

Annual Report

2017-18



ICAR-Central Avian Research Institute
(ISO 9001:2008 Certified)
Izatnagar-243 122 (UP) INDIA





Annual Report

ICAR-CARI 2017-18



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Preface

Poultry farming, being practiced in India for past 6,000 years, has transformed from backyard farming to a vibrant organized industry over last four decades. Poultry has emerged as one of the fastest growing segments of the Indian agricultural sector. The total poultry population of the Country was 729.2 m as per 19th Livestock Census (2012) which increased by 12.39% over 18th Livestock Census. The annual egg production was approximately 88.1 b (BAHS-2017) bringing India at 3rd position in egg production. Indian poultry accounts for 5.1% of world's poultry. Indian poultry industry alone contributes approximately 0.6% of total GDP which is around 10% of livestock GDP of Country. But, the growth rate is pegged at nearly 8% for eggs. The Institute with its limited farm capacity has supplied over 30 lakh units of improved germplasm of diversified poultry species to the beneficiaries in the Country. As a result of the multiplier effect, the population of diversified poultry including ducks, quails, Guinea fowls, turkey, emus etc. has increased by 951%, from 12,67,000 in 1997 to 1,33,16,000 in 2012 as per Livestock Census data. The total population of fowls, ducks and turkey including others was 61.8m, 2.8m and 0.3m during 2007, respectively. The corresponding figures in 2012 were 69.3m, 2.4m and 1.3m as per Livestock Census figures. Recently, the performance of birds, both in terms of meat and egg production, has also improved. Feed is one of the major inputs for poultry production. The feed industry is providing great support to exploit the genetic potential of birds. Moreover, for a successful poultry operation, consistent supply of high quality feed throughout the year is necessary.

Poultry, on one hand serves as a tool for livelihood and nutritional security for the poor; on the other hand, it exhibits potential for high-end business for corporate sector. It is worthwhile to mention that poultry has great potential for “Doubling the Farmers' Income (DFI)” by 2022, the dream of Hon'ble Prime Minister of India. Marching in line with the call of Hon'ble Prime Minister, the Central Avian



Research Institute is devoting itself to help farmers in doubling their 'REAL INCOME' and not just the 'NOMINAL INCOME', through poultry farming and developing poultry entrepreneurship.

Since its establishment on November 2, 1979, this institute is significantly contributing towards popularization and growth of diversified poultry species such as ducks, turkey, Guinea fowls and Japanese quails in the Country in addition to native chicken and commercial broilers and layers. The Institute is also focusing on integrating poultry (duck) with paddy and fish farming besides offering the technology for duck production in Polythene Ponds, suitable for the areas where water bodies are not available. The Institute is advancing towards developing artificial insemination technology for ducks, first of its kind in the Country, to give further impetus to genetic improvement of ducks. The Institute is conserving Country's indigenous germplasm and is proactively promoting indigenous chicken for backyard poultry production, which not only have immense potential to increase farmers' income but also to minimize the problems of waste and pollution associated with intensive poultry production systems. The multi-coloured turkey variety and two desi crosses are undergoing evaluation and will soon be joining the inventory of Institute's germplasm repository. The Institute is also putting efforts for utilization of poultry waste in generation of biogas and organic manure. The research works carried out in cutting edge areas like molecular and reproductive biology, nutrigenomics, metagenomics etc. have also helped in developing some newer



technologies like universal semen diluents for poultry species, newer probiotic strains like *L. plantarum* and *L. reuteri*. Number of alternate feed resources like dried distillery grains with solubles (DDGS), rice gluten meal, decorticated cotton seed meal, high protein roasted guar korma, enzymes, red sea-weed based formulations, medicinal and aromatic plants have been evaluated and standardized for augmenting poultry production with reduced feed cost. The Institute is continuously developing and refining poultry production and processing technologies so as to offer ample opportunities for the young entrepreneurs to establish their own agribusiness. The capacity building and entrepreneurial developing training programs organized at the Institute have helped the educated youth and the farmers to setup their own business especially under Start Up scheme of Govt. of India. The Institute made significant strides in supply of germplasm with approximately 2.28

lakh units of diverse poultry species supplied throughout the Country.

I extend my sincere gratitude to Dr T. Mohapatra, Secretary DARE & DG, Dr J.K. Jena, DDG (Animal Sciences) and Dr R.S. Gandhi, ADG (AP&B), ICAR for their valuable advice and guidance. I extend my heartfelt thanks to Dr R. Prabakaran, Chairman, QRT and all the members of the Team for their untiring efforts to review the Institute's research outputs and to prepare and submit the QRT report to the Council. I am also thankful to Dr V. Prabhakar Rao, Chairman, RAC for their comments and inspiring views. I am extremely happy to present the Annual Report duly acknowledging the sincere inputs of the dedicated team of scientists. I look forward to the feed-back from the readers. I am sure that, as ever, this Institute will rise to newer heights and will ever remain an important instrument of nation building.

(A.B. Mandal)
Director, ICAR-CARI





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1. Executive Summary

Productivity Enhancement of Selected Poultry Species

- Japanese quails with 6 different plumage varieties viz., CARIUTTAM™, CARIUJJAWAL, CARIPPEARL, CARISWETA™, CARISUNEHARI, CARIBROWN, along with controls were maintained in conservation mode.
- The limitation of seasonality in egg production in Guinea fowl was resolved through dietary supplementation of phytoestrogen and injectable GnRH (with 20% protein and 18 h photoperiod) which initiated and sustained egg production in peak winters also similar to that in summers.
- Phenotypic and genetic responses for 5 weeks body weights in Synthetic Male and Dam Lines (SML and SDL) were significant with 14.82 ± 0.12 and 13.10 ± 1.17 g and 14.78 ± 0.82 and 13.06 ± 1.05 g/generation, respectively.
- Four elite layer strains (WLH- H, I, G and J) were maintained in the conservation mode. The economic traits in these strains were maintained over generations.
- Pure lines of Aseel Peela, CARIREDD, Aseel Kagar, Nicobari, Ankaleswar, Kadaknath, Silky, Coloured Necked Neck and Coloured Frizzle fowls were maintained and utilized for supplying improved crosses.
- Reciprocal crosses of CARINIRBHEEK and CARISHYAMA were superior over direct crosses (Aseel Peela x CARI-Red and Kadaknath x CARI-Red) for most of the economic and immunocompetance traits.
- Fertility in Khaki Campbell, Desi, White Pekin and Moti breeds of ducks was 53.4%, 78.9%, 78.1% and 56.7%, respectively, estimated on pooled records over the hatches. The highest fertility and hatchability on total egg set and fertile eggs transfer basis were recorded for Desi ducks followed by White Pekin, Khaki Moti and Campbell. The pooled average body weights of ducklings at day old age were recorded as 33.87, 36.12, 39.86 and 38.45 g for respective breeds.
- Feeding of fresh Azolla @ 200g/duck/day as replacement of 20% concentrate in feed of White Pekin laying ducks was beneficial in terms of improved FCR, performance efficiency index, egg production and egg quality traits with enriched yolk colour.
- Dietary inclusion of betaine @ 0.25 and 0.5g/kg was beneficial for improving growth performance, ameliorating heat stress and economical broiler production during hot dry and hot-humid conditions.
- The hatchability in broiler chicken eggs was not significantly affected due to *in ovo* injection of betaine. First three weeks' production data showed significant improvement by *in ovo* injection of betaine @60mg/100µl/egg.
- Inclusion of synbiotic (with MOS either at 0.1, 0.2 or 0.3% diet with probiotics *Bacillus subtilis* + *B. amyloliquifaciens* @10⁶ CFU/g) in diets of birds improved overall performance than in diet without synbiotic but the dietary inclusion of synbiotic including 0.3% MOS+ probiotic was found the most economical for production of broiler chicken during both hot-dry as well as hot-humid conditions.
- Addition of selenium @ 0.15 mg/kg to basal diets improved body weight, feed conversion, immune response and other welfare parameters besides reducing cost of production of broiler chickens during both hot-dry as well as hot-humid conditions.
- Dietary level of 80 ppm of zinc was found optimum during summers in broiler chicken diets. Nano-zinc proved to be the better source than inorganic or organic sources of zinc for their improved performance and immunity.
- Feed cost of broiler meat production was reduced by 3.3-6.7% through use of synbiotics and betaine during hot-dry and hot-humid conditions.
- Rice gluten meal as source of energy and crude protein can be safely added up to 15% level replacing costly conventional feedstuff like soybean meal in the diet of broiler chicken to economize the cost of meat production.
- Supplementation of choline chloride alone could not spare the requirement of methionine in broiler diet, but it could improve the growth, immune response and carcass traits when fed with NRC recommended level of methionine along with choline chloride @120% of NRC recommended level.
- Dietary supplementation of combination of nucleosides (adenosine, Guanosine, cytosine and Uridine) @0.1% each to broilers during the pre-starter phase improved their growth performance, intestinal development, secretions of amylase and lipases, intestinal



transport of calcium, phosphorus and villi length.

- *In ovo* feeding of gold nanoparticles did not affect the hatchability parameters and growth performance in meat type chicken, but eggs receiving 25 and 50 μg gold nanoparticles had almost 35-40g higher body weight at 42nd day in comparison to un-injected control. In egg type chicken, 25 μg gold nanoparticle/egg *in ovo* supplemented chicks had higher body weight ($P < 0.05$) at 56th day post-hatch.
- *In ovo* supplementation of silver + gold nanoparticles combination recorded 45 to 58g higher body weight at 42nd day post-hatch in comparison to un-injected control. *In vivo* immune response to SRBC and PHAP was increased in silver or silver + gold combination treatment in comparison to un-injected control.
- The expression of insulin like growth factor -1 in embryo increased (1.5 to 3.5 folds), amino acid transporter (2.1 to 4.7 folds) and fatty acid binding protein (2.4-4.5 folds) during post-hatch period in silver + gold nanoparticles *in ovo* supplemented chicks.
- Grobig @50g/ton (probiotic feed additive) increased the growth of beneficial microbes and reduced number of potential pathogens. Hence, it may be used as alternatives to Antibiotic Growth Promoter (AGP) for improving the health and performance of broilers.
- Feeding of *Tinospora cordifolia* to Turkey poult improved the feed conversion ratio however, it did not affect their body weight. Higher serum protein but lower serum cholesterol values were recorded in *Tinospora cordifolia* supplemented birds. Humoral immune response was significantly higher at 0.2% supplementation level, however lower feed cost per poult was observed with supplementation of 0.3% *Tinospora cordifolia*.
- Inclusion of *Kappaphycus alvarezii* and red sea weed based formulations (AF-KWP) at 1.50% level in growing layer diet reduced age at sexual maturity and successively improved production performance, immune response and egg quality traits in laying hens.
- For obtaining over 90% fertility levels in White Leghorn (WLH), freshly ejaculated semen can be diluted up to 1:7 (providing 36m sperms/ insemination) with CARI poultry semen diluent. However, dilution rate of 1:2 or 1:3 was recommended for best fertility.
- CARI semen diluent exhibited superior fertility of over 90% with fresh as well as 6 h stored at 12°C. Turkey semen as compared to

that in case of Beltsville Poultry Semen Extender (BPSE) and Lake's diluted semen.

- Field assessment of CARI poultry semen diluent was carried out by M/s Skylark Hatcheries Pvt. Ltd., Safidon (Jind), Haryana on 21,260 eggs obtained from Broiler parent F15 (Female-Hubbard F15 and males-M99), revealed average fertility and hatchability of 93.61 and 89.43%, respectively, comparable to commercially popular diluents.
- The metabolic activity (Methylene Blue Reduction Test- MBRT) and fertilizing ability of the spermatozoa with pre-ejaculatory fluid (PEF) was more than the spermatozoa without PEF at room temperature. However, no metabolic activity (MBRT) was detected in the spermatozoa with PEF when stored at 4°C.

Climate Resilient Poultry Production System and Waste Management

- Hen day egg production of CARIPRIYA™ layers from 24-40th weeks of age at the floor spaces of 450, 540, 675 and 900 Sq cm/ bird revealed no difference up to 30th week of age, but thereafter layers provided with 450 Sq cm space had significantly lower HDEP, daily feed consumption and poor FCR (kg egg/kg feed) than those provided with 540 Sq cm or more space. There was no difference in average egg weight, external and internal egg quality, immune response, H:L ratio and SGPT and SGOT levels due to different floor spaces. Poor feather quality and incidence of cannibalism was more in birds provided with 450 Sq cm spaces.
- Kadaknath birds expressed better performance than Aseel under acute thermal stress in terms of physiological and haemato-biochemical attributes.
- Carbonaceous materials, i.e., plant leaves, paddy straw and saw dust had almost similar efficacy in aerobic composting of poultry excreta at 25:1 C:N ratio and at 50-55% moisture.

Value Addition, Food Safety, Quality Assurance and Product Development

- Inclusion of flaxseed meal alone @ 10% level in standard broiler ration during 2-5 weeks of age resulted in ω -3 fatty acids enrichment in meat and optimum growth performance whereas the oxidative stability of the meat was compromised.
- Sausages prepared from minced chicken meat fermented with *Lactobacillus plantarum* and supplemented with malted oat flour (2% w/w) were found to possess higher antioxidant attributes as compared to control groups both during refrigeration and frozen storage.



- Processing technology and formulation for development of functional Turkey meat loaf was standardized for effective utilization of tough meat from adult turkey.
- Post-mortem tenderization for 24 h at $4 \pm 1^\circ\text{C}$ was optimum for utilizing breast meat from spent chicken for processing of good quality chicken meat Tikka. Marination time of 2 h was optimum in development of chicken meat Tikka. Optimum cooking time for processing of chicken meat Tikka using electric grill was 35 min at 180°C .
- Process for development of functional Turkey meat loaf was standardized with the formulation containing 3% spouted black gram dal, 0.1% rosemary, 0.08% α -tocopherol acetate (Vit. E) and 0.6% fructo-oligosaccharides (FOS).
- Inclusion of symbiotic (Mannan oligosaccharides-MOS at 0.2% and *Lactobacillus acidophilus* at 10^6 CFU/g) in low energy low protein diet improved production performance, immune response, gut health with increased beneficial bacterial concentration, physio-biochemical characteristics and reduced microbiological counts in fresh and stored (14 d) meat of broiler chickens.

Human Resource Development and Capacity Building

- Under Farmers First Programme, 15 farmers from 3 villages, namely, Nisoi, Ismailpur, Aterchedi near Aonla block, Bareilly were trained for poultry farming and 10 farmers were provided with 50 CARINIRBHEEK birds per family along with limited feed.
- The Institute organized 4 regular and 1 sponsored training programme on *Poultry Production Management* and trained 285 poultry farmers and entrepreneurs.
- In all 9 specialized training courses were organized on various aspects of poultry

production. A total of 50 trainees participated and completed the courses successfully.

- The Institute organized two one-day workshops on “Skill and poultry entrepreneurship development in Uttar Pradesh” on March 23 and 26, 2018.
- Farm school on AIR entitled “टर्की उत्पादन द्वारा रोजगार सृजन एवं आय अर्जन” (Turkey utpadan द्वारा rojgar srajan and aay arjan) was organized with All India Radio, Rampur w.e.f. Feb. 14, 2018.
- Summer School on Stress and Welfare: Concepts and Strategies to Address the Current Challenges in Poultry Production was organized during Sept. 06-26, 2017.

Important Activities and Services

- Dr T. Mohapatra, Secretary (DARE) & DG (ICAR) inaugurated the newly constructed Duck Research Complex at Regional Centre CARI, Bhubaneswar on Feb. 02, 2018.
- Dr R. Prabakaran, Chairman submitted the final QRT report of the Institute to the Council on Aug. 03, 2017.
- License Agreements (LA) pertaining to three product technologies developed by the Institute were signed for their commercialization as part of ITMU activities.
- The Institute signed three MoUs for supply of Kadaknath and Ankleshwar chicken germplasm.
- The Institute also provided consultancy services under ABI to three entrepreneurs and prepared DPRs for establishing poultry units
- The Institute observed International Yoga Day on June 21, World Egg Day on Oct. 13, Institute Foundation Day on Nov. 2 and Agriculture Education Day on Dec. 03, 2017.
- The Institute generated revenue receipts amounting to Rs. 22688026.
- Under Swachh Bharat Abhiyan, several on and off campus awareness and cleanliness drives were organized by the Institute.



2. Introduction

Having established on November 2, 1979, the Central Avian Research Institute under the aegis of Indian Council of Agriculture Research, New Delhi has been the major driving force steering the Indian poultry sector through various phases of development during the past four decades. It has been providing much needed support in terms of production and processing technologies, trained manpower through post-graduate education, training and extension in all sub-disciplines of Poultry Science for promoting sustainable diversified poultry production at both commercial and small scale rural poultry production in the Country. The premier Institute with its main campus at Izatnagar, Bareilly, Uttar Pradesh and a Regional Centre at Bhubaneswar, Odisha is the only one of its kind wholly dedicated to Poultry Science research, education and extension in the Country.

Basic and applied research through multi-disciplinary approach on diversified poultry species is conducted at the Institute. The remarkable growth achieved in the Indian poultry sector has been due to several factors like initiation of pure line breeding in the Country especially at Central Avian Research Institute, leading to availability of elite germplasm of ducks, Japanese quails, turkey, native fowls and commercial layer and broiler chicken and parallel development of other input sub-sectors like feed, hatchery and farm appliances, poultry biologicals, feed analysis and disease diagnostics, modern mechanized poultry and egg processing plants, vertical and horizontal integration in poultry farming, availability of soft credit and above all, ever-increasing demand of poultry products, etc.

The Institute has been serving as the nerve Centre for popularizing ducks, Japanese quails, native fowls, Guinea fowls and Turkey and disseminating their germplasm in the nook and corner of the Country. The high performing improved germplasm has been in very high demand as they are highly suitable for the concept of 'production by masses'. The pure lines of various important breeds of diversified poultry species are available in the Institute, apart from the parent lines of the above mentioned commercial seed material. The Institute has also been providing focused support to the industry by

providing entrepreneurship development and business incubation facilities.

Mandate

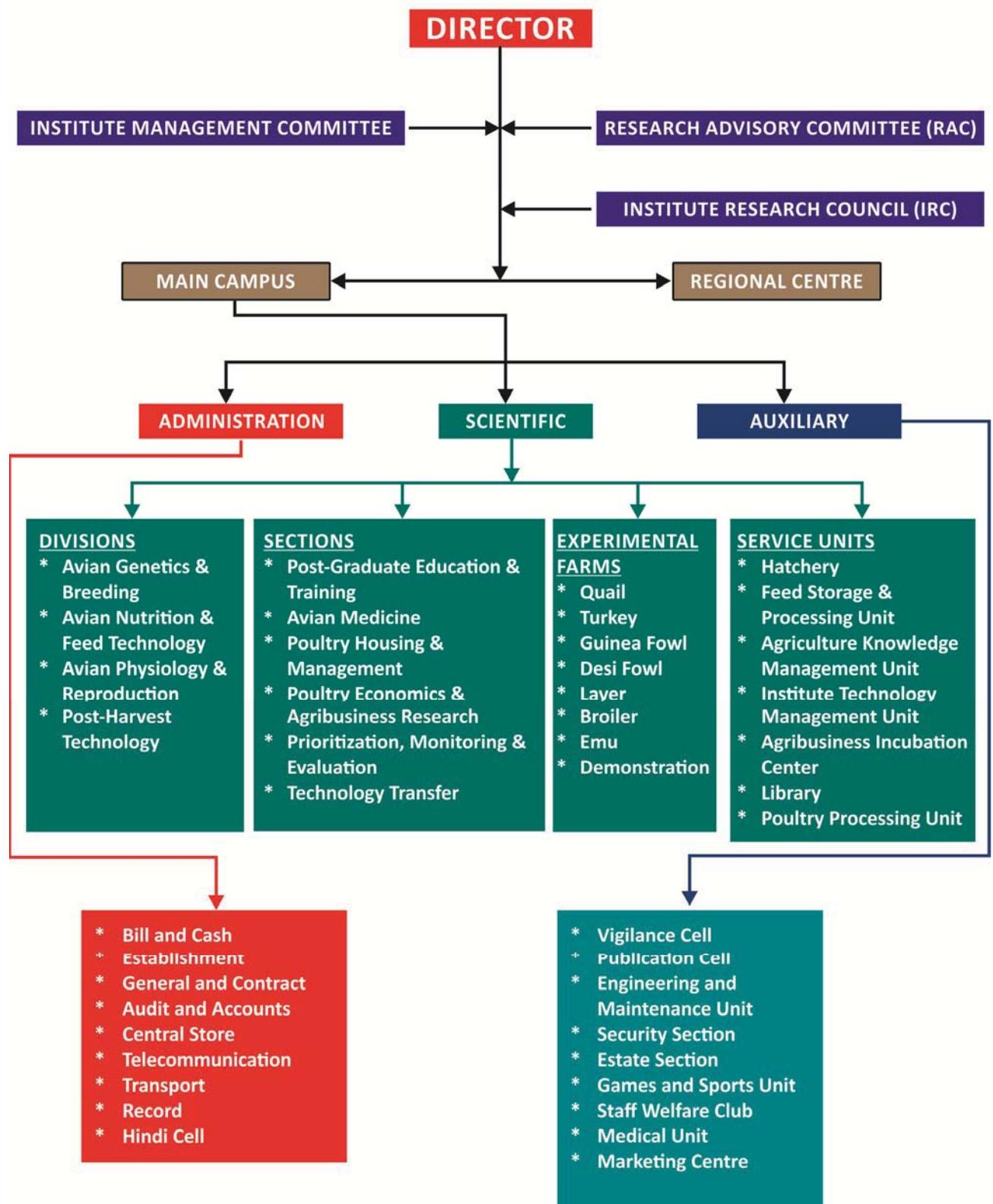
- **Basic and applied research on productivity enhancement for sustainable production in diverse avian species.**
- **Human resource development and capacity building.**

Major R&D Activities

The Institute is committed to the requirements of the small poultry entrepreneurs on one hand and is also responsive to the problems and challenges faced by the commercial poultry industry on the other hand. A wide range of challenges faced by the poultry industry are being addressed by the Institute, some of which are outlined as follows:

- Genetic improvement, characterization and propagation of diversified poultry species through selective breeding and molecular techniques, research in frontier areas and conservation of native poultry species.
- Poultry waste utilization as source of green energy.
- Basic and applied aspects of poultry nutrition including alternate feed resources for reduction in cost of poultry production, diagnostics and consultancy services in feed analysis and quality assurance etc.
- Physiological interventions for improved reproduction, digestion and stress management
- Development of value added and functional poultry products, innovative techniques for preservation, packaging and shelf life enhancement, processing and utilization of poultry by-products.
- Providing training, advisory and consultancy services including agribusiness incubation facilities and technology licensing.
- Development and dissemination of poultry production technologies through various extension methods, germplasm supply and publication of books/bulletins.
- Improvement of ducks and development of its germplasm for catering to the needs of coastal and North Eastern regions is undertaken at its Regional Centre at Bhubaneswar.

ORGANOGRAM



3. Research Achievements

Programme-1: Productivity Enhancement of Selected Poultry Species

Sub Programme– (i) Enhancement of productivity, reproductive efficiency and immune-competence of selected diversified poultry species along with development of improved package of practices.

