfare. In Compendium cum training manual of National Skill Development Corporation, Government of India sponsored Agriculture training programme on Scientific Piggery Farming published by ICAR-National Research Center on Pig, Rani, Guwahati, Assam. Pp: 89-92

Jaya B., Satish Kumar, Mohan, N.H. and B.C. Das 2020. Knowledge on basic internal organs vis a vis functional system of pigs. In Compendium cum training manual of National Skill Development Corporation, Government of India sponsored Agriculture training programme on Scientific Piggery Farming published by ICAR-National Research Center on Pig, Rani, Guwahati, Assam. Pp: 43-46

Jaya B., Satish Kumar, Mohan, N.H. and B.C. Das 2020. Pig Housing and Farm Management. In Compendium cum training manual of National Skill Development Corporation, Government of India sponsored Agriculture training programme on Scientific Piggery Farming published by ICAR-National Research Center on Pig, Rani, Guwahati, Assam. Pp: 34-42

Kumar, S, Bharati, J., Banik, S., Das, P. J. and Deb, R. 2020. Simple measures to control inbreeding in Pigs. In Compendium cum training manual of National Skill Development Corporation, Government of India sponsored Agriculture training programme on Scientific Piggery Farming published by ICAR-National Research Centre on Pig, Rani, Guwahati, Assam. Pp: 108-111

Kumar, S., Bharati, J., Kumar, S., Yadav A. K. and Deb, R. 2020. Maintenance of farm records for scientific pig production. In Compendium cum training manual of National Skill Development Corporation, Government of India sponsored Agriculture training programme on Scientific Piggery Farming published by ICAR-National Research Centre on Pig, Rani, Guwahati, Assam. Pp: 112-118

Kumar, S.h, Bharati, J., Banik, S., Das, P. J. and Yadav A. K. 2020. Different Indigenous Pig Breeds in India. In Compendium cum training manual of National Skill Development Corporation, Government of India sponsored Agriculture training programme on Scientific Piggery Farming published by ICAR-National Research Centre on Pig, Rani, Guwahati, Assam. Pp: 4-18

Kumar,A., Vishal Rai, Ajay Kumar Yadav, Laxmi Upadhyay, Mukesh Bhatt (2020). Post vaccination complication. Livestock line, pp 18-22: 12 (13).

Misha M. M., Ebalee Deori and Trilochan Karki Chetri. 2020. Knowledge on Extension Services and Importance of Technology Adoption. In Compendium cum training manual of National Skill Development Corporation, Government of India sponsored Agriculture training programme on Scientific Piggery Farming published by ICAR-National Research Centre on Pig, Rani, Guwahati, Assam.Pp.102-107

Misha M. M., Mohan N. H., Ebalee Deori, Trilochan Karki Chetri. Community meetings and record keeping: Common communication devices in veterinary extension services. In Compendium cum training manual of National Skill Development Corporation, Government of India sponsored Agriculture training programme on Scientific Piggery Farming published by ICAR-National Research Centre on Pig, Rani, Guwahati, Assam. Pp.119-122

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