Augmenting gut health and welfare of poultry through dietary approaches

The effect of three different stress alleviating agents i.e., betaine (0.25, 0.5 and 1g/kg); synbiotic (Mannon Oligo Saccharide (MOS) @ 0.1, 0.2 and 0.3% with probiotic @10⁶ cfu/g) and selenium (0.15, 0.3 and 0.45 mg/kg) in broiler pre-starter (day old to 14th day, protein 22%), starter (14 to 21th day, protein 21%) and finisher mash (21 to 42nd day of age, protein 19%) during hot-dry and hot-humid conditions on growth performance, hematological parameters (hemoglobin, H:L ratio) blood biochemical profiles (total protein, total cholesterol, AST and ALT), immune competence in terms of humoral immune response (HA titre to SRBC) and cell mediated immune (CMI) response (foot web index to PHAP), expression analysis of HSP70 and SGLT1 in jejunum tissue was studied along with its economics in terms of feed cost of production.

Dietary inclusion of betaine @ 0.25g/kg was beneficial for improving growth performance, ameliorating heat stress and economical broiler production during hot dry and hot-humid conditions, respectively. Expression of HSP70 was significantly down regulated and that of SGLT1 was up regulated in jejunum tissues due to betaine supplementation with all three doses at 42nd day of

age in comparison to control in both hot-dry and hot-humid conditions. Inclusion of synbiotic (with MOS 0.3% diet with probiotics *Bacillus subtilis* + *Bacillus amyloliquifaciens* @10⁶ CFU/g) in diets of broilers improved performance of broiler chicken in both hot-dry as well as hot-humid conditions. Expression of HSP70 was significantly down regulated and that of SGLT1 was up regulated in jejunum tissues in both hot-dry as well as hot-humid conditions for all the three stress alleviating agents. Addition of selenium @ 0.15 mg/kg in basal diets improved body weight, feed conversion, immune response, and other welfare parameters of broiler chickens during both hot-dry as well as hot-humid conditions. Feed cost of broiler meat production was reduced by 3.3-6.7% through use of additives (synbiotics and betaine) during hot-dry and hot-humid conditions but selenium supplementation did not reduce feed-cost. A six week biological experiment was conducted to evaluate different levels (40, 60, and 80 ppm) and sources of zinc [inorganic (IZ), organic (OZ), green nano (GNZ) and market nano zinc (MNZ)] in terms of broiler performance [body weight gain (BWG), feed intake (FI) and feed conversion ratio (FCR) and their immunity (response to PHAP and SRBC)] under heat stress using 3x4 factorial design. A dietary level of 80 ppm of zinc was optimum during summer and nano zinc (either commercial or green) proved to be better source than either inorganic or organic sources for improved performance and immunity of broiler chickens.

Effect of Zinc supplementation on performance and immune response in broiler chickens

Zinc Source	B. wt gain (g)	FCR	H/L	PHAP	SRBC
IZ (ZnO)	1481.6 ^a	1.97 ^c	0.44	0.23 ^a	6.44 ^a
OZ (ZnP)	1504.6 ^b	1.85 ^b	0.39	0.30 ^b	7.19 ^b
GNZ (Zn Acetate)	1583.3 ^c	1.78 ^a	0.36	0.39 ^c	7.42 ^c
CNZ (ZnO)	1584.2 ^c	1.78 ^a	0.35	0.37 ^c	7.42 ^c
	P<0.01	P<0.01	NS	P<0.01	P<0.01

Food-cost reduction through utilization of alternate feed resources

The effect of rice gluten meal (RGM at 20 and 40% levels) as an alternate source of energy and protein in broiler diets with or without protease and cocktail enzymes supplementation on growth performance, carcass traits, gut health, nutrient utilization and economics of broiler production was studied following 3x3 factorial CRD. The RGM contained (in percentage) dry matter 91.99,

crude protein 49.94, ether extract 5.79, total ash 3.31, acid insoluble ash 0.89, calcium 0.84 and phosphorous 0.98, besides ADF 16.24, NDF 43.41, IVPD 73.05% and 4050 kcal /kg gross energy. Incorporation of 15% RGM did not show any adverse effect on production performance, carcass traits, blood biochemistry, immunity and gut health in broiler chicken. Increasing the level of RGM from 15 to 20% in the diet showed a significant decrease in the production performance

of broiler chicken and protease enzyme supplementation has no significant effect on production performance and the cost economics of broiler production. The study revealed that crude protein intake and percent dry matter metabolizability (DMM) did not differ significantly ($P>0.05$) at different levels of RGM with or without enzymes supplementation. The interaction between RGM and both enzymes also did not have significant ($P>0.05$) effect on feed, CP, AMEn intake and DMM% at 20 and 40% replacement levels. The AMEn value of diet was not significant ($P>0.05$) at 20 and 40% replacement (3034 and 3027 kcal /kg) and no significant ($P>0.05$) difference was observed in energy and dry matter metabolizability of diets. Effect of RGM and enzyme interaction effect was found non-significant ($P>0.05$). With enzyme supplementation (protease and cocktail), the AMEn value of rice gluten meal was observed 3067, 3069 and 3076, 3055 kcal/kg respectively at 20 and 40% replacement respectively with a mean value of 3068 and 3066 kcal/kg, respectively. Six experimental diets adequate in all nutrients, were prepared, consisting of maize-soya control and five levels of rice gluten meal (5, 7.5, 10, 12.5 and 15%). Each diet was assigned to five replicated groups of 8 broiler (CARIBROVISHAL) chicks each for 0-2 (pre-starter), 2-4 (starter) and 4-6 wk (finisher) growth phases. The results indicated that the body weight gain, feed intake, feed conversion ratio, protein and energy efficiencies did not differ significantly ($P>0.05$). The humoral and cellular immune response, carcass traits, cut up parts and yields of digestive and immune organs' weights also remained statistically similar due to various dietary treatments. However, the cost of per unit meat production was significantly lowered as RGM was increased in the diet. It is evident from the results that high-protein RGM can safely and economically be added in broiler diet.

Interaction of dietary micronutrients

The methionine sparing effect of choline in broiler chickens was studied with reference to growth, immune response, carcass quality traits, blood biochemical profile, structural gut health, caecum microbiology and cost economics of broiler production. Nine dietary treatments with three levels of starting phase (0-3wks) methionine (0.50, 0.45 and 0.40% against NRC recommendation of 0.50%) and finishing phase (4-6wks) methionine (0.38, 0.34 and 0.30% against NRC recommendation of 0.38%); each methionine level with three levels of choline (1300, 1430 and 1560 mg/kg against NRC recommendation of 1300 mg/kg) during starting phase (0-3wks) and three levels of choline (1000, 1100 and 1200 mg/kg

against NRC recommendation of 1000 mg/kg) during finishing phase (4-6 wks) were evaluated using 3x3 factorial design. Humoral and cell mediated immune responses were assessed on completing fourth weeks of age. Histo-morphometry of small intestine was assessed at 21 days of age. Significantly higher ($P<0.05$) body weight, gain in body weight, efficiency of feed utilization and livability of broiler chicks were observed at a dietary concentration of 100% methionine (0.50 and 0.38%) with 120% choline (1560 and 1200mg/kg) during both the phases of growth. Cellular and humoral immune response remained unaffected by feeding different levels of methionine and choline. Weight of various immune organs (bursa, spleen and thymus) at 42nd days significantly decreased with decreasing concentrations of methionine in the diet. Significantly higher dressed yield and lower abdominal fat were observed at dietary concentration of 100% methionine (0.50 and 0.38%) and 120% choline (1560 and 1200mg/kg). Breast yield was significantly decreased with decreasing methionine levels and increased with increasing choline levels in the diets. Similarly, total cholesterol concentration and villus height of jejunum and duodenum were significantly decreased at dietary concentration of 100% methionine with 120% choline. Significantly lower feed cost and better performance index (PI) were found in a dietary combination of 100% methionine with 120% choline. Based on the results, it was concluded that supplementation of choline chloride alone could not spare the requirement of methionine in broiler diet, but it could improve the growth, immune response and carcass traits of broiler chicks at 120% when diet contains 100% methionine as against NRC recommendations.

Natural polyphenol as alternative to antibiotic growth promoters

Effect of polyphenol extracted from Tamarind seed powder (TSP) coat as a natural growth promoter on performance, carcass traits, humoral immune response, serum biochemical parameters and meat quality was assessed in day-old broiler chicks (n=280) assigned to 7 treatments (i.e. T1-control- maize-soy based diet, T2-C+125 TSP, T3-C+250 TSP, T4-C+5% fish meal replaced by soybean meal, T5-T4+125TSP, T6-T4+250 mg/kg TSP and T7-T1+0.025% antibiotic for 0-42 days in such a way that each treatment has 5 replicate having 8 chicks each. The results revealed that during the period of 0-21 days of age, the weight gain of broilers that received TSP extract at 125, 250 mg/kg TSP with or without fish meal in their diet was significantly ($P<0.05$) higher than

control. Overall period (0-42 d), the weight gain was numerically higher in T3 group. Feed intake of broilers in all groups did not differ significantly ($P > 0.05$) during all growth phases. The FCR was significantly ($P < 0.05$) lower in all TSP treated group in 0-3 week but did not differ significantly from control and antibiotic group in overall growth phase. The weight of thigh and drumstick was significantly ($P < 0.05$) higher in all treatments in comparison to control. TBARS value was significantly ($P < 0.01$) decreased in polyphenol diet at both levels (125 and 250 mg/Kg with fish meal). Lactobacillus population in duodenum and caecum was significantly ($P < 0.01$) increased in all polyphenol treated groups in comparison to control and lowest population was recorded in antibiotic group. Caecum coliform count was significantly ($P < 0.01$) lower in groups T2, T3, T5 and T6. This study demonstrated that tamarind seed coat polyphenol slightly improved average daily weight gain, gut health and lipid oxidation and may be a substitute for antibiotic.

Augmenting performance of broilers through betaine supplementation

The effect *in ovo* supplementation of betaine (@ 20, 40 and 60mg/100 μ l/egg) on 18th day of incubation was studied using 600 hatching eggs, divided into four groups (150 eggs per treatment) namely, control, T1, T2 and T3. In each group, 20 eggs were injected with 100 μ l of PBS which served as SAM control. The hatchability of the eggs was not significantly affected due to *in ovo* injection of betaine. In the first two weeks, the feed intake and body weight did not differ significantly among the groups. However, in the third week, the birds in the T3 (60mg/100 μ l/egg) group showed significantly higher body weights.

Breaking the seasonality in reproductive behavior

Effect of photoperiod, dietary protein, GnRH, phytoestrogen (Barseem) and Isoflavone on productive and reproductive traits in Guinea fowl was assessed in winters on 20-weeks old 135 Guinea fowl females of Pearl variety. The birds were reared on experimental diet containing 20% protein and 18 h photoperiod during Dec. to March. The limitation of seasonality in egg production in Guinea fowl was resolved through dietary supplementation of phytoestrogen and injectable GnRH which initiated and sustained egg production in peak winters also similar to that in summers. The hen day production ranged from 22.35 to 40.38% in different treatment groups. Egg production in control group was zero.

Improvement of reproductive efficiency of Turkey and Chicken

Chicken semen was diluted in CARI poultry semen diluent and fertility was examined 180 healthy adult females using freshly ejaculated semen from 20 healthy adult males of white leghorn (WLH) chicken. Different dilution rates i.e. 1:1, 1:3, 1:5, 1:7, 1:9, 1:11, 1:3, 1:15 and 1:17 were used in this study for 0 h (freshly ejaculated semen) stored semen. Superior fertility was obtained from 2 to 6 days of fertile period after A.I. in the dilution rate of 1:1 (143.00 m sperm/AI) 1:3 (71.50 m sperm/AI) 1:5 (47.75 m sperm/AI) and 1:7 (35.75 m sperm/AI) which was ranging 91 to 94%. After higher dilution rate i.e. 1:9 (28.60 m sperm/AI) and 1:11 (23.83 m sperm/AI) fertilizing ability of sperm reduced to 87.23 and 85.13% respectively. Further enhancing the dilution rate like 1:13 (20.42 m sperm/AI), 1:15 (17.88 m sperm/AI) and 1:17 (15.89 \times 10⁶ m sperm/AI), fertility was again reduced gradually to 81.15, 78.16 and 75.60%, respectively. Similar pattern of fertility was obtained from 2-8 days of fertile period, as it was 91.46% at dilution rate of 1:1 and reduced gradually to 71.43% at the dilution rate of 1:17. Thus, a minimum of 36 m sperm (1:7) are required for good fertility in chicken. It may also be concluded that for higher fertility, freshly ejaculated semen can be diluted up to 1:7 with CARI poultry semen diluent.

Effect of three semen dilutors, CARI poultry semen diluent, Beltsville Poultry Semen Extender – (BPSE) and Lake's diluents on fertility of Turkey spermatozoa was studied. Semen samples from the Turkey toms were collected by the massage method and good quality of pooled semen of Turkey toms was diluted equally in three semen dilutors. AI was done at different time intervals (0 and 6h). Thirty hens, divided in 3 groups, were inseminated (60-100 m spermatozoa) with the freshly (0 h) ejaculated semen diluted (1:2) with CARI poultry semen diluent, BPSE, and Lake's diluent respectively. These hens were again inseminated after 45 days in the similar manner with the 6h stored semen at 10-12°C and fertility was assessed after single intra-vaginal insemination. Best diluent, based on fertility results, was selected for physical and biochemical evaluation of semen quality at different time intervals (0, 6 and 12h). The fertility of fresh semen diluted with CARI diluent exhibited higher ($P < 0.05$) overall fertility (94.23 \pm 0.85%) followed by BPSE (89.93 \pm 1.15%) and Lake (78.80 \pm 1.41%) diluents. The mean values of 6 h stored Turkey semen using various semen diluents on fertilizing ability of spermatozoa indicated that stored semen diluted with CARI diluent expressed higher ($P < 0.05$) overall fertility (92.86 \pm 2.70%) than

Lake ($76.19 \pm 1.55\%$) and BPSE ($71.04 \pm 2.76\%$) diluents. Therefore, CARI diluent was selected for physical characteristics examination of freshly (0 h) ejaculated and stored (6 and 12h) Turkey semen. Sperm motility was found significantly higher in fresh ($83.60 \pm 1.12\%$) and 6 h ($82.00 \pm 1.70\%$) stored semen than 12 hr ($64.49 \pm 1.23\%$). The live spermatozoa count were lower ($P < 0.05$) in 12 h ($78.00 \pm 1.10\%$) stored semen than fresh and 6 h stored semen. The dead spermatozoa percentage was low in fresh semen ($8.16 \pm 0.68\%$) as well as 6 h stored semen (9.01 ± 0.48) in comparison to 12 h ($12.16 \pm 0.66\%$). Similar trend was observed in morphologically abnormal spermatozoa which were lower in fresh semen ($6.83 \pm 0.50\%$), 6 h ($7.80 \pm 0.40\%$) and higher in 12 h ($9.83 \pm 0.53\%$) stored semen. It may be concluded that CARI poultry semen diluent is superior to others to preserve the Turkey semen for 6 h under *in vitro* condition.

A field assessment of CARI poultry semen diluent was carried out by M/s Skylark Hatcheries Pvt. Ltd., Safidon (Jind), Haryana. The diluent was tested on 21,260 eggs obtained from Broiler parent F15 (Female - Hubbard F15 and males - M99). The average fertility was found 93.61% whereas hatchability was 89.43% which was comparable to popularly well-known commercially available diluent. The sperm storage capacity of CARI poultry diluent ranged from 24 to 48 h in chicken whereas in commercially available diluents it is hardly 6 h. CARI poultry semen diluent was found economically superior than the others.

Development and evaluation of synthetic broiler sire and dam lines

A total of 3165 chicks were hatched from CSML, SML and control lines with fertility percentage ranging from 75.57 to 85.83. Mean 5-week body weights in SML and Control lines were 1133.46 ± 8.31 and 749.28 ± 12.35 g, respectively. Hatchability percentage based on TES and FES ranged between 68.43 and 76.67; and 89.61 and 90.56, respectively. Overall average body weight of mixed sexes at 5 weeks in SML and control were 1133.46 ± 8.31 and 749.28 ± 12.35 g, respectively. Phenotypic and genetic responses in SML were significant with 14.82 ± 0.12 and 13.10 ± 1.17 g/generation, respectively. The phenotypic response for 5-week body weight in the control population was non-significant (1.72 ± 0.95 g / generation).

The fertility percentage was 83.69 and hatchability percentage based on TES and FES were 77.80 and 92.95, respectively in CSFL. Corresponding values in SDL were 80.34, 70.76 and 88.08 percent. The overall average body

weight at 5 weeks in SDL was 1121.92 ± 6.71 g. Phenotypic and genetic responses in SDL were significant with 14.78 ± 0.82 and 13.06 ± 1.05 g/generation, respectively.

Monitoring of poultry diseases and implementation of bio-security measures

Health care management of diversified poultry species was carried out and mortality pattern in all the species was well within the normal limits. No outbreak of any infectious disease was witnessed. The immunity profile against RD was assessed from time to time in different poultry species and the vaccine schedule was re-designed as per the level of RD antibody titre. A total of 5,05,935 doses of different vaccines were given in different poultry species which comprised RDF 2,62,600 doses; MD 97,500 doses; R2B 22,500 doses; fowl pox 25,500 doses; IBD (Live) 81,000 doses and IBD killed 16,835 doses. Biosecurity measures were monitored from time to time. Cleanliness of the farm premises, disinfection of the area around and inside different sheds and hygienic disposal of dead birds was carried out and constituted as essential components of biosecurity measures.

Quality assessment of feed stuffs and poultry feed

Various feed samples (148) received from the farmers, industries, Institutes, Government farms; NGOs were subjected to analysis for different quality parameters such as protein, fibre, ether extract, total phosphorus, urease activity, glucosinolates and mycotoxins. The data revealed that the quality control, especially in terms of consistency and mycotoxins contamination, needs to be strengthened.

Development of different value added poultry products for income generation



Functional chicken meat bites, sausages and quail egg pickles were developed for selling them through Institute Marketing Centre for popularization and income generation. All these



products were evaluated for different physical-chemical, nutritional and microbiological quality to ensure safety to the consumers. A total 110 packets of chicken meat bites and 49 packets sausages were sold.

Standardization of processing technology for development of functional Turkey meat loaf utilizing adult turkey

Processing technology and formulation for development of functional Turkey meat loaf was standardized for effective utilization of tough meat from adult turkey. For processing of meat loaf spouted black gram dal (2, 3 and 4%), rosemary (0.1%), α -tocopherol acetate (Vit. E, 0.08%) and fructo-oligosaccharides (FOS, 0.6%) were mixed with other ingredients. The emulsion was filled in aluminium mold and cooked for 50 min. Different physicochemical quality parameters were assessed. The product was well accepted by the sensory panel members.

Sub Programme (ii): Development of package of practices for rural poultry production system Management practices to optimize Turkey production

The effect of dietary supplementation of *Tinospora cordifolia* at different inclusion levels for 10 weeks (0-10 weeks) duration on immunity and gut health of Turkey poults was studied. The dietary treatments included one control (T1-commercial standard diet- 0 levels of *T. cordifolia*), T2- 0.1% of dried stem powder of *T. cordifolia*, T3- 0.2% of dried stem powder of *T. cordifolia*, T4- 0.3% of dried stem powder of *T. cordifolia*. Straight run day old Turkey poults (n=160) were randomly divided into four dietary treatment groups in battery brooder, each cage consist of 4 replicates of 10 birds (4×4×10) each, and the experimental diets were offered *ad libitum*. The body weight and body weight gain (g/b) did not differ significantly among different dietary treatments. Overall feed consumption was lowered at 0.3% inclusion level (T4) compared to other treatment groups and control. Feed conversion ratio was improved in 0.2 and 0.3% treated birds. Higher serum protein, globulin and albumin but lower cholesterol values were recorded in *Tinospora cordifolia* supplemented birds. Significantly (P<0.001) higher serum AST (aspartate amino transferase), but lower values of alanine amino transferase (ALT) was recorded in *Tinospora cordifolia* supplemented birds. The blood profiles, carcass traits including cutup yields were similar in *Tinospora cordifolia* supplemented and control birds. However, the size of internal organs like heart, liver, gizzard and proventriculus

increased significantly in *Tinospora cordifolia* supplemented birds than the control birds. No significant difference (P>0.05) was observed in intestine and pancreas weight, jejunal histomorphology (villus height, villus width and crypt depth) and gut microbial count (coliform, lactobacillus and total plate count) of treatment groups and control birds. The relative weight of immune organ (thymus, spleen and bursa) was similar in all the treatment groups. However, humoral immune response (HA titre to SRBC injection) was significantly (P<0.05) higher at 0.2% inclusion level. The cell-mediated immune response did not differ significantly (P>0.05) among different dietary treatments. Significantly (P<0.05) lower feed cost per poult was observed in 0.3% supplementation of *Tinospora cordifolia*.

Conservation of elite layer stock

Layer production traits *viz.*, BW16, BW40, EW28, EW40 and EP40 have been recorded in 131 and 137 females of IWG and IWJ part-period egg production and AFE and BW16 on 233 and 246 females of IWH and IWI annual egg production strains of WLH chicken. The ASM (days), BW16 (g), BW40 (g), EW28 (g), EW40 (g) and EP40 (eggs) in IWG strain averaged 136.62 ± 1.44 , 1010.43 ± 9.68 , 1495.28 ± 27.35 , 45.99 ± 0.34 , 51.41 ± 0.33 and 112.51 ± 1.86 , respectively. The corresponding estimates in IWJ strain were 138.73 ± 0.84 , 931.90 ± 13.0 , 1416.01 ± 15.9 , 44.25 ± 0.36 , $48.64 \pm .56$ and 107.60 ± 1.51 . The heritability estimates of ASM, BW16, BW40, EW40 and EP40 in IWG strain were 0.678 ± 0.349 , 0.182 ± 0.277 , 0.899 ± 0.458 , 0.089 ± 0.348 and 0.342 ± 0.392 , respectively; however, it could not be estimated for EW28. The heritability estimates of, BW16, BW40, EW28, EW40 and EP40 in IWJ strain were 0.439 ± 0.302 , 0.407 ± 0.331 and 0.499 ± 0.371 , respectively; however, it could not be estimated for ASM, BW40, EP40. The AFE and BW16 were 142.25 ± 0.63 days and 967.47 ± 8.27 g in IWH and 140.76 ± 0.56 day and 974.98 ± 6.78 g in IWI strain.

Preservation of elite germplasm of Japanese quails

In pursuance of ICAR letter No. AS/11/1/2013/ASR-II dated 26 June 2014, the breeding and research work on Japanese quail was stopped. A total of 11,443 good chicks of 06 different plumage colour varieties of Japanese quails *viz.* CARIUTTAM™, CARIUJJAWAL, CARIPPEARL, CARISWETA™, CARISUNEHARI, CARIBROWN, CROSS LINE and CONTROL LINE were hatched, brooded and managed out with following details.

Performance of various Quail strains maintained under conservation.

S. No.	Strains	No of eggs setting	Infertile eggs	Transfer eggs	Good chicks	Hatchability (%, TES)
1.	CARIUTTAM™	2471	21	2450	1183	48.28
2.	CARIBROWN	1489	05	1484	950	64.02
3.	CARISUNEHERI	1097	05	1092	706	64.65
4.	CARIUJJAWAL	1562	07	1555	984	63.27
5.	CARISWETA™	1496	09	1487	1032	69.40
6.	CARIPEARL	2393	07	2386	1518	63.62
7..	GENERAL	8267	23	8244	5070	61.49
	TOTAL	18775	077	18698	11443	

Utilization for native chicken for family poultry production

A total of 2278 Aseel Peela, 565 Aseel kagar, 1458 CARI Red, 596 Nicobari, 3562 Kadakanath, 351 Ankaleshwar, 156 coloured Frizzle, 177 coloured

Naked Neck and 4204 gene pool line chicks were hatched and were utilized for production of 42936 parent and commercial chicks for family poultry production.

Details of reproductive traits of different pure breeds/lines

Breed	No. of Egg Set	Good Chicks	Fertility%	TES%	FES%
CARIRED	2702	1458	67.13%	54.62%	81.36%
Aseel Peela	3371	2278	79.70%	68.11%	85.44%
Aseel Kagar	1118	565	68.96%	51.07%	74.05%
Nicobari	1143	596	73.49%	52.49%	71.42%
Ankaleshwar	730	351	85.20%	48.63%	57.07%
Coloured Necked Neck	433	177	57.50%	42.26%	73.49%
Coloured Frizzle	272	156	69.11%	58.45%	84.57%
Silky	625	349	72.16%	56%	77.60%
Kadakhath	6132	3562	68.77%	58.38%	84.89%
Gene Pool line	6960	4204	75.03%	60.40%	80.50%
Total	23486	13696	72.64%	58.87%	81.05%

Highest hatchability (FES) of 85.44% was observed in Aseel Peela followed by Kadakhath (84.89%) and coloured necked neck (84.57%).

Comparative performance of reciprocal crosses of CARINIRBHEEK and CARISHYAMA

The Institute has developed some improved varieties of Desi Chicken viz. CARINIRBHEEK, CARISHYAMA, HITCARI and UPCARI using CARI-Red (CR) as female line. Study was carried out to evaluate comparative performance of reciprocal crosses of CARINIRBHEEK and CARISHYAMA.

Growth performances: Reciprocal cross CR x AP revealed almost similar body weight than respective direct cross at almost all age of measurement except at 0 and 10th wk, whereas, reciprocal cross CR x Kadakhath (KN) had significantly ($P < 0.01$) higher body weight at 0 and 20th wk. On the basis of average performance for body weight, reciprocal crosses had higher body weight, therefore, CR as male line and Aseel Peela

(AP) and KN as female line appear to be the most promising among the crosses. The analysis of variance reveals significant difference between mating system for body weight in combined sex at 0 and 20th week in AP crosses.

It was evident that reciprocal cross CR x AP had similar shank length except at 8 and 16th wk with respect to their direct cross and no significant ($P > 0.05$) difference was observed in shank length of both direct and reciprocal cross of KN and CR. Reciprocal cross CR x AP had almost similar keel length with respect to their direct cross AP x CR at almost all ages. Whereas, no significant ($P > 0.05$) difference in keel length was observed in direct and reciprocal cross of KN and CR. Reciprocal cross CR x AP had highly significant ($P < 0.01$) breast angle as compared to their direct cross at 4 and 20th wk. Reciprocal cross of CR x KN had significantly higher ($P < 0.05$) breast angle than their direct cross at all age of measurement except at 20th wk. Reciprocal cross CR x KN had lower FCR value than their respective direct cross except



at 5-6th wk and 7-8th wk and reciprocal cross CR X AP had lower FCR at 0-2th wk, 7-8th wk, 9-10th wk and FCR increased as age of bird increased. Reciprocal cross CR x KN depicted lower mortality whereas, reciprocal cross CR x AP depicted highest mortality between 0-6th wk of age and between 7-20th wk of age CR x KN depicted higher mortality whereas, KN x CR depicted lower mortality.

Immunocompetence traits: Reciprocal crosses had slightly higher or almost similar HI titre as compared to their respective direct crosses. No significant ($P > 0.05$) difference was found in foot web index of the crosses.

Carcass traits: Reciprocal cross, CR x KN, had significantly higher ($P < 0.05$) thigh% with respect to their direct cross whereas, reciprocal cross and direct cross CR x AP had similar thigh, back, drumstick, neck, dressing and giblet percentage was found non-significant ($P > 0.05$) among the groups. In case of wing% no significant ($P > 0.05$) difference was observed between direct and reciprocal crosses of both AP, KN with CR. Reciprocal cross of both AP and KN with CR had almost similar evisceration% ($p < 0.05$), shrinkage%. Reciprocal crosses of both AP and KN with CR had significantly ($p < 0.01$) higher feather% than respective direct crosses. Direct cross AP x CR had significantly higher blood loss% ($p < 0.01$) than respective reciprocal cross and no significant difference was found in blood loss% in direct cross and reciprocal cross of KN and CR. Reciprocal crosses had better economic and immunocompetence traits as compared to their direct crosses and CR as male line and AP & KN as female line has ample opportunity to develop suitable superior crosses for rural poultry production.

The average 8 and 20 wk body weight of Aseel Peela was 414.60 and 1461.60 g, respectively. During same period, 20 week male and female body weights were 1717.57g and 1236.50g, respectively.

A total of 2624 (1414: CARIDHAWAL and 1210: CARINEERA Safed) grower chicks were distributed to 08 (eight) farmers for the performance evaluation of these strains at the farmers' door step.

Programme 2: Climate resilient poultry production system and waste management

Sub Programme– Impact assessment, adaptation evaluation and amelioration strategies to combat extremes of climate through genetic / molecular, nutritional, physiological, shelter management and evolving efficient technologies for utilization of poultry waste.

Welfare of chicken under different housing conditions

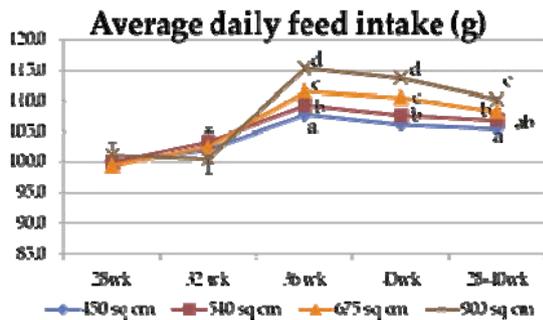
To study the optimum floor space requirement for economic egg production in White Leghorn layer birds. The CARIPRIYA™ layers at 24 weeks of age were housed in colony cage housing system (Size 45 x 18 x 17 inch) and provided floor space of 450 Sq cm/ bird (12 birds per cage), 540 Sq cm/ bird (10 birds per cage), 675 Sq cm/ bird (8 birds per cage) and 900 Sq cm/bird (6 birds per cage). The production parameters related to hen day egg production (HDEP), daily feed consumption (g), biweekly hen day egg production (%), biweekly feed conversion ratio, biweekly egg weight (g) and mortality percentage have been recorded. The egg quality parameters (approx. 20 eggs from each treatment) were studied at 32nd week of age. At early stage of production (up to 32nd week of age) there was no difference in the production performance, but thereafter the layers provided with 450 Sq cm space had significantly lower HDEP, daily feed consumption and poor FCR (kg egg/kg feed) than those provided 540 Sq cm or more space. However, no difference was seen in average egg weight, external and internal egg quality due to floor space.

The immune response to Sheep RBC or PHA-P did not differ among the birds provided with different floor space. Apparently higher H:L ratio and SGPT but higher SGOT was recorded in birds provided with 450 Sq cm space. Poor feather quality and incidence of cannibalism was more in birds provided with 450 Sq cm spaces.

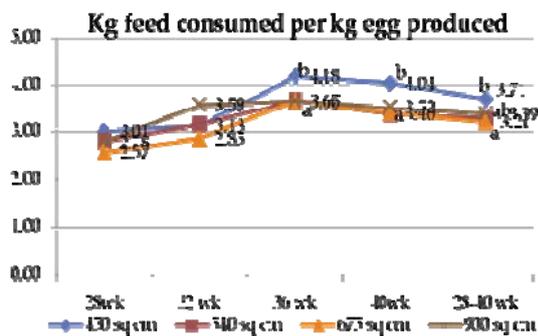
Hen day egg production (HDEP)% of WLH layers at different floor spaces

Floor space	24-28 wks	29-32 wks	33-36 wks	37-40 wks	28-40 wks
450 sq cm (12 birds)	61.60	55.90	57.7 ^a	57.7 ^a	58.7 ^a
540 sq cm (12 birds)	63.10	59.40	61.1 ^{ab}	69.1 ^b	63.7 ^b
675 sq cm (12 birds)	71.10	65.70	63.8 ^b	68.4 ^b	66.9 ^{bc}
900 sq cm (12 birds)	67.30	64.80	68.5 ^c	71.1 ^b	68.6 ^c
SEm	1.95	2.10	1.17	1.46	0.96
P Value	0.32	0.19	0.003	0.001	0.001

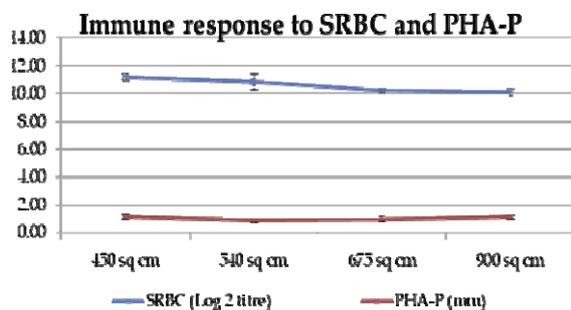
Means with different superscript in a column differ significantly ($P < 0.05$)



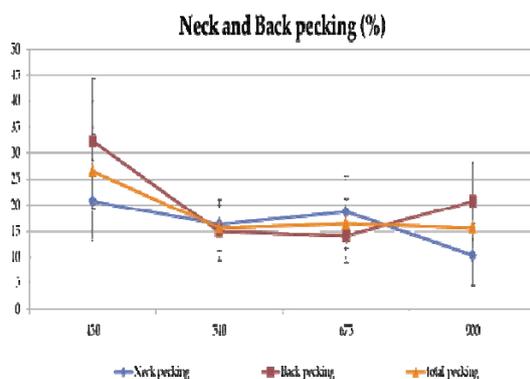
Average daily feed intake of the WLH layers in different floor space



Kilogram of feed consumed per kg egg produce in layers at different floor space



Immune response to SRBC (Log₂ titre) and PHAP (mm foot web thickness) in WLH layers provided with different floor space



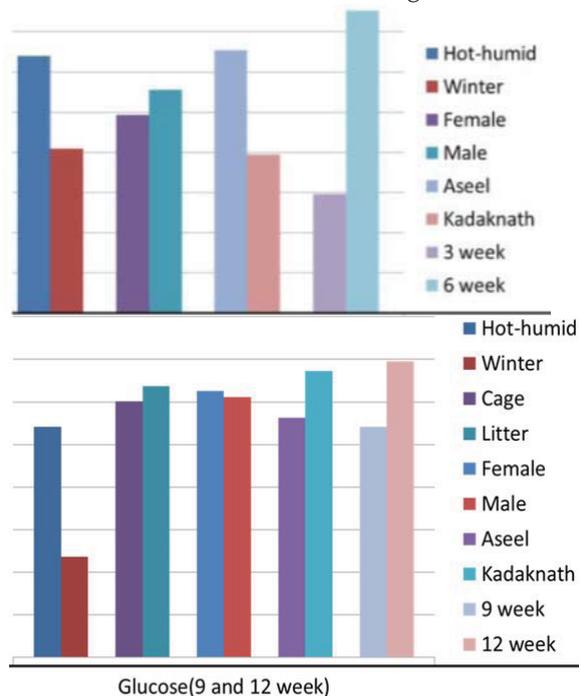
Neck and back pecking (%) in WLH layers provided with different cage spaces

Blood and serum enzyme profile of the WLH layers provided with different cage space

Floor space	H:L ratio	Hb	PCV	SGPT	SGOT
450 sq cm (12 birds)	0.368	8.25	26.25	25.4	115.6
540 sq cm (12 birds)	0.350	7.38	22.75	20.1	132.3
675 sq cm (12 birds)	0.323	7.75	24.00	23.3	134.5
900 sq cm (12 birds)	0.304	8.25	25.50	24.7	131.6
SEm	0.015	0.083	0.52	1.88	3.67
P Value	0.528	0.208	0.079	0.797	0.252

Physiological responses under normal and stressed conditions in indigenous and improved varieties of poultry

Season, breed, age and sex interaction effect was significant ($P < 0.05$) on cholesterol (mg/dl) for 3 and 6 weeks. Season, breed, age, sex and rearing system interaction effect was also significant ($P < 0.01$) at 9 and 12 weeks. Breed had significant ($P < 0.01$) effect for 3 and 6 weeks age groups. Season and rearing system and sex effect had no significant ($P > 0.05$) effect on cholesterol for all age groups. Highest value was recorded for Aseel female during winter season as 136.33 ± 3.01 and lowest value was recorded as 53.20 ± 1.93 for Kadaknath female at 3rd week during winter.



There was significant ($P < 0.01$) effect of season, breed, age and sex interaction on glucose content (mg/dl) for 3 and 6 weeks. Season, breed, age, sex and rearing system interaction effect was significant ($P < 0.01$) for 9 and 12 weeks. Sex and

season had significant ($P < 0.01$) effect for 3 and 6 weeks age groups. Season and age effect was significant ($P < 0.01$) for 9 and 12 weeks.

The total protein values (g/dl) ranged between 2.66 ± 0.05 to 5.30 ± 0.12 in both the seasons. Season, breed, age and sex interaction effect was significant ($P < 0.01$) on total protein for 3 and 6 weeks. Similarly, season, breed, age, sex and rearing system interaction effect was observed significant ($P < 0.01$) for 9 and 12 weeks. Breed and season had affected total protein significantly ($P < 0.01$) for 3 and 6 weeks age groups. The effect of age and season were significant ($P < 0.01$) on total protein for 9 and 12 weeks. Sex, rearing system and breed had no significant ($P > 0.05$) effect at 9 and 12 weeks.

Comparison of uric acid (mg/dl) in Aseel and Kadaknath at various ages revealed that highest value was recorded for Kadaknath female during 6th week in winter season as 5.86 ± 0.02 and lowest value was recorded as 4.29 ± 0.09 for Aseel male at 3rd week during hot-humid. Season, breed, age and sex interaction effect was significant ($P < 0.01$) on uric acid for 3rd and 6th weeks. Season, breed, age, sex and rearing system interaction effect was significant ($P < 0.01$) for 9 and 12 weeks. There was significant ($P < 0.01$) effect of age and season on uric acid for all age groups. Breed and rearing system affected uric acid levels significantly ($P < 0.05$) for 9 and 12 weeks.

The highest value of creatinine (mg/dl) was recorded for Kadaknath female at 3rd week in winter season as 1.17 ± 0.37 and the lowest value was recorded as 0.73 ± 0.03 for Kadaknath female in cage at 12th week during winter season. Season, breed, age and sex interaction effect was significant ($P < 0.05$) on creatinine for 3 and 6 weeks. Season, breed, age, sex and rearing system interaction effect was significant ($P < 0.01$) for 9 and 12 weeks. There was significant ($P < 0.01$) effect of season on creatinine for all age groups. Breed effect was significant ($P < 0.01$) for age groups 3 and 6 weeks.

The lowest value of alanine transaminase (ALT, IU/L) was recorded for Kadaknath female 3rd week in winter season as 1.80 ± 0.33 and the highest value was recorded as 7.60 ± 0.37 for 12 week old Aseel female in cage in winter season. Individual effect of breed, age and interaction effect of season, breed, age and sex was significant ($P < 0.01$) on ALT for 3rd and 6th week. Season, breed, age, sex and rearing system interaction effect was significant ($P < 0.01$) for 9 and 12 weeks. There was significant ($P < 0.05$) effect of season on ALT for all age groups.

The highest value of aspartate transaminase (AST IU/L) was recorded for Aseel female in litter at 12th week in winter season as 192.15 ± 1.28 and

the lowest value was recorded as 94.11 ± 1.73 for Kadaknath female in litter at 12th week during winter season. There was significant ($P < 0.01$) effect of season on AST in all age groups. Season, breed, age and sex interaction effect was significant ($P < 0.01$) on AST for 3 and 6 weeks. Season, breed, age, sex and rearing system interaction effect was significant ($P < 0.01$) for 9 and 12 weeks.

Effect of thermal stress on haemato-biochemical attributes in Aseel and Kadaknath birds

The study was conducted to investigate the effect of acute heat stress on physiological and haemato-biochemical attributes in native chicken. A total of 48 adult (30 weeks old) male and female birds of Aseel and Kadaknath breeds were selected and distributed equally in two groups which were reared simultaneously under normal and acute heat stress conditions. For acute thermal stress treatment, the birds were shifted to psychrometric chamber. After adaptation period of four days, birds were exposed to acute heat stress under temperature of $40 \pm 1^\circ\text{C}$ and relative humidity $55 \pm 5\%$ (THI ≈ 91) for four hours daily from 10:00 am to 02:00 pm for continuous seven days. All the physiological observations for birds under normal and heat stress conditions were recorded on pre and post-exposure. Microclimatic observations in the shed were recorded two times (08:00 am and 04:00 pm) daily. The study revealed that body weight was influenced ($P < 0.05$) by breed and sex, with higher body weight observed in Aseel males. Acute thermal stress adversely affected the body weight in both the native breeds. There was higher mortality in Aseel under thermal stress conditions. Egg production, egg weight and shell thickness was reduced ($P < 0.05$) after thermal stress exposure. Aseel birds were comparatively more affected than Kadaknath. Feed intake and respiration rate were affected ($P < 0.05$) by thermal stress, breed and sex. Water intake, body and comb temperature were affected ($P < 0.05$) by heat stress and sex. Increase in water intake, respiration rate, body and comb temperature were observed after thermal stress exposure with reduced feed intake. Haematological parameters *viz.* Hb, PCV, TLC and H: L ratio were affected ($P < 0.05$) by thermal stress, breed and sex. Total RBC count was affected by thermal stress and breed. Decrease in Hb, PCV, total RBC and TLC was observed with increase in H:L ratio after thermal stress exposure. Kadaknath breed had higher haematological values than Aseel. Serum electrolyte profile revealed that sodium was affected ($P < 0.05$) by thermal stress and breed. Higher serum total protein was observed in females. Serum globulin, cholesterol and calcium were affected ($P < 0.05$) by thermal

stress and sex. Blood glucose, uric acid, triglyceride, ALT and AST were significantly ($P < 0.05$) affected by thermal stress, breed and sex. Higher glucose, triglyceride, cholesterol and AST values were observed in heat stressed birds. Acute heat stress significantly ($P < 0.01$) reduced intestinal villi length. It may be concluded that acute thermal stress adversely affected the performance of native chicken and Kadaknath birds showed better performance than Aseel under acute thermal stress.

Poultry waste for green energy and organic fertilizer generation

Aerobic composting technique using poultry excreta with different carbonaceous materials like plant leaves, paddy straw and saw dust was standardized using C:N::25:1 and moisture 50-55%. Meshed iron wire made composting bins measuring 1.2m length x 1.2m width and 1.2m height were fabricated by the use of discarded poultry cages. There were ample air spaces for better aeration. The composting bins were placed on concrete base to avoid percolation of water and nutrients in the soil. The poultry excreta and respective carbonaceous materials were mixed in following ratios to maintain C:N ratio 25:1.

Poultry excreta: plant leaves: water: 1: 0.35: 0.25

Poultry excreta: paddy straw: water: 1: 0.30: 0.25

Poultry excreta: saw dust: water: 1: 0.35: 0.20

Composting bin loaded with plant leaves, paddy straw and saw dust mixed with calculated amount of poultry excreta was designated as T₁, T₂, and T₃ group, respectively. Composting bin loaded only with poultry excreta and without any type of carbonaceous material was treated as control group (T₀) and the initial C:N ratio was 10:1. The amount of carbonaceous materials and poultry excreta used in different composting treatments were determined after considering their initial dry matter (DM), total organic carbon (TOC) and total nitrogen (N). Composting was carried out by sequential layering of carbonaceous materials and poultry excreta. First, the carbonaceous materials were spread in each bin and then a layer of poultry excreta was applied over it. The same was repeated 3-4 times. Measured quantity of water was also added during filling to maintain constant moisture (50-55%) in all the treatments except control. The temperature of different composting bins gets elevated from 2nd day onwards. The turning of composting bins was undertaken after completion of primary phase. Primary phase was supposed to get completed when bin temperature started declining trend and reached near to initial filling temperature. After turning and refilling of respective composting bins, temperature again elevated.

The average bin temperature was significantly ($P < 0.05$) higher in all the treatments than control group both during primary and secondary phases of composting. Similar trend was observed for peak temperature. The composting period was significantly ($P < 0.05$) higher in all treatment groups than control. The initial moisture content was significantly higher ($P < 0.05$) in control than other three treatment groups during initial and final stages of composting. Volume and weight reduction (%) was numerically lower in control than other treatment groups. Initial and final pH was significantly ($P < 0.05$) higher in control than other three treatment groups. The TOM and TOC were significantly higher ($P < 0.05$) in treatment groups than control during initial, turning and final stages of study. The C:N ratio was significantly ($P < 0.05$) higher in treatment groups than control, both during initial and final stages of composting. The total bacterial count (TBC) and *E. coli* count (\log_{10}) were significantly ($P < 0.01$) lower in different treatment groups than control at final stage.

Among various plant nutrients total nitrogen, during initial stage, was significantly ($P < 0.01$) higher in control than treatment groups. At turning and at the final stage the difference was non-significant in all the groups. The calcium at initial and turning stage was non-significant among different treatment and control groups. However, difference was significant ($P < 0.05$) at final stage. Similarly, P and K concentrations were non-significantly different at various stages of composting. Since effective composting process was not observed in control group, it was not considered for economic analysis. Better value addition was observed in T₁ followed by T₂ and T₃ groups due to free availability of plant leaves. Germination (%) was similar in all the treatment groups, however, no germination was observed in control group. About 2.0-2.5 times value addition can easily be expected from aerobic composting of poultry excreta using various carbonaceous materials.

Purification of bio-gas and production of Synthetic Natural Gas (SNG) exclusively from poultry excreta

A novel 'DAC' technology for all-weather biogas production exclusively from poultry excreta was developed at CARI, Izatnagar on pilot scale. The produced bio-gas had various impurities like H₂S, NH₃, CO₂, H₂O etc. H₂S and NH₃ was reduced to permissible level (<4 ppm) by acidification technology.



Programme 3: Value addition, food safety, quality assurance and product development

Sub Programme – Development of value added poultry feed and poultry products with functional attributes and quality assurance including product development.

A biological trial, completely randomized design (CRD), was conducted for six weeks to investigate the optimum time duration of flaxseed meal (FM) feeding in broiler chicken for optimum growth performance, carcass characteristics, and cost economics of broiler chicken production. Two types of diets were formulated, one with 10% flaxseed replacing soybean and other without flaxseed. The flaxseed based diet was fed for different durations giving rise to six dietary treatment used in the experiment viz., T1 (control without FM), T2 (10% FM; 0-5th week), T3 (10% FM; 1-5th week), T4 (10% FM; 2-5th week), T5 (10% FM; 3-5th week), and T6 (10% FM; 4-5th week). A total of 240 day-old broiler chicken of uniform body weight and same hatch were taken and each treatment was allocated 5 replicates at random with 8 chicks in each. The results revealed that addition of 10% flaxseed have revealed negative effects on overall growth performance of the birds. However, negative effects were overcome by reducing the duration of flaxseed feeding from five weeks to three weeks. The growth performance of birds fed flaxseed from 2-5 weeks of age was similar to that of control diet (no flaxseed) fed birds. No significant effect of feeding flaxseed meal for different durations was found on the carcass traits studied. However, increasing the duration of flaxseed feeding from zero to three weeks resulted in progressive decline of abdominal fat percentage. The cost per kilogram live weight and cost per kilogram meat yield increased progressively with increasing duration of flaxseed feeding. The feeding of flaxseed meal alone at 10% level in standard broiler ration during 2-5 weeks of age resulted in n-3 fatty acids enrichment in meat and optimum growth performance and cost per kg live weight of birds. However, the oxidative stability of the meat got compromised by the feeding of flaxseed meal @ 10% level during 2-5 weeks of age of broiler chicken.

Lactobacillus plantarum for enhancement of functionality and shelf-life of poultry products

Based on analysis of biochemical, proximate, microbiological and sensory parameters for control, *Lactobacillus plantarum* (Lp) control and treatment groups under earlier experiment, the chicken sausages prepared with incorporation of 2% w/w level of malted oat flour (T2) was found

best group among all the groups and thus, chicken sausages prepared after fermentation of minced chicken meat with Lp and with incorporation of 2% malted oat flour (T2 group) along with control groups (chicken sausages prepared from minced chicken meat with and without addition of Lp) were further used for evaluation of antioxidant and antimicrobial profile both under refrigeration ($4\pm 1^\circ\text{C}$) and frozen (-18°C) storage conditions for a period of 14 and 60 days, respectively. The results revealed that antioxidant activities (ABTS⁺ and SASA scavenging activity) of Lp control and treatment group were found significantly ($P<0.001$) higher in initial days of storage than the control group and with successive refrigerated ($4\pm 1^\circ\text{C}$) and frozen storage ($-20\pm 1^\circ\text{C}$) days, the activities were reduced, however, ABTS and SASA scavenging activities of treatment group remained significantly ($P<0.05$) higher as compared to control and Lp control group throughout the refrigerated ($4\pm 1^\circ\text{C}$) and frozen storage ($-20\pm 1^\circ\text{C}$). TBA activity of T2 group was significantly ($P<0.001$) higher than control and Lp control group during refrigeration storage, however, during frozen storage, it remained non-significant with control and Lp control. Total plate count was significantly ($P<0.001$) increased for control, Lp control and treatment group (T2) under refrigerated storage, however, the count remained non-significant ($P<0.001$) in frozen storage with very low count. Coliform, yeast and mould and *Salmonella* spp. were not detected both under refrigerated ($4\pm 1^\circ\text{C}$) and frozen ($-20\pm 1^\circ\text{C}$) storage. Based on the antioxidant and sensory parameters, fermented chicken sausages with incorporation of malted oat flour were better antioxidant attributes during storage both under refrigeration and frozen storage conditions and were acceptable up to 9 days of refrigerated and till 60 days of frozen storage.

Standardization of growth conditions for Lactobacillus plantarum with barley as substrate in broth conditions

A study was carried out to assess growth conditions for *Lactobacillus plantarum* (Lp) under *in-vitro* under laboratory conditions in brain heart infusion (BHI broth at refrigeration ($4\pm 1^\circ\text{C}$) and 20°C temperatures for a period of 24 h with added levels (0, 1.0, 2.0, 3.0 and 4.0% w/v) of malted barley flour (MBF) with an aim to explore the suitability of using MBF as substrate for Lp in minced chicken meat during fermentation. Incorporation of MBF supported growth of Lp at both temperatures as compared to control group throughout the storage period, however, Lp growth profile in BHI with % w/v MBF was comparatively better than other treatment groups. It was

concluded to use this level in minced chicken meat for better growth profiling of Lp during fermentation in minced chicken meat for exploring possibility of development of chicken sausages with better functional attributes.

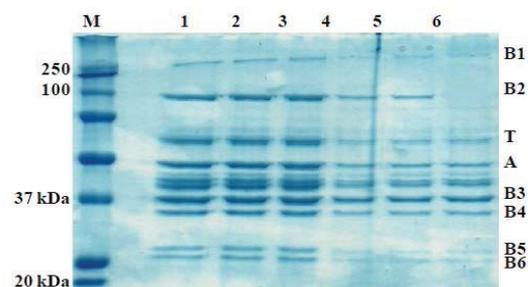
Shelf-life extension of selected traditional meat products prepared from spent chicken using natural antioxidant and antimicrobial compounds

For standardization of post-mortem tenderization of breast meat, it was held at refrigeration ($4 \pm 1^\circ\text{C}$) temperature for evaluation of different physicochemical quality at intervals of 0.5, 3, 6, 12, 18, 24 and 36 h. Besides this, electrophoretic pattern of myofibrillar proteins, Warner-Bratzler shear force value (WBSFV), myofibrillar fragmentation index (MFI) and protein extractability of the samples were also determined. The electrophoretic patterns of the myofibrillar proteins due to action of proteolytic enzymes during refrigeration holding indicated that there were 6 important modifications- viz., one protein of MWt near 110 kDa disappeared 24 h post-mortem though it was distinctly visible at 6 h and fairly visible at 12 and 18 h. Similarly, 2 proteins of approximately 29 and 30 kDa, first appeared immediately after post-slaughter, and then band clearance increased up to 6 h, but on subsequent ageing for 12-24 h, the bands disappeared. The 110 kDa protein could be α -actinin, which is known to be a substrate of calpains. The bands were observed at 43 and 65-70 kDa could due to the presence of proteins actin and tropomyosin, but additional bands predicted at 33 and 35.4 kDa might be due to protein α -tropomyosin and troponin T, respectively. In general, during post-mortem ageing all the cytoskeletal proteins along with few regulatory and myofibrillar proteins started to disappear or degraded into other forms due to action of calpains.

The pH value of breast meat was consistently decreased up to 24 h. The PM acidification of breast muscle, which reflects the development of rigor mortis, and pH stabilization at a value called ultimate pH, at which the muscle enters rigor developed at 24 h during ageing. WHC of meat was decreased ($P < 0.05$) with the increase of ageing times and the values ranged from 24.43 to 7.67% at 36 h. The WBSFV was declined significantly ($P < 0.05$) up to 12 h but thereafter values differed non-significantly ($P > 0.05$). All the colour coordinates were significantly influenced ($P < 0.05$) by PM ageing. The colour coordinates of *a*- (redness) and *b*- (yellowness) values decreased and increased respectively with the increase of ageing times. The Hue angle (*H*) and Chroma (*C*) value also followed similar trends to that of redness and yellowness value since they are

estimated value. However, PM ageing had little influence in increase of TBARS value since this value varied from 0.31 mg MDA/kg at 30 min to 0.39 mg MDA/kg at 24 h while free fatty acids (FFA) value was affected significantly only after 12 h of ageing period. The peroxide value was unaffected because after ageing it showed about 0.17 meq/kg.

MFI was increased significantly ($P < 0.05$) with the increase of ageing time until 24 h. The water soluble proteins (WSP) and salt soluble proteins (SSP) were increased and decreased respectively and they reached a plateau at 24 h. During initial stage of ageing, the higher protein extractability for SSP could be due to myosin and actin molecules of muscle fibres were in free form and when they progress toward rigor state the availability of free myosin and actin molecules were minimum thereby showed lower SSP at 24 h of ageing. The increased WSP with the increase of ageing periods could be correlated with denaturation of sarcoplasmic proteins at early post-mortem due to rapid post-mortem glycolysis as a result of decreased in muscle pH.



SDS-PAGE shows degradation of protein bands of breast muscle from broiler breeder during ageing at refrigeration temperature ($4 \pm 1^\circ\text{C}$)

Lane 1, 2, 3, 4, 5 & 6: Representing protein bands after 0.5, 3, 6, 12, 18, 24 and 36 h of PM ageing, respectively. Protein Markers: Bio-Rad Precision plus Protein All Blue Standard (10 – 250 kDa)

A: Actin (Predicted size 43 kDa), B1: Myosin HC, B2: α -actinin, B3: Troponin T (predicted size, 35.4 kDa), B4: α Tropomyosin (predicted size, 33 kDa), B5: Degradation protein of Troponin T, B6: Degradation protein of Troponin T, T: Tropomyosin (predicted size, 65-70 kDa)

Standardization of marination time in development of chicken tikka using spent hen meat

Several preliminary trials were conducted to optimize chunk size, marinating temperature, method of grilling etc. before standardization of marination time. After completion of 24 h of post-mortem ageing, breast meat of spent chicken was cut into cubes (L \times W; 1 \times 1 inches) and then kept into marinade contained water, table salt, STPP, sodium ascorbate, sodium nitrite, white pepper, red chilli (degi mirch), condiment, vegetable oil,

cumin and cinnamon powder and dahi as base ingredients. Since, several ingredients were used in preparation of marinade, it was standardized based on preliminary trials. Total three treatments were assigned viz., T₁, T₂ and T₃ (1, 1:30, 2 h marination, respectively). It was observed that time variation of marination for chicken tikka had highly significant effect ($P < 0.01$) on different physicochemical parameters and sensory attributes. The proximate composition however did not vary significantly amongst the samples, except moisture. The pH and cooking yield of chicken tikka was lowest in T₃ sample. The moisture content was marginally higher for T₁ samples. WBSFV and myofibrillar fragmentation index (MFI) was lowest and highest for T₃ samples, respectively. All the colour co-ordinates (redness, yellowness, Hue angle and Chroma value) did not differ significantly amongst the samples. This parameter was also correlated with the sensory colour scores since they differed non-significantly ($P > 0.05$) and rated very good to good. Textural scores however varied significantly amongst the different treatments. The T₃ had significantly ($P < 0.05$) higher textural scores compared to T₁ and non-significantly ($P > 0.05$) from T₂. The flavour and juiciness scores were also significantly higher for T₃ samples. The overall acceptability scores were higher for T₃ samples and lowest for T₁. Based on above results, it was observed that marination of chicken tikka for 2 h produced products with desirable physicochemical quality and better sensory acceptability of finished products. This marination time was therefore, selected for standardization of cooking schedule for further studies.

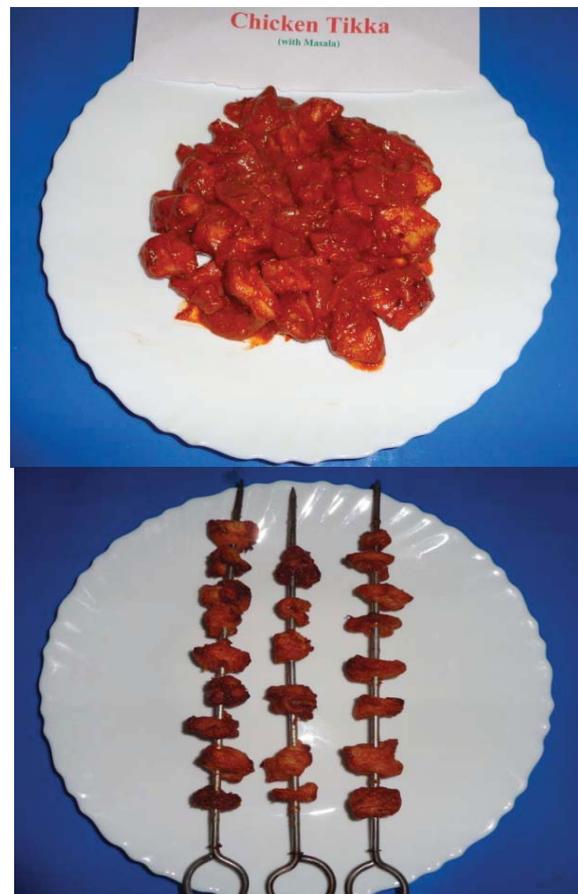


Marinated chicken meat Tikka

Standardization of cooking time for processing of chicken Tikka using spent hen meat

Three different cooking schedules viz., 25, 30 and 35 min were selected for grilling at 180 ± 2 °C temperature for optimization of cooking time/schedule using broiling/ grilling techniques. Samples cooked for 25, 30 and 35 min were

designated as T₁, T₂ and T₃, respectively. It was observed that T₁ had comparatively lower pH than other two samples but differences amongst the samples were non-significant.



Chicken meat Tikka with Tikka masala Read-to-eat Chicken meat Tikka

Cooking yield showed however significant ($P < 0.05$) effect and was highest for T₁ followed by T₂ and T₃. The cooking yields recorded were 68.14, 65.4 and 64.50% for T₁, T₂ and T₃, respectively. Moisture content was highest for T₁ samples and values differed significantly ($P < 0.05$) from T₂ and T₃. Other chemical compositions i.e., protein, fat and ash content were nearly similar for all samples. MFI and instrumental colour value were very little affected and thus, product cooked for 35 min experienced colour development. The data for sensory attributes revealed highly significant ($P < 0.01$) effect on texture and overall acceptability, significant effect ($P < 0.05$) on juiciness but non-significant effect ($P \geq 0.05$) on appearance and colour and flavour attributes. Though T₃ sample had lower juiciness scores but exhibited highest scores for appearance and colour, texture and flavour scores. So, on the basis of above parameters grilling for 35 min (T₃) was selected as the best since it produced suitable quality chicken meat Tikka.

EXTERNALLY FUNDED PROJECTS**Seaweed based formulations for improving productivity and health**

The effect of dietary inclusion of *Kappaphycus alvarezii* and red sea weed (AF-KWP) on production performance (egg production, body weight changes, feed intake and feed conversion ratio), egg quality (including functional properties) and keeping quality of eggs on 300 day-old female layer chicks was studied, wherein chicks were divided in 4 dietary treatment groups (4 x 75 = 300). A commercial basal diet (control-T1; T1) was formulated, the rest three test diets were prepared by adding different levels of AF-KWP i.e, T1+ 1.25% AF-KWP (T2), T1+ 1.50% AF-KWP (T3) and T1+ 1.75% AF-KWP (T4). Egg production from each treatment was recorded for two phase's i.e, age at sexual maturity to 25th wks and 26-40th wks. Two hundred eggs were collected, 50 eggs from each treatment for each phase. The results indicated that inclusion of *Kappaphycus alvarezii* and red sea weed based formulations (AF-KWP) at 1.50% level in layer diet reduced the age of sexual maturity and improved the production performance i.e, egg number, egg weights and egg quality traits. The effects of *Kappaphycus alvarezii* and red sea weed (AF-KWP) on lipid oxidation parameters of eggs e.g. *Thiobarbituric Acid reactive Substances (TBARS)*, 2-thiobarbituric acid (TBA), *Free fatty acid and Peroxide value*, were studied. No significant ($P > 0.05$) differences were recorded in free fatty acids concentration among the dietary treatments groups in the both the phases. Whereas, Thiobarbituric acid reacting substances (TBARS) activity values significantly ($P < 0.05$) increased in AF-KWP@1.50% supplemented groups in fresh and stored (14 d) eggs. Peroxide values were also not significant (except storage for 14 d) among the dietary treatment groups.

Enhancing livelihood security of farming community

Under Farmers' First programme, Nisoi, Ismailpur, Aterchedi near Aonla block (UP) were selected for poultry module. A special training programme was conducted from July 10-14, 2017 on poultry production wherein 15 farmers were trained for rural poultry farming and 10 farmers from these villages were provided with 50 CARI-NIRBHEEK birds (25 males and 25 females) to each farmer in August/September, 2017. The farmers constructed the houses with locally available materials. Limited feed was also provided to these poultry farmers. Regular meetings were made with farmers at their home/farm and necessary help was rendered. Out of 10

farmers one farmer disposed off all the 42 birds (8 died) @ Rs 250 per bird, thus earned Rs 10500.00. Nine farmers are rearing the birds as per our advice and having regular income. They have sold the male birds @ Rs. 500 per bird (Rs. 350-750) and utilize this to meet out the expenditure for feed and their personal need. Daily, the farmers were getting 10-15 eggs from the laying hens. During winter they sold eggs @Rs. 15/egg, but in other seasons @ Rs. 8 per egg. The farmers, in their feedback, revealed that they have gained confidence in rearing the birds; others are now interested to take up poultry as source of business. Marketing of eggs in summer was reported to be a major constraint.



Detection and control bacterial pathogens in poultry

The study was aimed to isolate *Salmonella* and *Campylobacter* from the broilers samples (faecal swab) collected from local poultry farms located in and around Bareilly city. The *Salmonella* isolation was done using both conventional as well as PCR based methods. The pre-enrichment was carried out in buffered peptone water (BPW) and tetrathionate as selective broth was used as selective media. Subsequently, after 24 h of incubation in selective broth, inoculum were streaked on Hektoen as selective agar and further identification was carried out using biochemical tests poly "O" sera. The results revealed that out of 224 faecal swab samples, 6 were found positive for *Salmonella* spp. which was further confirmed by PCR using *invA* gene.

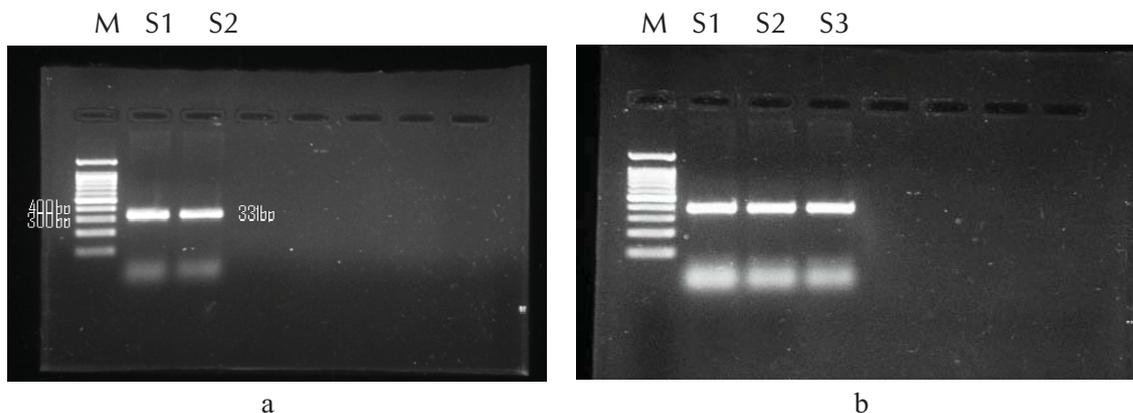
The isolation of *Campylobacter* was carried out under microaerophilic conditions. Inoculums were collected from scrapings of lumen of caecum and were directly plated on the campylobacter blood free agar incorporated with selective supplements and polymixin B as antibiotic. The presumptive colonies were collected for further confirmation using carbol fuchsin staining, sodium hippurate hydrolysis, catalase and oxidase tests and nalidixic acid sensitivity tests. Further, isolates were also confirmed by PCR which were visualized on agarose gel with a product size of 331 and 391bp for *C. jejuni* and *C. coli*, respectively. The results of isolation revealed that from 268 caecal swab samples, 5 were identified as *Campylobacter* spp. which included 2 as *C. jejuni* and 3 as *C. coli*.

Synbiotics supplementation for improved nutrient utilization and safe poultry meat production

The effect of dietary inclusion of Synbiotics [*Mannan oligosaccharides* (MOS) and *Lactobacillus acidophilus*] on growth performance and immune response were studied on 336 day-old straight-run broiler chicks, divided in 7 dietary treatment groups with 6 replicate each (7 x 6 x

8=336). A commercial basal diet (control-1; T1) and a low energy low protein diet (LELP) basal diet (control-2; T2) was formulated, the rest nine test diets were prepared by adding BMD 20 mg/kg diet (T3), T2+ MOS @ 0.1% + *Lactobacillus acidophilus* @10⁶ cfu/g (T4), T2+ MOS @ 0.1% + *Lactobacillus acidophilus* @10⁷ cfu/g (T5), T2+ MOS @ 0.2% + *Lactobacillus acidophilus* @10⁶ cfu/g (T6), T2+ MOS @ 0.2% + *Lactobacillus acidophilus* @10⁷ cfu/g (T7). Results of the present study revealed that the broiler chicks treated with dietary synbiotics (MOS @ 0.1% + *Lactobacillus acidophilus* @10⁶ cfu/g) elicited a significant (P<0.05) increase in body weight gain in starting (0-21d) and growing (21-42 d) phase and also in final body weight gain (0-42d) in comparison to antibiotic growth promoter (AGP) and control group. In case of low energy low protein (LELP) diet, significant (P<0.05) increase was observed in T4 group (MOS @ 0.1% + *Lactobacillus acidophilus* @10⁶ cfu/g) followed by T5 (MOS @ 0.1% + *Lactobacillus acidophilus* @10⁷ cfu/g) as compared to the commercial diet and other synbiotics inclusion. Feed intake and feed conversion ratio (FCR) did not differ (P>0.05) due to feeding diets containing different levels of synbiotics in LELP and commercial diet in all the three growth phases i.e., 0-21d or 21-42d or 0-42d. Humoral immune response and cell mediated immune response significantly (P<0.05) improved in low energy low protein (LELP) diet treated with symbiotic (MOS @ 0.1% + *Lactobacillus acidophilus* @10⁶ cfu/g) compared to the commercial diet and antibiotics treated group. Better immune responses (humoral and cell mediated) were recorded in T4 (MOS @ 0.1% + *Lactobacillus acidophilus* @10⁶ cfu/g) and followed by T5 (MOS @ 0.1% + *Lactobacillus acidophilus* @10⁷ cfu/g) in LELP diet, respectively.

Another study was conducted to study effect of synbiotics on blood biochemical parameters and expression of genes related to growth in broiler chickens. At the end of feeding experiment, blood samples from 8 birds/ treatment (2 birds / replicate)



Amplified product of genes of *Campylobacter jejuni* (a) and *Campylobacter coli* (b)

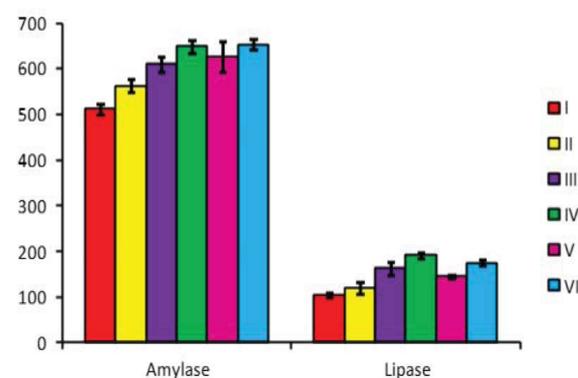
were randomly collected into sterile glass test tube without addition of anticoagulant. Test tubes containing the blood were kept in slanted position at room temperature for half an hour to facilitate separation of serum. Serum was separated by centrifugation at 3000 rpm for 10 minutes and serum was decanted into plastic vials, and then stored at -20°C for estimation of serum enzymes [alkaline phosphatase, AST/SGOT, (ALT) /SGPT], kidney function test (serum creatinine and uric acid), serum minerals (calcium and phosphorus), serum total cholesterol, total protein and albumin. To achieve these objective three birds from each treatment were sacrificed on day 42. Liver and spleen samples were collected aseptically in RNA lysis solution and were kept in -20°C. Real time PCR was performed to quantify the mRNA expression levels of IGF-2, TGF- β and IL-6. Already reported primers were used to quantify the above mentioned genes. mRNA expression levels of target genes were quantified relative to β -actin gene (house keeping gene). The $2^{-\Delta\Delta Ct}$ method was used to analyze the real time PCR data.

No significant ($P > 0.05$) difference was observed in total protein, creatinine, calcium, phosphorus, concentration and ALP activity in any of the dietary synbiotic treatment group but serum albumin, serum enzymes (AST and ALT), kidney function test (uric acid) and total cholesterol concentration were significantly ($P < 0.05$) increased or decreased in LELP with synbiotic i.e., MOS @ 0.1% + *Lactobacillus acidophilus* @ 10^6 cfu/g supplemented group. This experiment examined correlated responses to selection in the developmental gene expression of the peptide transporter (PepT1), the sodium-dependent glucose transporter (SGLT1), and the glucose transporter (GLUT5) genes in the small intestine of 21st d of age. Specific trends were observed in nutrient transporter genes expression and significant differences were observed in their fold expression among all the three genes. In relative fold expression of genes associated with nutrient transporter at 21 d, all the three genes i.e., GLUT5, PepT1 and SGLT1 were up-regulated significantly ($P < 0.05$) in T4 and T5 group. GLUT5, PepT1 and SGLT1 were upregulated in T6 and T5 group but the expression levels were not significant ($P > 0.05$). GLUT5, PepT1 and SGLT1 were down-regulated in T2 and T3 group.

Gut health and immunological functions in broilers

Study was conducted to standardize the dose for individual as well as combination of nucleosides for enhancing gut health and immunological functions in broiler chickens using 240 chicks, divided into 6 groups. Treatments

included T1: Control, T2: Adenosine (0.1%); T3: Guanosine (0.1%); T4: Cytosine (0.1%); T5: Uridine (0.1%) and combination of all four nucleoside bases (Adenosine, Guanosine, Cytosine and Uridine) (T6) each at 0.1%. The bases were administered orally daily for 14 days in the early morning before feeding. Birds were sacrificed after 7, 14 and 42 days. The body weights were recorded at 7d intervals and the change in body weight was assessed. After 7, 14 and 42d of feeding the randomly selected chicks (n=10 per group) were sacrificed and the intestinal morphological changes were recorded. The body weight showed significant increase from the second week of age due to supplementation but not in first week and hatch weights. A significant increase in the length of intestines was observed in chicks supplemented with combination of nucleotides, while the intestinal weight was significantly reduced. Significant increase in intestinal weight was observed during first week in chicks supplemented with adenosine, compared to other nucleosides and their combination. During 14th day slaughter, there was no significant difference in either intestinal weight or length in all groups. On final slaughter after 42 days, significant increase in intestinal length was observed in combination supplemented group, followed by adenosine supplemented group. The intestinal enzymes amylase (280 vs. 332 U/L) and lipase (98.5 vs. 141.96 U/L) also showed numerical increase in activity due to supplementation. The serum biochemical parameters did not show any treatment variation. The intestinal villi length, diameter, crypt depth and villi length: crypt depth ratio showed significant ($P < 0.01$) improvement in the nucleoside supplemented groups as compared to control. The administration of mixture of nucleoside favourably increased the body weight, intestinal villi development and also the activities of intestinal amylase and lipase enzymes activities.



Effect of individual and combination of nucleosides feeding on plasma digestive enzymes in broiler chicks

Nanoparticles for improving the incubational and post-hatch status of egg and meat type chicken

Effect of gold nanoparticle: *In ovo* feeding of gold nanoparticle did not affect the hatchability parameters and growth performance in meat type chicken, but eggs receiving 25 and 50 µg/egg of gold nanoparticle had almost 35-40g higher body weight at 42nd day of age in comparison to un-injected control. However, in egg type chicken, 25 µg/egg gold nanoparticle supplemented chicks had higher body weight ($P < 0.05$) at 56th day post-hatch. Relative weight of spleen and response to PHA-P was higher ($P < 0.01$) in gold nanoparticle supplemented meat type chicks but not in egg type chickens.

Effect of combination of nanoparticles: Hatchability parameters were similar but 45 to 58g higher body weight was recorded in gold and silver + gold nanoparticle combination in

comparison to un-injected control on 42nd day post-hatch. Spleen weight was higher in silver nanoparticle treated chicks while *in vivo* immune response to SRBC and PHAP was increased in silver or silver + gold combination treatment in comparison to un-injected control.

Effect of gold nanoparticle on body weight

Treatments	BW (g) of broiler at 42d	BW (g) of layer birds at 56d
Un Inj. control	1270.6	564 ^a
Sham Control	1265.6	576.7 ^{ab}
12.5µg/egg	1296.5	590.0 ^{ab}
25µg/egg	1310.9	612.8 ^b
50µg/egg	1306.9	589.4 ^{ab}
SEM	16.87	5.53
Sig.	0.7	0.05

Means with similar superscript in a column did not differ significantly ($P > 0.05$)

Effect of gold and silver nanoparticles on fertility and immunity

Treatments	Egg wt. (g)	Chick wt. (g)	Chick: Egg wt.	Hatchability %	BW (g)	Response to PHAP	Response SRBC
Control	65.7	46.0	70.0 ^a	94.6	1200	0.31 ^a	7.60 ^a
Sham	65.8	46.2	70.7 ^{ab}	95.3	1200	0.36 ^{ab}	8.25 ^{abc}
Silver 35	66.0	46.9	71.0 ^b	92.8	1221	0.49 ^c	8.63 ^{bc}
Gold 30	65.6	46.0	70.1 ^a	92.3	1258	0.41 ^{abc}	7.88 ^{ab}
Silver + Gold	65.6	47.0	71.7 ^b	95.5	1245	0.45 ^{bc}	8.80 ^c
SEM	0.21	0.21	0.23	NA	20.5	0.02	0.14
Sig.	0.96	0.23	0.03	NA	0.62	0.03	0.03

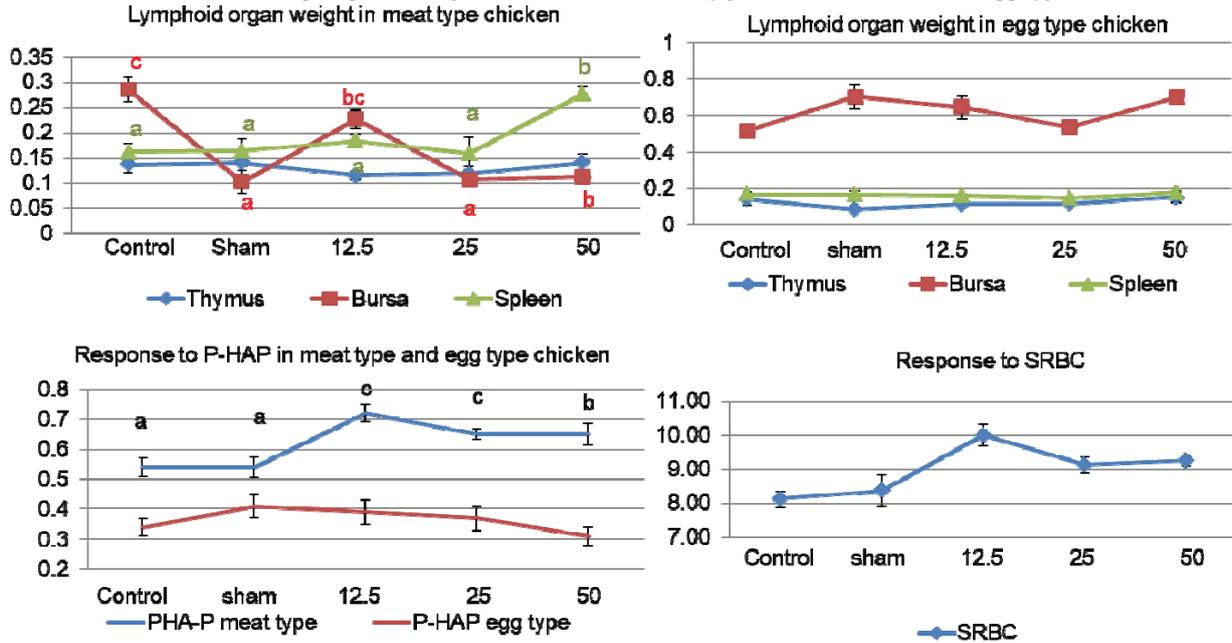
Means with similar superscript in a column did not differ significantly ($P > 0.05$)

Effect on growth and nutrient transfer gene: The expression of insulin like growth factor -1 (IGF-1) gene was up-regulated during embryonic period particularly in silver and gold nanoparticles (1.5 to 3.5 folds) but did not differ during post hatch period. The expression of essential amino acid transporter (EAAT 3) gene was up-regulated (2.1 to 4.7 folds) in silver nanoparticle supplemented chicks during both pre and post hatch period or in silver + gold nanoparticle group during post-hatch period. Whereas, the expression of fatty acid binding protein (FABP) was up-regulated (2.4 – 4.5 folds) during both pre and post-hatch period in silver nanoparticle supplemented chicks.

Study was conducted to evaluate the effect of dietary incorporation of Grobig[®] BS in diet on broiler production performance. A total of 600 chicks were randomly divided into six groups, having four replicates with twenty five birds in each. The chicks were reared in deep litter for 42 d under standard managerial conditions and fed with pre-starter, starter and finisher diets at 0-14, 15-28 and 29-42 d of age. Six treatments were T1

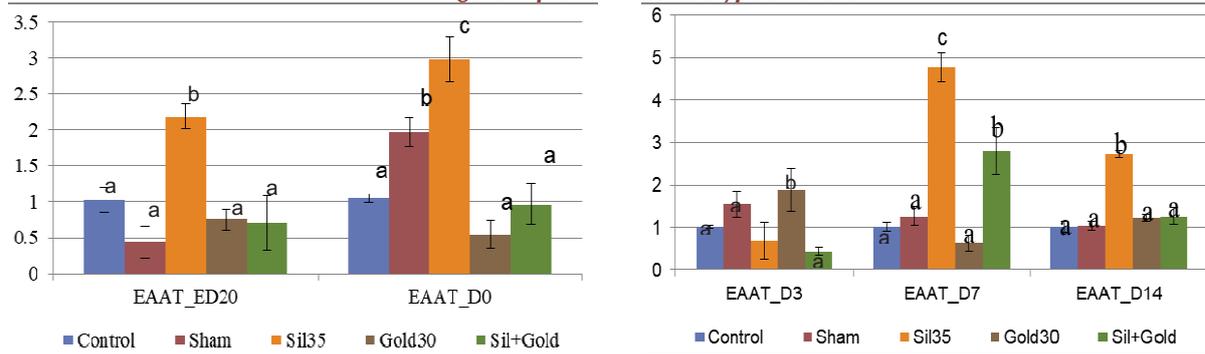
(Basal diet), T2 (Basal diet+ *Bacillus subtilis* QST713 (Grobig[®] BS) @ 50mg/kg), T3 (Basal diet+ *Bacillus subtilis* PB6), T4 (Basal diet+ *Bacillus subtilis* 4×10⁹ CFU/g DSM17299), T5 (Basal diet+ Bacitracin Methylene Disalicylate@), T6 (Basal diet+ Enramycin HCl@63-125gm/ton). The incorporation of Grobig[®] BS in broiler diet resulted in significantly ($P < 0.001$) better production performance from fourth week onwards compared to antibiotic as well as other probiotic fed groups. *Bacillus subtilis* QST 713 (Grobig[®] BS) improved gut health ($P < 0.001$) by favoring the growth of beneficial microbes and development of intestinal morphology (villi height and width) compared to antibiotic supplemented group. Grobig[®] BS improved immune response (cellular & humoral) and alleviated stress in broilers, leading to better welfare of flock. Dose of Grobig[®] BS was significantly less than that of other probiotics used in present trail. Grobig[®] BS @ 50g/ton could be an economical and effective alternative to antibiotic growth promoters in broilers.

Effect of *in ovo* feeding of gold nanoparticles on the immunity parameters in meat and egg type chickens

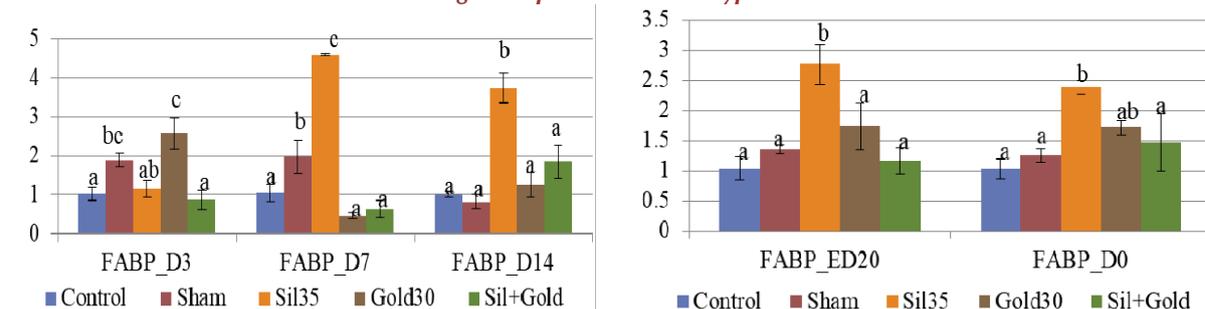


Contract Research Project

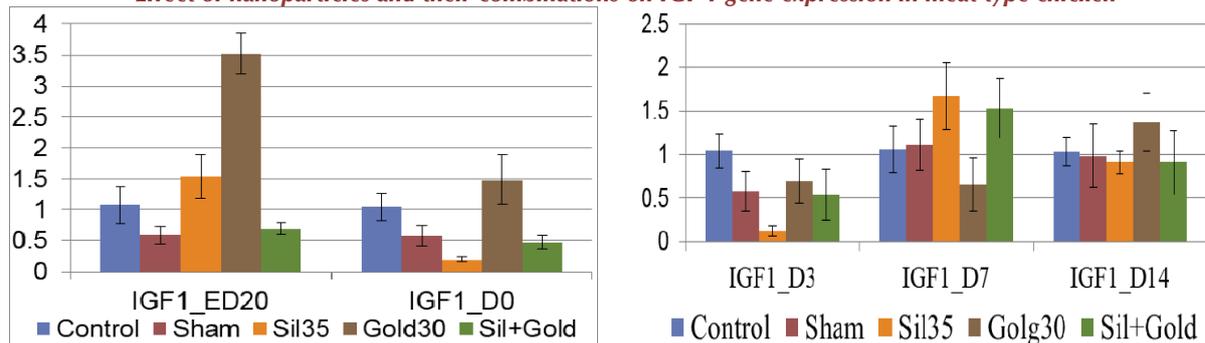
EAAT gene expression in meat type chickens



FABP gene expression in meat type chickens



Effect of nanoparticles and their combinations on IGF-1 gene expression in meat type chicken



4. Regional Centre, Bhubaneswar

Programme-1: Productivity enhancement of selected poultry species

Sub Programme– (i) Enhancement of productivity, reproductive efficiency and immune-competence of selected diversified poultry species along with development of improved package of practices.

Azolla as an alternative feed resource for economic production of duck meat and egg. Three pits of equal size (2M x 2M x 0.2 M (Length-2M, Width-2M, depth-0.2 M) were maintained in partial shade near tree. The area was also covered with green net to avoid direct sunlight and falling of tree leaves in the pit. The bottom of each pit was leveled at all the four corners to maintain uniform depth of water throughout the pit. For each pit, Silpauline sheet (15 ft x 12 ft) was used to line the entire pit and the projections from all sides were covered with a line of bricks from all sides to

keep it in proper position over the pit. About 10 kg of sieved fertile soil was added to each pit and spread uniformly throughout the bottom surface of the pit. Two kg of cow dung and 30g of superphosphate were mixed in 10 lit. of water and added to the pit. More water was added and the water level was maintained at 10 cm depth throughout the pit. Then, 500g of Azolla (*Azolla pinnata*) culture was added to each pit and spread over entire water surface of the pit. One kg of cow dung and 20g of superphosphate was added to each pit per week to maintain the nutrient level. About 25% of water was replaced with fresh water on every 15th day. The water level was checked on every alternate day and maintained at 10 cm level. From 10th day onwards, about 500g of Azolla was harvested daily from each pit.



Silpauline lining of the pits and addition of soil



Silpauline lining of the pits with addition of soil, fertilizer and water



Inoculation of Azolla in Silpauline pit



Azolla Production in Silpauline Pit 5th day



8th day of Azolla growth in the silpauline pit



10th day of Azolla growth in the silpauline pit

Chemical composition of Azolla (*Azolla pinnata*)

Proximate constituents	Sample 1	Sample 2	Sample 1	Mean ± SE
Dry matter	4.72	4.82	4.68	4.74 ± 0.04
Crude Protein	25.25	24.98	24.56	24.93 ± 0.20
Ether extract	3.51	3.36	3.38	3.48 ± 0.07
Crude fibre	13.52	13.89	13.99	13.80 ± 0.14
Total ash	17.14	16.85	16.54	16.84 ± 0.17

Performance of White Pekin layer ducks fed with Azolla (*Azolla pinnata*)

A study was conducted to see the effect of feeding of fresh Azolla (*Azolla pinnata*) on the performance of White Pekin laying ducks (60 nos, 56 weeks) divided into three groups (each group had four replicates with five laying ducks per replicate) and were randomly fed three diets i.e. T1-control diet (Standard duck layer diet(SDLD)), T2 (SDLD reduced by 10% + fresh azolla @ 100g/duck/day) and T3 (SDLD reduced by 20% + fresh azolla @ 200g/duck/day). Egg production and egg weight increased significantly ($P < 0.05$) due to the feeding of Azolla at both the levels. The feed consumption was significantly ($P < 0.05$) higher for T₂ group. The feed conversion ratio (FCR), performance efficiency index and shape index of eggs were significantly ($P < 0.01$) improved for the Azolla fed ducks. The egg quality characteristics viz., haugh unit score, albumen index, yolk index and shell thickness with or without shell membrane (mm) were similar for both control and Azolla fed ducks. The yolk colour of ducks fed with Azolla was deep orange compared to the control group. It may be concluded that feeding of fresh Azolla @ 200g/duck/day as replacement of 20% of concentrate feed in White Pekin laying ducks was beneficial in terms of improved FCR, performance efficiency index, egg production and egg quality traits with enriched yolk colour.



Azolla Feeding Experiment in White Pekin Ducks

Sperm storage tubules and development of technology for short-term préservation and utilisation of male gamètes in duck

Pre-ejaculatory fluid (PEF) is secreted in large quantities in ducks during semen collection. The

role of this fluid in fertilizing ability of duck spermatozoa is not clear. The present study indicated that the metabolic activity (Methylene Blue Reduction Test- MBRT) and fertilizing ability of the spermatozoa with PEF was more than the spermatozoa without PEF at Room Temperature. However, No metabolic activity (MBRT) was detected in the spermatozoa with PEF when stored at 4°C.

Group-1	Group-2
No. of drakes = 10	No. of drakes = 10
No. of ducks = 11	No. of ducks = 12
Total no. of eggs set = 140	Total no. of eggs set = 131
Total no. of fertile eggs = 59	Total no. of fertile eggs = 106
Total no. of infertile eggs = 81	Total no. of infertile eggs = 25
Fertility (%) = 42.14	Fertility (%) = 80.92

Sub Programme– (ii) Development of package of practices for rural poultry production system

Four duck breeds (viz. Khaki Campbell, White Pekin, Moti and Desi) were maintained under the project and the replacement stocks of G4 generation (2017-18) for different duck breeds were regenerated using random mating and the fertility & hatchability of parent stocks were recorded. The replacement stock of Khaki Campbell, Desi, White Pekin and Moti breeds was regenerated in 3, 3, 3 & 2 hatches, respectively. The percent fertility, estimated on pooled records over the hatches, was observed as 53.44, 78.85, 78.09 and 56.71% for Khaki Campbell, Desi, White Pekin and Moti breeds, respectively. The percent hatchability on total egg set & fertile eggs transferred basis was found to be 31.08 & 58.16; 56.26 & 71.36; 46.60 & 59.67 and 6.19 & 10.91% for corresponding breeds. The highest fertility & hatchability were recorded for Desi followed by White Pekin, Khaki Campbell and Moti.

The data recording on juvenile growth traits (i.e. body weight up to 10 weeks of age) in G-4 generation for 1-2 hatches of different duck breeds has been undertaken. The body weights of replacement stocks of different breeds of both the hatches were recorded at day old, 6, 8 and 10 weeks of age. The body weights were recorded for both the sexes from day old to 10 weeks of age.

The pooled average body weights at day old age were recorded as 33.87, 36.12, 39.86 and 38.45g, respectively for Khaki Campbell, Desi,

White Pekin and Moti. The pooled mean body weights for respective breeds at 6 weeks of age were 260.66, 203.00, 218.05 and 275.54g. The average body weights at 8 weeks of age were 336.33, 339.38, 372.87 and 201.33g for corresponding breeds. Ten weeks body weights were 426.37, 408.87, 573.85 and 251.16g for respective breeds. Relatively consistent lower body weights of all the breeds from day old to 10 weeks of age might be attributable to some health problems faced by all the stocks during brooding (1-3 weeks age).

Programme 4: HRD, market intelligence and technology dissemination

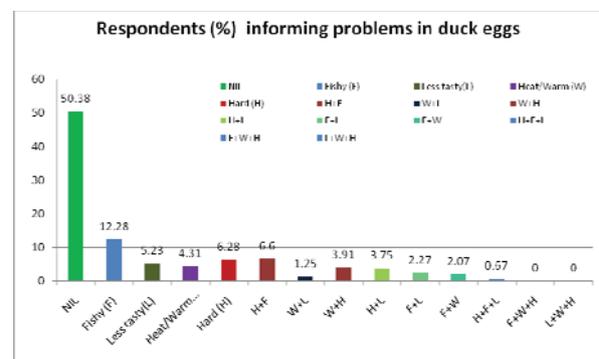
Sub Programme (i): Market intelligence, contingency planning and economic implications of emerging issues in poultry value chain

Data were collected from 526 consumers who visited Regional Centre (RC) for purchase of duck eggs. On an average 3 to 4 consumers were visiting on every working day for purchase of table duck eggs. Most of the consumers informed that main reason for purchasing duck egg is price and larger egg size. Preparations (dish) made by consumers from the duck eggs are omelet (O), scrambled egg (S), boil (B) and curry (C). All the consumers are consuming eggs as combination of the above dishes than any single dish. Out of 399 consumers asked about duck eggs problems 198 preferred chicken egg compared to duck eggs, however, 201 (50.38%) informed no problems with duck eggs and they prefer only duck eggs over chicken. Last year only 32.65% informed about the same.

All 69 consumers who purchased ducks for meat purpose consumed it by making curry or by frying with condiments. The duck meat required more condiments as compared to chicken meat and it should be taken as hot. If served cold it had some fishy smell. In total 4793 ducklings were supplied to 30 consumers with number of ducklings varied from 11 to 329. The supply was more from Desi followed by Khaki Campbell and White Pekin. Many farmers informed that there was no problem in duck farming but few informed that initial mortality was a problems and water scarcity, the another one. Positive factors for duck farming is that it can be used as integrated farming in fish pond and also for utilization of marshy land/river/canal. Their expectation was that ducklings should be available on demand in short duration and at right time of the year. Grown up ducklings should be available throughout the year in the RC. Small farmers wanted that the ducklings should be available at their door step. June, July,

August and September were considered as the best time to start duck farming.

A total of 234 farmers contacted the RC for ducklings/duck farming from different states of the Country; mostly from Odisha. Demand was more for Khaki Campbell followed by Desi and White Pekin. Forty-nine shop keepers of Khurda, Cuttack and Puri districts were interviewed about duck marketing; 38 of them informed that non-availability of duck egg and live duck was a problem that they are not keeping in the counter. There was demand for duck egg and meat but less as compared to chicken. Bengalis consumers preferred duck meat and eggs. Most of the retailers informed that they sale duck in piece than in weight basis. Those purchasing duck egg and meat from the retailers informed to the shopkeepers that taste of duck meat is good and is more tastier than chicken.



Information of consumer about the problem for duck egg consumption

Inauguration of Duck Research Laboratory Complex

Dr Trilochan Mohapatra, Secretary (DARE) & DG (ICAR) visited Regional Centre, ICAR-Central Avian Research Institute Bhubaneswar on Feb. 2, 2018 along with Dr J.K. Jena, DDG (Animal science) and Dr A.K. Singh, DDG (Extension), and inaugurated the newly constructed first floor of Duck Research Laboratory Complex. The programme was organized by Dr M.K. Padhi, In-charge, Regional Centre along with Dr Sandeep Saran, HD/PME who accompanied Dr A.B. Mandal, Director to the Regional Centre for the purpose. Dr T. Mohapatra during his address exhorted the scientists to utilise the Complex for more focussed research on ducks. He emphasized to document, characterize, conserve and register different duck breeds of India. He further stressed that there is lot of scope for improvement of ducks for which the Centre needs to be strengthened in terms of infrastructure and scientific manpower. **Dr J.K. Jena**, DDG (AS) thanked the DG on behalf of the SMD Animal Science. **Dr Himanshu Pathak**, Director, ICAR-NRRI, **Dr J.K. Sunderray**, Director,



ICAR-CIFA, **Dr B. Pattnaik**, Director, ICAR-PDFMD, **Dr S.K. Srivastava**, Director, ICAR-CIWA, **Dr S.K. Singh**, Director, DKMA, **Dr H.K. Pradhan**, Former I/c HSADL, Bhopal and In-charges/Head of

Regional Centres/Stations of various ICAR Institutes located at Bhubaneswar, including scientists, staffs and other dignitaries of ICAR were present to grace the occasion.



New Look of Duck Research Complex, RC CARI, Bhubaneswar

Mandated Duck Germplasm

The RC is mandated to carryout research and development activities on ducks and to popularize appropriate technologies for duck

farming preferably in the coastal and NE regions. The Centre is conducting its programmes on exotic as well as native meat and egg type ducks.



Khaki Campbell (Exotic egg type)



White Pekin (Exotic Meat Type)



Kuzi (Native egg type)



Moti (Native meat type)

Farmers First Project in collaboration with NRRI Cuttack



Women farmer feeding the birds



Native Ducks (RC CARI) in scavenging



Exposure visit of Farmers under FARMERS FIRST Project

5. P.G. Students' Research and Education

The Post-Graduate Education and Training (PGET) Section coordinated the post-graduate education programme leading to M.V.Sc., Ph.D. degree in Poultry Science (PSc) discipline and National Diploma in Poultry Husbandry (NDPH) course under IVRI Deemed University, Izatnagar. The Section also organized the Specialized Training Courses (STC) in various aspects of PSc for different categories of personnel in various organization/ institution/ departments etc. Additionally, the Section also co-ordinates PG education leading to M.V.Sc., and Ph.D. degree in Animal Genetics and Breeding/ Animal Nutrition/ Livestock Production & Management of IVRI Deemed University as well as in Poultry Science under various State Agricultural/ Veterinary Universities. There were 34 Ph.D., 24 M.V.Sc. and nil NDPH students on roll during 2017-18.

Research Highlights

Development and Quality Assessment of Selected Health Oriented Poultry Meat Products for Their Nutritional Profiles, Consumer Acceptability and Functional Activity (Dr Sudeep Kumar, PSc/MVSc/5585; Advisor: Dr Ashim Kumar Biswas)

Now-a-days functional meat foods are getting popularity in the global market because of consumer concern about diet related health problems. It has been reported that consumption of high calorie and fat rich meat product leads to development of different cardiovascular diseases, diabetes, cancers etc. Though health related problem through consumption of poultry meat (white meat) is less but due to consumer concern about all types of meat products it is logical and meaningful to developed health oriented meat products which are less in fat, easily digestible and also provide many functional attributes. So, an approach was undertaken to develop few selected health oriented/functional poultry meat products using dietary fiber rich whole grain oat and sorghum flours, fruit by products (apple peel paste, banana peel paste), aloe vera gel, oregano, basil and foxnut powder (Makhana) to improve their nutritional profiles, consumer acceptability and functional activity. These fruits, plants and herbs contained diverse bioactive compounds rich in phenolics, flavonoids, flavones, β -carotene, α -tocopherol, glucosides, dietary fibers and macro-minerals. To conduct the study three different functional meat products along with their respective controls were processed and they were evaluated for different physicochemical quality,

nutritional profiles and consumer evaluation. These products were also provided to experimental mice up to 90 days for evaluation of functional activity *in-vivo*. A control group of mice was also maintained and they were provided basal diet. Results of physicochemical parameters of developed products indicated that emulsion stability and cooking yield were found to be significantly higher ($P < 0.01$) in WT, FT and BT compare to WC, FC and BC, respectively. However, emulsion and product pH were found to be significantly lower ($P < 0.01$) in WT, FT and BT compare to WC, FC and BC respectively. Water absorption index (WAI) was ranged from 2.90 to 3.03, higher ($P < 0.05$) value in WT, FT than WC, FC respectively. The higher redness (*a*-value) of control wafer and finger chip samples was noticed as compare to treatment products. The reverse is true for yellowness (*b*-value) value. With regard to proximate composition, significantly higher moisture, crude fiber, total ash, total phenolics, β -carotene and α -tocopherol acetate were observed in treated products. However, total protein and ether extract were found to be significantly lower in treated products. Microbial counts were very nominal. In all products, SPC was around $1 \log_{10}$ cfu/g of sample and the growth for other microbial species like *Staphylococcus* spp., *Salmonella* spp., total coliforms, and yeast and moulds were absent. It has been observed that all the treated samples exhibited higher ($P < 0.01$) ABTS and DPPH activity compared to their respective control groups. Panelists had markedly higher preference for the treated products over the control and the upper age groups of people liked poultry meat product more than younger and middle age people. Consumer of low and high income groups had higher liking for treated chicken meat bites. As expected, overall acceptability was significantly higher ($P < 0.01$) for functional bites (BT) in case of graduate level education and also significantly higher ($P < 0.01$) for functional wafers (WT) in case of college level education. Experimental trials on laboratory animal (mice) indicated that functional wafer (WT) fed group showed lower total cholesterol and LDL-cholesterol content than WC. The HDL-cholesterol levels was significantly ($P < 0.01$) higher in mice fed with functional (WT, FT and BT) than the control fed groups. The activity of AST, ALT and ALP at 90th day was significantly lower ($P < 0.01$) in WT fed mice than the WC. Catalase and glutathione peroxides were significantly higher ($P < 0.01$) in WT fed group than the WC and control (basal). The triglycerides content was significantly lower in FT and BT fed



group than the FC and BC respectively. The ABTS and DPPH activity was significantly higher in WT, FT and BT fed group than the WC, FC and BC respectively. The serum glucose levels significantly reduced at day 90 in WT and BT fed group compare to day 30. Thus, health oriented poultry meat products developed with the incorporation of functional ingredients have better physicochemical quality, nutritional profiles and consumer acceptability besides improving functional activity *in-vivo* (mice). So these products may find their way in the market place to create a viable enterprise.

Development of storage quality of chicken sauces powder (Dr P. Ravichandran, PSc/MVSc/5495; Advisor: Dr CK Beura)

Soup normally serves as a pleasant opening to a large meal particularly in cold weather and forms a good vehicle for vegetable, meat, milk, cheese etc. Soups are popular because of their nutritive values, palatability, easy digestibility, low cost and simple techniques involved in their preparation. The frantic rhythm of modern life and the increase in the number of people who live alone have determined changes in food preparation and in the habits of consumption. Less time is available for a cook to make food. In this consequence, the rapid progress of the ready-oven food technology and its products has to be mentioned. Dried soups play an important role in the nutrition of people because they fulfill present and future social consumer requirements. Meat from layer chicken, after end of their production life, is tough and under-utilized. Spent hens are usually slaughtered and used in feed production and concentrated stock preparations, or sold for domestic consumption. However, a better use of hens at the end of laying cycle, for example, in the processing of food products with higher added value, could provide economic benefits. The experiment was designed to develop functional chicken soup powder incorporated with fiber rich cereals, leaves and herbs having antioxidant, antimicrobial and flavor enhancing activity. Preliminary trials were conducted to standardize formulation for the development of functional chicken soup powder. Experiments were conducted to identify the type and optimum levels of cereal flour(s), leaves and herbs. The functional chicken soup powder, thus developed was stored at 37+2°C in incubator and a detailed storage quality study was carried out. Thus, the studies were broadly divided into 2 phases; first phase consisting of preliminary trials, second section consisting of 3 experiments (Exp. 1, Exp. 2A and 2B, Exp. 3 and Exp. 4). In Exp.1, standardization of levels of cereal flour(s) - oat flour and corn flour in

development of functional chicken soup powder and in Exp. 2A, standardization of selected leaves (curry leaves, coriander leaves and mint leaves) and their levels in development of functional chicken soup powder were done. In Exp. 2B, standardization of selected herbs (oregano, rosemary and thyme) and their levels in development of functional chicken soup powder were done. In Exp. 3, samples were replicated twice and storage stability of functional chicken soup powder during storage at ambient temperature (37+2°C) under aerobic packaging condition was studied. In Exp. 4, economics for the development of functional chicken soup powder thus developed was worked out. Oat flour and corn flour at nine different levels were incorporated in the formulation and different quality parameters were analyzed. The sensory qualities viz., colour and appearance, Flavour, consistency, sourness, saltiness and overall acceptability were highest for T4. Based on the sensory scores it has been observed that 70% meat and 30% corn flour (T4) was suitable for the development of functional chicken soup powder. Two different levels of curry leaves, coriander leaves and mint leaves were incorporated into the best formulation selected in the Exp. 1. Incorporation of mint leaves (0.1%) in the product (T5) markedly improved all sensory attributes of functional chicken soup powder except colour and appearance. Two different levels of herbs-oregano, rosemary and thyme were incorporated into the best formulation selected in the Exp. 1. For storage stability study, functional chicken soup powder were developed with added flours, leaves and herbs that were considered for quality evaluation under ambient temperature storage on aerobic packaging conditions. Even after 60 days of storage PV, FFA, TBARS values of the products were observed lower than the threshold/maximum permissible limits. Proximate values of control and treatments did not show any significant difference throughout the storage period. In regards to microbiological quality, treated sample had significantly lower total plate count (TPC) compared to control. But TPC increased in both the treated and control samples with the increase in storage days. Total coliform, E.coli, Staphylococcus spp., Salmonella spp. counts were not detected during the storage period. Yeast and mold (Y&M) count was also absent. The formulations can be satisfactorily stored for 60 days at ambient temperature without significant change in the sensory attributes. The cost of production of the functional chicken soup powder calculated as Rs. 63 per 50 g packet. Thus, spent hen meat can be effectively utilized for development of functional chicken soup powder.

Evaluation of production performance, immune response and gut health status of Turkey poults fed diet supplemented with *Tinospora Cordifolia* (Giloy) (Dr Akash Uniyal, PSc/MVSc/5588; Advisor: Dr S Majumdar)

The present work was carried out to study the effects of dietary inclusion of *Tinospora cordifolia* (Giloy) on growth performance, immune response and gut health status of Turkey poults on 160 day-old straight-run Turkey poults reared following cage rearing system under uniform conditions. A commercial basal diet (control; T1) was formulated, the rest three diets were prepared by adding different inclusion level of dried stem powder of *T. cordifolia* viz. 0.1% (T2), 0.2% (T3) and 0.3% (T4) with basal diet. Production performance in terms of feed conversion ratio (FCR) improved in T2, T3 and T4 compared to control. Though body weight gain (g) increased numerically in treatment groups but significant differences were not observed. Significant ($P < 0.05$) reduction in feed intake was observed in diets with 0.2 and 0.3% inclusion level of *T. cordifolia* compared to 0.1% inclusion and control. No significant difference was recorded in total cholesterol, serum protein and albumin levels but serum enzymes (AST and ALT) influenced significantly ($P < 0.001$) on dietary inclusion of *T. cordifolia*. Blood profile (hemoglobin, packed cell volume, total erythrocyte count, MCV, MCH, MCHC) showed no significant difference among treatment groups and control. Significant increase was observed in liver, gizzard and giblet yield. Different carcass quality traits (blood loss, feather loss, eviscerated yield and dressing yield) did not differ due to dietary treatments. Cut-up parts revealed significant ($P < 0.05$) increase in neck and back yield (% live weight), decrease wings yield due to different dietary treatments whereas breast, thigh and drumstick did not differ due to dietary treatments. No significant differences were observed in coliform, lactobacillus and total plate count in both caecal digesta and excreta samples at 5 and 10th week of age. Histomorphological indices like villi height, villi width and crypt depth did not differ significantly among dietary groups. Humoral immune response i.e., HA titre was significantly ($P < 0.05$) higher at 0.2% inclusion level of giloy than control. Cell-mediated immune response did not differ significantly among different dietary treatments. Serum corticosterone value did not differ among dietary treatment groups and control. The results of the present study showed that it is beneficial for inclusion of dried stem powder of *Tinospora cordifolia* at 0.2% level in diet for improved feed utilization efficiency and welfare of Turkey poults.

Production performance, immune response and meat quality traits of broiler chickens fed diet incorporated with prebiotics (Dr Namit Mohan, PSc/MVSc/5587; Advisor: Dr Avishek Biswas)

The effects of dietary inclusion of prebiotics i.e., Mannan oligosaccharides (MOS) and Fructo oligosaccharides (FOS) on growth performance, immune response, blood biochemical parameters and meat quality traits in broiler chickens were evaluated on day-old straight-run broiler chicks ($n = 352$). A commercial basal diet (control-1; T1) and a low energy low protein diet (LELP) basal diet (control-2; T2) were formulated, the rest nine test diets were prepared by adding Bacitracin Methylene Di-Salicylate (BMD) @ 20 mg/kg diet (T3), T2+MOS @ 0.1% (T4), T2+ MOS @ 0.2% (T5), T2+FOS @ 0.1% (T6), T2+FOS @ 0.2% (T7), T1+ MOS @ 0.1% (T8), T1+ MOS @ 0.2% (T9), T1+ FOS @ 0.1% (T10) and T1+ FOS @ 0.2% (T11). Significant ($P < 0.05$) increase in body weight gain of broiler chicken during growing (0-21 days) and overall growth phases (0-42 days) were observed in comparison to antibiotic growth promoter (AGP) and control groups. Feed intake and feed conversion ratio (FCR) did not differ ($P > 0.05$) among the prebiotics incorporated LELP and commercial diet. Immune responses (humoral and cell mediated) improved significantly ($P < 0.05$) in low energy low protein (LELP) and commercial diet treated with prebiotics as compared to the control group and antibiotics treated group. No significant ($P > 0.05$) difference was observed in total protein, creatinine, calcium, phosphorus, concentration and ALP activity in any of the dietary prebiotic treatment group but serum albumin, serum enzymes (AST and ALT), kidney function test (uric acid) and total cholesterol concentration were significantly ($P < 0.05$) increased or decreased in LELP with prebiotic i.e., MOS @ 0.1 or 0.2% supplemented group. No significant ($P > 0.05$) difference was observed in eviscerated and organs yields and also sensory evaluation. Significantly ($P < 0.05$) higher breast yields were recorded in T4 (LELP@0.1% MOS), T5 (LELP@0.2% MOS) and T8 (CSD @0.1% MOS) groups. No significant difference was recorded in pH, drip loss and Lovibond tintometer colour in fresh or 14d stored meat. Water holding capacity, meat cholesterol, abdominal fat pad and extract release volume differed significantly ($P < 0.05$) due to prebiotic treated groups but better results were noticed in MOS treated groups. Lipid oxidation (TBARS, free fatty acid and peroxide values) and anti-oxidant parameters (ABTS⁺ and DPPH) of fresh and frozen (14d) meat were significantly ($P < 0.05$) improved in commercial and LELP diet with prebiotic inclusion. Microbial load i.e., standard plate count (SPC), Coliforms and



Staphylococcus count significantly ($P < 0.05$) decreased in fresh (0d) and frozen meat (14d), whereas yeast and mould was not detected in any of the dietary prebiotic treated and control groups. From the present study it was concluded that mannan oligosaccharides (MOS) at 0.1% inclusion in low-energy low-protein diet improved production performance, immune response, physico-biochemical characteristics, reduced microbiological counts in fresh and stored (14d) meat as well as feed-cost of production of broiler chickens. Mannan-oligosaccharide was better than fructo-oligosaccharides as prebiotic.

Comparative analysis of growth and immune competence traits in reciprocal crosses of Aseel x CARIRED and Kadaknath x CARIRED (Dr Santosh Pal, PSc/PhD/5572; Advisor: Dr Raj Narayan)

An experiment using three chicken breeds namely Kadaknath (KN), Aseel Peela (AP) and CARI-Red (CR) was undertaken to evaluate efficiency of direct and their reciprocal crosses with respect to body weight, conformation traits, body weight gain, carcass quality traits, immune organ and immunocompetence traits. AP x CR had highest body weight, shank length, keel length than other crosses of experiment at all age of measurement. Significant difference had been revealed for body weight, conformation traits, carcass traits and immunocompetence between mating system and genetic group. Reciprocal crosses were found superior for most of the carcass traits such as dressing percentage, evisceration percentage, feather percentage, drumstick percentage and breast percentage. Reciprocal crosses had high HI titre and CMI and out of these CR x KN had highest HI titre against NDV and highest CMI response against PHA-P. In general reciprocal crosses had lower FCR value than their respective direct crosses and FCR increases as age of bird increases. It was found that reciprocal cross CR x KN showed lowest mortality between 0-6 weeks of age. It was concluded that reciprocal crosses were superior to the direct crosses for most of economic traits under study. CR as male line and AP & KN as female line appears to be the most elite cross among the cross bred studied.

Effect of different semen extenders on fertility of chicken spermatozoa during short term preservation (Dr Beulah Pearlina V, PSc/MVSc/5602; Advisor: Dr Jag Mohan)

Attempts were made to determine the semen quality characteristics of indigenous (Nicobari and Ankleshwar) breeds in comparison to White Leghorn (WLH) in winter and summer season. The semen volume was observed lower while the semen motility, concentration and live counts were recorded higher in WLH than the native

breeds. Dead and abnormal sperm counts were recorded more in Nicobari and Ankleshwar chicken. The physical characteristics of semen tend to deteriorate in summer irrespective of the breeds. The total protein concentration was observed lesser while triglyceride and cholesterol concentration were recorded more in WLH than the native breeds. The transaminase activity was found higher and alkaline phosphatase activity was recorded lower in native chicken than WLH birds. The mean values of Resazurin Reduction Test (RRT) were found higher in WLH than Nicobari and Ankleshwar chicken. In summer, the transaminase activity in seminal plasma increased while the RRT ratio declined irrespective of the breeds. Overall, WLH showed superior semen quality followed by Ankleshwar and Nicobari. Various semen diluents (CARI, EK, Tselutin) were used in this study in which, CARI poultry semen diluent expressed higher motility as compared to others at different storage intervals (0, 24, 48, 72 and 96 h). Effect of various diluents on fertility of freshly ejaculated (0 h) chicken spermatozoa during 2-6 and 2- 8 days of fertile period showed superior fertility in CARI poultry semen diluent, which is comparable with EK extender, while Tselutin extender showed lower fertility. In case of 24 h stored chicken semen, maximum fertility was expressed by CARI poultry semen diluent as compared to other diluents. While studying the effect of different dilution rates on motility of chicken spermatozoa, all the dilution rates (1:2-1:20) expressed nearly similar high motility at 0 h storage period. Subsequently, there was a gradual reduction in the sperm motility with the increase in dilution rates and storage period from 24-96 h. No motility was observed in 1:14 and 1:10 dilution rates at 72 and 96 h storage period respectively. However, with respect to fertility assessment of freshly diluted semen, superior fertility was obtained in the dilution rates of 1:2, 1:4, 1:6 and 1:8 during 2-6 days of fertile period after AI using CARI poultry semen diluent. From this study, it can be concluded that irrespective of season, WLH expressed better semen quality. However, it was deteriorated in summer months in all the breeds. As compared to others, CARI diluent showed superior fertility.

Evaluation of functional attributes of chicken sausages prepared after fermentation of minced chicken meat with *Lactobacillus plantarum* and supplemented with malted oat flour (Dr Mitam Kumar Halder, PSc/MVSc/5613; Advisor: Dr AS Yadav)

The present study was undertaken to assess the growth of *L. plantarum* after at refrigeration temperature for 0, 6, 12 and 24h under *in-vitro*

conditions with addition of different levels of malted oat flour. Results indicated that supplementation of malted oat flour in broth enhanced growth profile of *L. plantarum* as compared to control group which was devoid of malted oat flour. Further studies were also done to evaluate the antimicrobial activity of *L. plantarum* against artificially inoculated and incubated *E. coli* and *Salmonella Typhimurium* *in vitro* conditions in broth and the results indicated antimicrobial action against *E. coli* and *S. Typhimurium*. Subsequently, a study was done to evaluate the functional attributes of *L. plantarum* in chicken sausages prepared from minced chicken meat fermented with *L. plantarum* and incorporated with different levels of malted oat flour. The results showed that the antioxidant potential against ABTS⁺ radical cation and superoxide anion (SASA) was found higher in those groups in which different concentration of malted oat flour were supplemented than non-supplemented groups, however, the antioxidant potential of *Lp* control was found higher than that of control group without *Lp*. After fermentation, total plate count and coliform count of raw minced meat declined in *Lp* control and each of the treatment groups than control group. Higher sensory scores were observed in all the groups in which malted oat flour was supplemented as compared to *Lp* control group and control group. Group, in which malted oat flour was added at 2% (w/w) level came forth as the better group from sensory as well as from antioxidant attributes and was selected as the best group which was subjected for refrigerated and frozen storage along with sausages made for control and *Lp* control group. During refrigerated (4±1°C) and frozen storage (-20±1°C), higher antioxidant potential was maintained throughout the storage period in sausages of treatment group incorporated with 2% malted oat flour as compared to control and *Lp* control group. Based on the physicochemical, antioxidant, microbiological and sensory parameters, fermented chicken sausages with better functional attributes were found acceptable up to 9 days of refrigerated (4±1°C) and till 60 days of frozen storage (-20±1°C). Chicken sausages prepared after fermentation of minced chicken meat with *L. plantarum* and with the addition of malted oat flour at 2% (w/w) level exerted better antioxidant and antimicrobial attributes. Thus, the antioxidant and antimicrobial potentiality of *L. plantarum* could be exploited for industrial application for making minced chicken meat more functional and health enhancing.

Effect of dietary inclusion of leaf powders containing essential oils as growth promoters in broiler chicken (Dr Mohd. Nawaj Shurfuddin, PSc/M VSc/5623; Advisor: Dr Divya)

The present study was done to look for an alternative to antibiotics as a growth promoter. Four plant leaves containing essential oil were selected as an alternative to the antibiotics. Four plants are *Moringa oliefera*, *Curcum longa*, *Murray koeinigii* and *Aegle marmelas*. The dried leaf powder of these plants were included at two percent rate (w/w) in broiler chicken diet (4 groups) and various parameters related to growth performance, carcass characteristics, immunity, blood biochemical, gut health and sensory evaluation were recorded and compared with diets containing antibiotic growth promoter and without any feed additive i.e only basal diet. In growth performance highest feed intake was recorded for diet containing antibiotic growth promoter and lowest feed intake was observed in diet containing curry leaf powder. Moringa leaf powder containing diet had higher feed intake in grower phase (0-3weeks). Moringa leaf powder containing diet recorded highest body weight gain in all growth phases and also had lower FCR in finishing phase (4-6weeks). All diets containing leaf powder had better immune response as compared to basal diet and diet containing moringa leaf powder had better immune response than diet containing antibiotic growth powder. Similarly all diets containing leaf powder had lower triglyceride and total cholesterol than diet with antibiotic growth promoter. Total coliform count was low for diets containing moringa leaf powder or antibiotic growth promoter. Lactobacillus count and jejunal villus length was higher for moringa leaf powder containing diet. So the diet containing moringa 2% leaf powder had performed better than other treatment diets in terms of body weight gain, FCR, immune response, lipid profile, coliform and lactobacillus counts, and jejunal villi length. The other diets containing leave powders also performed better in terms of lowered lipid profile and coliform count. But in overall performance of broiler chicken diet containing moringa leaf powder performed better and can be considered as a green and cheap alternative to AGPs as a growth promoter in broiler chicken diet.

Effect of feeding of *Kappaphycus alvarezii* red sea weed based formulations on production performance and meat quality traits of broiler (Dr Sayed Shaid Navi Quadri, PSc/MVSc/5625; Advisor: Dr Avishek Biswas)

The effects of dietary supplementation of *Kappaphycus alvarezii* and sea weed based

formulation (AF-KWP) in diet on growth performance, immune response, blood biochemical parameters, carcass characteristics and meat quality traits in broiler chickens were evaluated on 210 day-old straight-run broiler chicks. Seven diets formulated, the rest six test diets were prepared by adding 0% (control- T1), 0.25% AF-KWP (T2), 0.50% AF-KWP (T3), 0.75% AF-KWP (T4), 1.00% AF-KWP (T5), 1.25% AF-KWP (T6) and 1.50% AF-KWP (T7) and all the diets were iso-calorific and iso-nitrogenous. Body weight gain (g) significantly ($P < 0.05$) improved in growing (21-42 d) and overall (0-42 d) phase, however feed intake (g) were significantly ($P < 0.05$) differed in T7 and T6 compared to control and other treated group due to inclusion of AF-KWP. Feed conversion ratio (FCR) did not differ significantly ($P > 0.05$) by the feeding of diets containing different levels of AF-KWP. Haem-agglutination (HA) titre and cell mediated immunity (CMI) were significantly increased ($P < 0.05$) in AF-KWP supplemented groups as compared to control group. No significant ($P > 0.05$) differences were observed in protein and albumin concentration and ALP activity but serum enzymes (AST and ALT), creatinine and uric acid, serum minerals (Ca and P) and total cholesterol concentration were significantly ($P < 0.05$) improved in AF-KWP supplemented groups comparison to control group. No significant ($P > 0.05$) differences were recorded in Yield (percentage of carcass traits) and organs amongst the dietary groups but cut - up parts significantly differed ($P < 0.05$). No significant ($P > 0.05$) differences were recorded in sensory evaluation of meat at fresh and frozen condition after dietary supplementation of AF-KWP with basal diet. In physico-biochemical parameters of meat (fresh and frozen), no significant differences were recorded in pH, drip loss and Lovibond tintometer colour (except b^* value) but water holding capacity (WHC), cholesterol, fat and extract release volume (ERV) found significantly ($P < 0.05$) improved in AF-KWP supplemented group compared with control group. In lipid oxidation parameters, no significant differences were observed in free fatty acid (%) at fresh and storage meat among the control and dietary AF-KWP supplemented groups, whereas, peroxide values improved in frozen meat not in fresh meat. TBARS activity of fresh and frozen (14d) meat improved ($P < 0.05$) in AF-KWP supplemented group compared to control. Antioxidant parameters i.e., ABTS⁺ and DPPH of frozen (14d) meat increased ($P < 0.05$) in AF-KWP supplemented group (T7 & T6) compared with control and other dietary treated groups, but no significant differences were recorded in fresh meat. Microbial load in terms of standard plate count,

Coliforms and *Staphylococcus* decreased significantly ($P < 0.05$) in fresh (0) and frozen meat (14 d) in AF-KWP supplemented group (T7 & T6) compared with control group, whereas yeast and mould was not detected in any of the dietary AF-KWP supplemented as well as control group. From the above said discussion it may be concluded that *Kappaphycus alvarezii* and red sea weed based formulations (AF-KWP) can be incorporated at 1.50% level in broiler diet for improved performance, immunoresponsiveness, breast yield, physio-biochemical characteristics, lipid oxidation, antioxidants activities and reduction of microbial counts in fresh and storage (14 d) meat.

Growth performance and expression of heat stress related genes in broiler chicken as influenced by stress alleviating agents during hot dry and hot humid conditions (Dr Sajad Ahmad, PSc/Phd/1757; Advisor: Dr AB Mandal)

High temperature is major concern for poultry in hot region like India resulting in poor growth performance, immune-suppression, occurrence of more respiratory diseases and high mortality. In the process of developing packages for mitigation of heat stress during extreme summer (hot-dry and hot-humid), three different stress alleviating agents Betaine (0.25, 0.5 and 1g/kg); Synbiotic (MOS @ 0.1%, 0.2% and 0.3% with Probiotic- @ 10^6 cfu/g) and Selenium (0.15, 0.3 and 0.45 mg/kg) were tried individually in broiler pre-starter (day old to 14th day, protein 22%), starter (15 to 21st day, protein 21%) and broiler finisher mash (22 to 42nd day of age, protein 19%) both during hot-dry (April-May, 29.0 ± 0.700 to $36.0 \pm 1.40^\circ\text{C}$, Rh,%: 61.0 ± 1.3 - 70.1 ± 0.82) and hot-humid (Aug-Sept, 27.0 ± 0.12 - $34.25 \pm 0.37^\circ\text{C}$, Rh,%: 76.95 ± 0.9 - 86.15 ± 0.61) conditions and their efficacy were judged through growth performance, blood biochemicals, immune competence, expression analysis of HSP70 and SGLT1 and H:L ratio at 42nd day of age in broiler chickens. Inclusion of betaine @ 0.25g/kg diet was beneficial in improving body weight gain, feed conversion efficiency, carcass traits, immune response, hematological and biochemical profile, economics, and overall welfare during extreme hot dry conditions and 0.5g/kg during hot-humid conditions. Inclusion of betaine @ 0.25g/kg diet was also found economical for broiler production in hot-dry conditions. The heterophil to lymphocyte ratio decreased, the relative expression of HSP70 was down regulated and SGLT1 was up regulated in jejunum both in hot-dry and hot-humid conditions on dietary inclusion of betaine at any level (0.25, 0.5 or 1.0g/kg diet). Inclusion of synbiotic in diets of broilers improved overall performance than in diet without synbiotic

but the dietary inclusion of synbiotic including 0.3% MOS+ probiotic was found the most economical for production of broiler chicken during both hot-dry as well as hot-humid conditions. Carcass traits did not show any significant difference between synbiotic supplemented diets and control during hot-dry and hot humid conditions. There was significant improvement in the levels of total protein, total cholesterol, AST and ALT, HB and H:L ratio on addition of synbiotic at any level. Synbiotic at any level down regulated expression of HSP70 in jejunum and expression of SGLT1 was up regulated at 42nd day. The results of synbiotic inclusion indicated improvement in performance and welfare parameters during both hot-dry and hot-humid conditions but were more beneficial during hot-dry conditions. Addition of selenium @ 0.15 or 0.30 mg/kg to basal diets improved body weight, feed conversion, immune response, cost economics and other welfare parameters during both hot-dry and hot-humid conditions but better results were found at 0.15 mg Se/kg of diet. There was a significant improvement in the levels of total protein, total cholesterol, AST and ALT, Hb and H:L ratio on addition of Se at all three levels of supplementation. Selenium at all three levels down regulated expression of HSP70 in jejunum and the expression of SGLT1 was up regulated. Thus inclusion of betaine @ 0.25 and 0.5g/kg diet may be recommended for economical broiler production during hot-dry and hot-humid conditions, respectively. Synbiotic with 0.3% MOS+ probiotic @ 10^6 CFU/g was beneficial for economical production and welfare of broiler chickens during both hot-dry as well as hot-humid conditions. The best supplemental level of selenium emanated was 0.15mg/kg diet during both hot-dry as well as hot-humid conditions. Therefore, it can be concluded that as all nutritional agents, used in this trial had special beneficial functions in heat stressed poultry, thus mineral and vitamin premixes can suitably be developed for heat-stressed broilers for improved performance, welfare and feed-cost efficient production.

Studies of dietary supplementation of choline and betaine on methionine spraying effect in broiler chickens (Dr Rupjyoti Hazarika, PSc/PhD/1745; Advisor: Dr Chandra Deo)

Three biological trials was conducted to evaluate Met sparing effects by supplementation of Choline and betaine either alone or in combinations in broiler diets with respect to growth, immune response, blood biochemical profile, structural gut health, carcass traits, caecum microbiology, gene Expression and

cost economic of broiler production. In 1st trial nine dietary treatments were formulated with three levels of Met 100%, 90% and 80% (NRC, 1994) each with three levels of choline 100%, 110% and 120% (NRC,1994). In 2nd trial nine dietary treatments were also formulated with three levels of Met 100%, 90% and 80% each with three levels of betaine 0mg, 500mg and 1000mg/kg and in 3rd trial twelve dietary treatments were formulated with three levels of Met 100%, 90% and 80% each with two levels of choline 110% and 120% and again each choline level two levels of betaine 500 and 1000mg/kg diet during starting and finishing phase were evaluated. Results of the 1st experiment revealed that supplementation of choline @120% in 10% Met deficient diet had positive effects on BWG but not in FCR. The immune organs significantly decreased with decreased Met levels. Supplementation of choline increased bursa and thymus weight at 21 days of age. Carcass traits such as eviscerated, dressed and breast yield significantly decreased with decreased Met levels and increased with increasing choline levels. Abdominal fat decreased with increased Met choline levels in diet. The cholesterol was significantly decreased with Met and choline levels increased. The villus height was decreased with decreased Met levels. Supplementation of 120% choline in 10% Met deficient diet found equal feed cost compared to control group. Results of the 2nd experiment indicated the betaine supplementation @ 1000mg/kg in 10% Met deficient diet had positive effects on BW, BWG and FCR. Cellular and humoral immune responses was significantly reduced with decreased Met levels and supplementation of betaine significantly improved cellular immunity and weight of bursa and thymus at 21 and 42 days. Supplementation of betaine improved eviscerated, dressed and breast yield and reduced abdominal fat deposition. Serum glucose and total protein was decreased and cholesterol and triglyceride increased as decreasing Met concentration but supplementation of betaine increased serum glucose and total protein and decreased cholesterol and triglyceride. Villus height of jejunum and duodenum decreased with decreased Met levels whereas, betaine supplementation increased the height of villus. Dietary combination of 90% Met with 1000mg/kg betaine accrued equal feed cost compared to control group fed diet containing 100% Met without added betaine. Results of 3rd experiment indicated that a dietary combination of 80% Met, 110% choline and 1000mg/kg betaine accrued higher BWG and efficiency of feed utilization to that group fed diet containing 100% Met, 110% choline and 500mg/kg betaine. Yield of bursa and thymus increased as Met and betaine levels



increased in diet. Dietary combination of 80% Met, 120% choline with 1000mg/kg betaine showed comparable carcass yield to that of 100% Met. Choline and betaine supplementation reduced the abdominal fat. Glucose, total protein, cholesterol and triglyceride had positive effect by supplementing choline and betaine in Met deficient diet. Villus height to crypt depth ratio increased with increased Met and betaine levels. Supplementation of choline @ 110% with 1000mg/kg betaine in 80% Met diet could reduce optimum feed cost. Expression of immune related genes IL-2, IFN- γ and IL-6 significantly better expressed in choline and betaine supplemented groups. Results concluded that (i) Supplementation of choline chloride alone could not spare the requirement of Met in broiler diet, but it could improve the performance of birds at 120% level when diet contains 100% Met. (ii) Supplementation of Betaine alone in broiler diet @ 1000mg/kg could spare 10% of the total Met requirement for optimum growth and allied traits. (iii) Supplementation of choline @ 110% with 1000 mg/kg betaine could spare the 20% of the total Met requirements for optimum growth and allied traits in broiler diet.

Evaluation of feeding value of rice gluten meal in broiler chickens (Dr Manzoor Ahmad Wani, PSc/PhD/1758; Advisor: Dr Pramod Kumar Tyagi)

The shortage of feed resources has diverted majority of research in the field of nutrition to look into possibilities to overcome the nutritional crisis. Rice gluten meal (RGM), a by-product of wet-milling of rice obtained during starch extraction and syrup preparation, is a highly concentrated protein source, which has a potential to replace costly feedstuff, soybean meal in the diet of broiler chicken. A series of biological trials were conducted to evaluate the feeding value of RGM on production performance, nutrient utilization, immune response, carcass traits, serum bio-chemicals, gut health, gene expression and cost economics of broiler chicken. In experiment I, RGM was subjected to estimate apparent metabolizable energy (AME) and *in vitro* studies at two substitution levels (20 and 40%) with and without protease and multi-enzymes in cockerels distributed into nine dietary treatments for 14 days. In experiment II, feeding trial was conducted to study the effect of feeding different levels of RGM (0, 5, 7.5, 10, 12.5 and 15%) on production performance and cost economics of broiler chicken. In experiment III, feeding trial was conducted to study the effect of feeding different levels of RGM (0, 15, 17.5 and 20%) with or without protease on production performance, gene (Mucin, EAAT3 and PepT1) expression and cost

economics of broiler chicken. The chemical analysis of RGM was found to contain moisture 7.70, DM 92.30, CP 50.00, EE 6.92, CF 9.47, TA 4.37, NFE 21.54, Ca 0.62, P 0.78% and gross energy 4537 kcal/kg. The AME value of RGM was found 3031 kcal/kg. However, with protease and multi-enzyme supplementation, the values were 3068 and 3066 kcal/kg, respectively, with a numerical increase of 37 and 35 kcal/kg of AME, which is 1.22 and 1.15% more upon supplementation of protease and multi-enzyme respectively. *In vitro* pepsin-pancreatin digestibility and available carbohydrate content (ACHO) of rice gluten meal were found 81.29 and 24.27%, respectively. The phytate and non-phytate phosphorous were found 0.43 and 0.35%, respectively. The results of experiment II revealed no significant ($P>0.05$) difference in BWG, but significant ($P<0.05$) difference was observed in FI on inclusion of RGM up to 15% level in the diet of broiler chicken without affecting the FCR. The nutrient utilization, immune response, carcass traits, serum bio-chemicals and gut health did not reveal any significant ($P>0.05$) difference between the control and treatment groups. However, the cost of production was significantly ($P<0.05$) decreased on inclusion of RGM up to 15% level in the diet of broiler chicken. The results of experiment III revealed significant ($P<0.05$) difference in BWG and FI on dietary inclusion of RGM up to 20% level without affecting the FCR. The BWG and FI were significantly ($P<0.05$) decreased in 17.5 and 20% RGM compared to control and 15% RGM supplemented groups. The nutrient utilization, immune response, carcass traits, haematology and serum bio-chemicals did not reveal any significant ($P>0.05$) difference between the control and treatment groups. The enzyme supplementation alone or in combination with RGM did not reveal any significant ($P>0.05$) difference on production performance, nutrient utilization, immune response, carcass traits, haematology and serum bio-chemicals. The least square analysis of variance of 40-ICT values of mRNA expression levels of nutrient transporter genes in broiler chicken at 21 days post hatch showed highly significant ($P<0.01$) differences in PepT1 and Mucin gene expression. In case of PepT1, maximum expression was found in the control diet and minimum expression was found in groups fed 0% RGM with enzyme and 20% RGM supplemented group. The Mucin gene showed maximum expression in control diet and minimum expression was found in 17.5% RGM supplemented group. At 42 days post hatch, significant ($P<0.001$) differences were observed in EAAT3 and Mucin gene expression. The EAAT3 and Mucin gene showed maximum expression in

the control group and minimum expression was found in 20% RGM plus enzyme supplemented group. The cost of production was significantly ($P < 0.05$) decreased on dietary inclusion of RGM up to 20% level compared to control diet. Neither enzyme supplementation alone nor interaction of RGM and enzyme had any significant ($P < 0.05$) effect on cost economics of broiler chicken production. It may be concluded that rice gluten meal is a good source of metabolizable energy and crude protein and it can be safely added up to 15% level replacing costly conventional feedstuff, soybean meal in the diet of broiler chicken to economize the cost of meat production.

Effect of seasonality diulients and nutritional interventions on reproductive efficiency of Turkey and chicken (Dr Prabakar G., PSc/PhD/1820; Advisor: Dr Jag Mohan)

Attempts have been made to improve the reproductive efficiency of birds through various studies. In the first study, effect of different seasons was observed on semen quality of Turkey and chicken. The results indicated that winter season expressed good quality of semen in both chicken and Turkey in comparsion to summer and monsoon. However, high semen volume obtained in summer and monson season in turkey. The anti-oxidant enzymes (catalase and lipidperoxidation) in blood and seminal plasma was significantly higher ($P < 0.01$) during the winter season in chicken whereas it was non-significant in turkey. Higher ($P < 0.05$) profile of serum testosterone and serum thyroxin was noticed in winter and summer respectively in both the poultry species. Second experiment was carried out for identification of best diluents for short-term preservation of Turkey semen using different diluents such as: Lake's diluent, BPSE and CARI semen diluents. Under this study, semen characteristic was evaluated at 0, 6 and 12h interval. Among the different diluents, during the fertile period of 1 to 10 day, CARI

semen diluent showed higher ($P < 0.05$) fertility (92.86%) compared to BPSE (71.04%) and Lakes (76.19%) semen diluents at 6 h storage at (12°C). In the first part of third experiment on role of nutritional interventions (carotenoids supplementation) on broiler breeder's production and reproduction was evaluated. For this study, combination of carotenoids (Canthaxanthin and Apocarotenoids) were used by taking healthy CARIBRO VISHAL males and females for 18 weeks (12-30 weeks of age). Birds were maintained with different doses of carotenoids like low dose -T₁ (6mg Canthaxanthin and 6mg Apocarotenoid) and high dose - T₂ (12mg Canthaxanthin and 12mg Apocarotenoid). The feeding of carotenoids (T₁ and T₂ group) increased the female broiler body weight and significantly ($P < 0.05$) improved the semen quality. Higher levels of estrogen and testosterone were noticed in the female and male chicken respectively in treated groups. The feeding of carotenoids at 12ppm to broiler breeders showed higher ($P < 0.05$) levels of cellular and humoral immunity and better yolk and shank color. Carotenoid feeding (12ppm) reduced ($P < 0.05$) the sexual maturity and increased fertility in broiler breeders. In the second part of third experiment, effect of zinc feeding was examined on productive and reproductive efficiency of adult CARIBRO VIASHAL breeders. Three groups (T₁, T₂ and T₃) of broiler breeders were fed three levels of zinc (i.e. 20, 40 and 60 ppm in addition to basal diet). Fourth group served as a control. The supplemented organic zinc (Zinc-methionine) significantly ($P < 0.05$) improved semen quality, cellular and humoral immunities and sex hormones in broiler breeders fed with a high doses(60 ppm) of zinc. The trace minerals zinc and copper content in seminal and blood plasma was recorded higher in T₂ (medium doses) and T₃ (high doses) group. In seminal plasma, higher zinc concentration was recorded in 40 ppm fed group.



6. Technology Assessed and Transferred

Technologies Assessed

- Post-mortem tenderization of breast meat from spent chicken was standardized.
- Processing technology for development of chicken meat *Tikka* was standardized.
- Processing technique for development of functional Turkey meat loaf was standardized.

Technologies Transferred

- A total of 42,936 fertile eggs/chicks/growers/adults of pure line desi chicken like Aseel peela, Aseel Kagar, Kadaknath, Ankaleshwar, Nicobari etc. and different commercial crosses (CARINIRBHEEK, CARISHAYAMA, HITCARI and UPCARI) were supplied to poultry farmers and different government as well as non-government organizations for rural poultry production.

Technologies Licensed

- Three License Agreements (LA) were prepared, signed with M/s Chaudhary & Chauhan Enterprises, Bareilly on March 01, 2018 in respect of the Egg Rasmalai, Functional Chicken Meat Bites and Quail Egg Pickle.



Supply of Germplasm

Germplasm	Fertile eggs		Day-old chicks		Grower		Adult	
	Parent line	Comm	Parent line	Comm	Parent line	Comm	Parent line	Comm
Quail	250			500				273
Guinea Fowl							1721	
Desi fowl	5500	4105	2542	25586	237	2178	2156	632
Broiler	10,395	81,321	4,150	49774	560	-	444	-
Layer	-	5,846	-	23,477	-	377	-	1554

RC CARI, Bhubaneswar: A total of 4793 day old ducklings were supplied to various agencies during the period under report.

Farmers Fairs

Uttar Kshetriya Krishi Mela- Varanasi

North Regional Farmers' Fair popularly known as *Uttar Kshetriya Krishi Mela* was organized at Indian Institute of Vegetable Research

(IIVR), Varanasi during Feb. 23-25, 2018. The Institute also exhibited its diversified poultry germplasm, products and technologies in the fair. Dr J.J. Rokade and Dr Gopi M. represented the Institute in the fair assisted by Shri S.R. Meena and



Shri Ramashraye. The CARI stall was visited by Shri Radha Mohan Singh, Hon'ble Union Minister, Ministry of Agriculture and Farmers' Welfare, GoI, along with several other high dignitaries from the Central and U.P. state Government who were briefed about various technologies exhibited by the Institute. Over 3000 farmers visited the stall and enquired about various varieties of poultry, poultry farming activities, trainings programme, etc. Dr Rokade gave a brief lecture entitled *Poultry farming - a viable enterprise* which was attended by more than 550 farmers.

Farmers Meetings at Bhubaneswar

Orissa Krushak Samaj, on the occasion of its Annual Day on Oct. 16, 2017, organized farmers' meeting and exhibition at Bhubaneswar, Odisha. Prof. (Dr) Khageswar Pradhan, President, Odisha Krushak Samaj and former Vice-Chancellor, OUAT presided over the function and felicitated Dr J.M. Kataria, Dr M.K. Padhi and Dr S. C. Giri, Principal Scientists for their contributions in backyard poultry and duck production in the state.



Dr K. Pradhan at RC, CARI Stall

Dr S.C. Giri participated in the exhibition organized on *Dhan Divas* and 71st Foundation Day of ICAR-National Rice Research Institute, Cuttack on April 23, 2017. Dr Trilochan Mohapatra, Hon'ble Secretary, DARE and Director General, ICAR, inaugurated the exhibition. He also visited CARI stall, enquired about availability of ducklings to the farmers.

Krishi Unnati Mela- New Delhi

The Institute participated in *Krishi Unnati Mela* organized by the ICAR during March 16 -19, 2018 at Indian Agricultural Research Institute, New Delhi. The mela was inaugurated by Hon'ble Prime Minister, Shri. Narendra Modi. The Institute displayed its germplasm and various poultry production and processing technologies in the *mela*. The Institute's stall was visited by Hon'ble Shri. Radhamohan Singh, Union Minister for Agriculture and Farmers' Welfare along with Dr Trilochan Mohapatra, Hon'ble Secretary (DARE) &

Director General (ICAR) and Dr Joykrushna Jena, DDG (Animal Science), Dr R.S. Gandhi, ADG, ICAR. During the *mela*, the CARI stall was visited by over 20,000 visitors including farmers, entrepreneurs, students, industry personals etc. They were enlightened about poultry farming techniques, improved germplasm, management practices and trainings offered by the Institute etc. The visiting farmers were given handouts which covered information regarding improved CARI germplasm and their health management tips. The team representing the Institute comprised of Dr A.S. Yadav, Dr J.J. Rokade, Dr Gopi, M., Sh. S.R. Meena, Sh. Ramashraye and Sh. C.L. Meena.



The address of Hon'ble Prime Minister, Shri. Narendra Modi to the farming community was live webcast before a gathering of about 1050 farmers apart from all the scientists and staff of CARI and IVRI in the IVRI ground. The event was jointly organized by CARI and IVRI on March 17, 2018. Shri Santosh Gangwar, Hon'ble Minister of State (Independent Charge), Ministry of Labour and Employment, GoI; Shri Kasher Singh, Dr Arun Kumar, Dr D.C. Verma and Shri Chhatra Pal Singh, Hon'ble Members of Legislative Assembly, U.P. and Dr Umesh Gautam, Mayor, Bareilly, addressed the gathering on the occasion. Dr J.S. Tyagi served as Coordinator.

Krishi Mela- Mukteshwar



The Institute participated in *Krishi Mela* organized by Indian Veterinary Research Institute, Mukteshwar during Feb. 27- March 2, 2018 to enlighten the farmers about high altitudes farming practices. The *mela* was inaugurated by Prof. B. S. Bisht, Director, Birla Institute of Applied Sciences, Bhimtal, U.K. along with Dr Mahesh Chandra, Head, Extension Education, IVRI. Farmers were briefed about the poultry farming technologies and management practices to be adopted in hilly regions. The CARI stall was visited by over 500 visitors including farmers and K.V. students, etc. In the Kisan Gosthi, Dr Jaydip Rokade delivered lecture on importance of poultry farming and its

management in hilly regions. Dr A. Mishra, Medical officer, conducted health camp for young children. The farmers showed keen interest in poultry farming and their queries were appropriately responded.

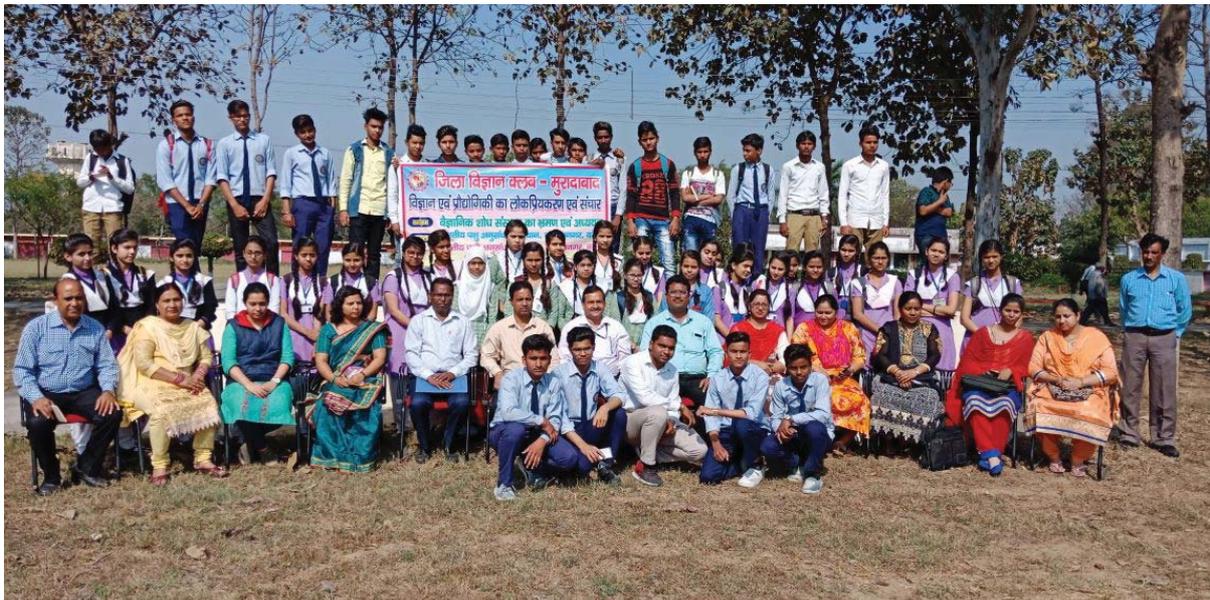
Sensitization of Women Farmers

Brief training and demonstrations related to backyard poultry and duck production was imparted to the adopted farmers by Dr S.C. Giri, PS and his team at RC CARI, Bhubaneswar for capacity building of women participants.



Mass Media Communication

Dr J.S. Tyagi, Principal Scientist, ICAR-CARI, participated in live programme– Hello Kisan on मुर्गी पालन तथा हैचरी व बॉयलर व्यवसाय telecast by Door Darshan, New Delhi on Feb. 22, 2018.



7. Awards and Recognition

- Dr Ashim Kumar Biswas**, selected as Associate Editor in Food Science & Nutrition Technology, Medwin Publisher, USA.
- Dr Sanjeev Kumar and Dr Avishek Biswas** were awarded **Fellow of Indian Poultry Science Association** during XXXIV Annual Conference of Indian Poultry Science Association on Nov. 28, 2017 at Bengaluru.
- Dr Avishek Biswas** received **SERB-DST Travel Grant Award** and **DBT Travel Grant Award** to present research paper in 20th World Veterinary Poultry Association Congress- 2017 held during Sept. 4-8, 2018 at Edinburg, United Kingdom.
- Dr Avishek Biswas** received **CSIR Travel Grant Award** to present research paper in 11th Asia Pacific Poultry Conference-2018 held during Mar 25-27, 2018 at Bangkok, Thailand.
- Dr Avishek Biswas** received **Krishi Vigyan Garurav-2017 Award** for best Hindi research article published in Bhartiya Krishi Anushandhan Patrika, Agricultural Research Communication Centre (ARCC), Karnal, India.
- Dr Avishek Biswas** received **Reviewer Excellent Award** from Indian Journal of Animal Research & Asian Journal of Dairy and Food Research, Agricultural Research Communication Center, Karnal, India.
- Dr Avishek Biswas** was nominated as Assistant Editor, Agricultural Science Journal, North America.
- Dr S.K. Bhanja** nominated as member, Expert Panel constituted by Animal Husbandry, Feeds & Equipment Sectional Committee, FAD 05, BIS, Manek Bhavan, New Delhi to review *Code of practices for raising of egg laying hens*.
- Dr S.K. Bhanja** was awarded the Mentorship of Mr. Alabi Joel, Ph.D. student, Federal University of Agriculture, Nigeria under Sandwich Postgraduate Fellowship Programme-2017 of DBT, Govt. of India and The World Academy of Sciences (TWAS), Italy.
- Dr S.C. Giri** received **Krushi Pratibha Award-2017** from Orissa Krushak Samaj on Oct. 16, 2017 on World Food day for outstanding contribution in duck production in tribal and non-tribal region of Odisha.
- Dr Gopi, M.** recognized as Technical Editor in Asian Journal of Animal and Veterinary Advances, U.K.
- Dr A.B. Mandal** served as Vice-President, Indian Poultry Science Association and Councilor, World Poultry Science Association (India Branch).
- Dr M.K. Padhi** acted as **Co-Chairman** in the technical session on *Poultry-Health, Production & Management* in national seminar on Opportunities and Challenges of Translational Research in the Frontier Areas of Animal Biotechnology Sept. 22-23, 2017, OUAT, Bhubaneswar.
- Dr M.K. Padhi** received **Krushak Bandhu Award-2017** from Orissa Krushak Samaj on World Food Day on Oct. 16, 2017.
- Dr J.J. Rokade** acted as **Rapporteur** in a session in XXXIV Annual Conference of Indian Poultry Science Association during Nov. 28-30, 2017, Bengaluru.
- Dr J.J. Rokade** received **British Poultry Science Limited Travel Grant-2018** to present research paper in 29th Australian Poultry Science Symposium Feb. 05-07, 2018, Sydney.
- Dr J.J. Rokade** served as **Member, Scientific Advisory Board**, International Journal of Livestock Research and received **Certificate of Appreciation** for valuable contribution in service of scientific community during 2017-18.
- Dr Sanjeev Kumar** was awarded with **P.K. Pani Research Award-2015** during IPSASCON-2017, Bengaluru.
- Dr Simmi Tomar** received **Distinguish Woman in Agricultural Science Award** conferred by Venus International Foundation during its Annual Women's Meet held on March 3, 2018, Chennai, India.
- Drs Vijay Singh, Raj Narayan, V.K. Saxena, P.K. Tyagi and Chandrahas** received P.K. Pani Research Award-2016 during IPSASCON-2017, Bengaluru.
- Drs Vineetha P.G., S. Tomar, V.K. Saxena, R. Narayan, J.K. Patra and A. Khan** received **Ayurved Award-2015** during IPSASCON-2017, Bengaluru.
- Drs Chandrahas, Raj Narayan and V.K. Saxena** received first prize for Hindi article during Hindi Saptah, Sept. 14-20, 2017 at CARI, Izatanagar.
- Drs Chandrahas, R. Narayan, V.K. Saxena, S. Saran and H. Ali** received second prize for Hindi article Hindi Saptah, Sept. 14-20, 2017 at CARI, Izatanagar.
- Drs J. Mohan, S.K. Sharma, J. Singh, Gautham K. and Gopi M.** (2017) received second prize for Hindi article Hindi Saptah, Sept. 14-20, 2017 at CARI, Izatanagar.
- Dr J.J. Rokade, Gopi M., Sandeep K. and V.K. Saxena** received third prize for Hindi article Hindi Saptah, Sept. 14-20, 2017 at CARI, Izatanagar.
- Dr S.K. Bhanja** was appointed as thesis examiner for Ms Madeeha Untoo, Ph.D. scholar (Poultry Science), Sher-E-Kashmir University of Agricultural Sciences & Technology, Kashmir.
- Dr Sandeep Saran** served as Alternate Representative on Agricultural Systems and Management Sectional Committee (FAD-22), Bureau of Indian Standards, New Delhi.



- Dr Sanjeev Kumar** was appointed as external examiner to conduct comprehensive examination of Ph.D. (AG&B) scholars, held on Nov. 20, 2017 at NDRI, Karnal.
- Dr Sandeep Saran** was nominated as Chairman, Screening Committee for direct recruitment of T-3 in the Institute vide F. No. 6-8/Rectt./Tech./2015/Estt./2960-63 dated Nov. 24, 2017.
- Dr Sandeep Saran** acted as Co-Chairman in the session on *Reshaping extension system in ICAR* in the workshop on “**Reshaping agricultural research, education and extension**” on Aug. 31, 2017 at NAARM, Hyderabad.
- Dr M.K. Padhi**, acted as a **judge** to evaluate Dr P.K. Pani Research Award-2015 for XXXIV Annual Conference of the Indian Poultry Science Association, 2017, Bengaluru.
- Dr Sanjeev Kumar** acted as a **judge** to evaluate Dr P.K. Pani Research Award-2016 for XXXIV Annual Conference of the Indian Poultry Science Association, 2017, Bengaluru.
- Dr M.K. Padhi** acted as member, Evaluation Committee, Dr P Kothandaraman Memorial Award 2017 for XXXIV Annual Conference of the Indian Poultry Science Association, 2017 Bengaluru.
- Dr Sandeep Saran** served as Chairman, Assessment Committee for Technical Personnel for the functional group *Laboratory Technician*, IVRI, Izatnagar in the meeting held on April 21, 2017 (Vide F.No. 35-4/2007-E.I dated April 13, 2017).

Committee, FAD 5 on Nov. 14, 2017 at Bureau of Indian Standards, Manak Bhavan, New Delhi-110002.

- Dr S.K. Bhanja** was invited as expert member for the Pre-Conclave discussion on Animal Husbandry sector for Perspective Planning during Resurgent Agriculture & Allied sector Conclave at Itanagar, Arunachal Pradesh on Feb. 6-7, 2018.
- Dr Sandeep Saran** was invited in the meeting on Aug. 10, 2017 convened by Director, DPR, Hyderabad to deliberate on Indian Poultry Markets in view of the WTO case regarding domestic market access for US poultry products.
- Dr Sandeep Saran** attended the meeting convened by DDG (AS) for cadre review of SMD (AS) in ICAR, New Delhi during May 08-09, 2017.
- Dr Sandeep Saran** attended Public Accounts Committee (PAC) meetings during April 07-08, 2017 and May 19, 2017 at New Delhi.
- Dr Sandeep Saran** attended meetings with Director (F), Director (W) and US (AS) on May 11, 2017 and May 30-31, 2017 at ICAR HQ, New Delhi to deliberate on the PAC audit note /letter.
- Dr Sandeep Saran** served as Member, Evaluation Committee to evaluate cleaning work carried out under *Swachhta hi sewa* programme organized during Sept. 15 - Oct. 2, 2017, CARI, Izatnagar.
- Dr D. Mondal, S.K. Sahoo, S.K. Mishra and Dharendra Kumar.** A best-poster presentation award was credited to, by organizers of 36th Ann. convention, of Indian Society of Vety. Medicine held at OUAT, Bhubneswar during Fev. 01-03, February, 2018.

Important Assignments

Dr S.K. Bhanja attended 17th meeting of Animal Husbandry, Feeds and Equipment Sectional





8. Linkages and Collaboration

Sl. No.	Project	PI and Associates	Date of start/ duration	Sanctioned funds (Rs. in lakh)	Project location
NASF, New Delhi					
1.	Detection and control of bacterial pathogens in poultry by developing chemical genomic strategies to combat multiple antibiotic resistance	Dr Naveen Navani, Associate Prof., IIT Roorkee (PI) Dr Ajit Singh Yadav (CCPI) Dr Ranjana Pathania, Associate Prof., IIT Roorkee (CCPI)	26.5.2017 (3 years)	104.36	IIT, Roorkee & ICAR-CARI, Izatnagar
2.	Aflatoxin-tolerant duck production through genetic and epigenetic approaches	Dr S.K. Mishra (PI) Dr.B.K. Swain (Co-PI) Dr P.K. Naik (Co-PI) Dr Dharendra Kumar (Co-PI)	01.04.2017 (3 years)	238.45	RC, ICAR-CARI, Bhubaneswar
DBT, Govt. of India, New Delhi					
3.	Evaluating of probiotics, prebiotics and synbiotics supplementation in low energy and low protein feed for improved nutrient utilization and safe poultry meat production.	Dr A. Biswas (PI) Dr A B Mandal (Co-PI) Dr S K Bhanja (Co-PI) Dr A.S. Yadav (Co-PI)	27.03.2015 (3.5 years)	50.57	ICAR-CARI, Izatnagar
4.	Genome editing of primordial germ cells (PGCs) using CRISPR/Cas9 system and production of myostatin knock out chicken	Dr Renu Singh (PI) Dr V.K. Saxena (Mentor)	20.11.2017 (3 years)	55.66	ICAR-CARI, Izatnagar
DST, Govt. of India, New Delhi					
5.	Embryonic feeding of Nanoparticles for improving the incubational and post-hatch status of egg and meat type chicken.	Dr Akshat Goel (PI) Dr S.K. Bhanja (Mentor)	18.04.2016 (2 years)	19.2	ICAR-CARI, Izatnagar
CSIR, New Delhi					
6.	<i>Kappaphycus alvarezii</i> and red sea weed based formulations for improving productivity and health of broiler chickens and laying hens	Dr A B Mandal (PI) Dr Praveen K. Tyagi (Co-PI) Dr S K Bhanja (Co-PI) Dr A.K. Biswas (Co-PI) Dr Avishek Biswas (Co-PI)	30.3.2016 (2 years)	19.63	ICAR-CARI, Izatnagar



SERB, DST Govt. New Delhi

7.	Enhancing gut health and immunological functions in broilers through convergence of biotechnological and nutritional interventions	Dr Gopi M. (PI) Dr Jaydip J. Rokade (Co-PI)	24.3.2017 (3 years)	42.36	ICAR-CARI, Izatnagar
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RKVY, New Delhi

8.	Surveillance and monitoring of common diseases of ducks of Odisha	Dr Geeta, OUAT (PI) Dr Dharendra Kumar (CCPI) Dr P.K. Naik (Co-CCPI) Dr B.K. Swain (Co-CCPI) Dr S.K. Mishra (Co-CCPI)	01.04.2017 (2 years)	61.00	OUAT & RC CARI, Bhubaneswar
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Farmers' First

9.	Enhancing livelihood security of farming community through livestock and crop integration using proven technologies	Dr Ranvir Singh, IVRI (PI) Dr Jagbir Singh (CCPI)	28.10.2016 (2 years)	1.73	IVRI & CARI, Izatnagar
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9. Research Publications

a. Research Papers / Review Articles

- Agarwal, R., Gautam, K., Saxena, R., Sastry, K.V.H., Tripathi, V., Singh, R.P. and Mohan, J. (2017). Alternative induced molting method of feed withdrawal and their effect on post molting eggs quality parameter of white leghorn hens. *Indian Journal of Animal Sciences* 88 (3): 335-338 (NAAS 2018 Rating = 6.19).
- Alagawany, M., Abd El-Hack, M.E., Farag, M.R., Gopi, M., Karthik, K., Malik, Y.P.S. and Dhama, K. (2017). Rosmarinic acid: Modes of action, medicinal values and health benefits. *Animal Health Research Reviews* DOI: 10.1017/S1466252317000081.
- Awachat, V.B., Elangovan, A.V., Jose, N., David, C.G., Ghosh, J., Bhanja, S.K. and Majumdar, S. (2017). Influence of perinatal amino acid supplementation on hatchability, gastro-intestinal tract development and growth performance of broiler chicks. *Tropical Animal and Poultry Science* 1(4): 28-41.
- Bhattacharyya, A., Majumdar, S., Bhanja, S.K., Mandal, A.B. and Das, B.B. (2018). Effect of dietary manipulation and vaccination of Turkey breeder hens on immunoglobulin levels of yolk, yolk sac and neonate poults. *Journal of Animal Physiology and Animal Nutrition* DOI: 10.1111/jpn.12865. (NAAS 2018 Rating = 7.24).
- Bhattacharyya, A., Majumdar, S., Bhanja, S.K., Mandal, A.B. and Kadam, M.M. (2017). Effect of maternal dietary manipulation and *in ovo* injection of nutrients on the body weight gain, feed conversion ratio, development of lymphoid and digestive organs of Turkey poults. *Indian Journal of Animal Sciences* 87(5): 630-634 (NAAS 2018 Rating = 6.15).
- Bhattacharyya, A., Majumdar, S., Bhanja, S.K., Mandal, A.B., and Kadam, M.M. (2018). Effect of maternal dietary manipulation and *in ovo* injection of nutrients on the hatchability indices, post-hatch growth, feed consumption, feed conversion ratio and immunocompetence traits of Turkey poults. *Journal of Applied Animal Research* 46(1): 287-294 (NAAS 2018 Rating = 6.43).
- Biswas, A., Mohan, J. and Deo, C. (2017). Age dependent variation in oviduct and ovary of desi fowls from post-natal stage to adulthood. *Bhartiya Krishi Anushandhan Patrika* 32(2): 133-138 (NAAS 2018 Rating = 3.07).
- Biswas, A.K., Khoja, I.A., Majumdar, S., Bhanja, S.K. and Verma A.K. (2017). Egg quality parameters and fatty acid profiles of emu eggs collected from experimental farm of ICAR-CARI, Izatnagar. *Indian Journal of Poultry Science* 52(2): 199-202. (NAAS 2018 Rating = 4.35)
- Das, A.K., Kumar, S., Mishra A.K., Rahim, A. and Kokate, L.S. (2017). Genetics of body weights in a control line of Rhode Island Red grower chicken. *Indian Journal of Animal Sciences* 87(8): 1042-1045 (NAAS 2018 Rating = 6.19).
- Das, A.K., Kumar, S., Rahim, A. and Kokate, L.S. (2017). Genetic and non-genetic parameters of grower and layer performances in CARI-Sonali chicken. *Indian Journal of Animal Sciences* 87(6): 786-789 (NAAS 2018 Rating = 6.19).
- Das, A.K., Mishra, A.K., Kumar, S., Rahim, A. and Kokate, L.S. (2017). Characterizing grower performance, body conformation and morphology in crosses of RIR and Indian native chicken genotypes. *Indian Journal of Animal Sciences* 87(6): 782-785 (NAAS 2018 Rating = 6.19).
- Debnath, J., Kumar, S., Rahim, A. and Yadav, R. (2017). Genetic variability in egg production-associated microsatellites in Rhode Island Red chicken. *Indian Journal of Animal Sciences* 87(11): 1379-1384 (NAAS 2018 Rating = 6.19).
- Deo, C., Mandal, A.B. and Tyagi, P.K. (2017) Effect of feeding different levels of dietary copper on production performance, egg quality traits, serum and egg cholesterol content in laying quails. *Indian Journal of Poultry Science* 52(1): 58-61 (NAAS 2018 Rating = 4.35).
- Dinani, O.P., Tyagi, P.K., Mandal, A.B., Tyagi, P.K., Bhanja, S.K. and Popat, D.S. (2018). Effect of feeding rice based distillers dried grains with solubles (rDDGS) on gut health, immunity and intestinal histo-morphometry in broilers. *International Journal of Pure and Applied Bioscience* 6: 99-106. (NAAS 2018 Rating = 4.74).
- Gautam, K., Sastry, K.V.H., Agarwal, R., Prakash, A., Mohan, J. and Singh, R.P. (2017). Molecular and biochemical events in sperm storage tubules of oviducts in birds. *World's Poultry Science Journal* 74: 1-10 (NAAS 2018 Rating = 7.04).
- Gautam, K., Sastry, K.V.H., Agarwal, R., Saxena, R. and Mohan J. (2017). Expression of gonadotropin and sex steroid hormone receptor mRNA in the utero-vaginal junction containing sperm storage tubules of oviduct during sexual maturation in Japanese quail. *General and Comparative Endocrinology* 259: 141-146 (NAAS Rating = 8.59).
- Giri, A.K., Biswas, A.K. and Dinani, O.P. (2017). Influence of calpain mediated postmortem ageing on quality of broiler breeder breast fillets during holding at room temperature. *International Journal of Pure and Applied Bioscience* 5(3): 1025-1034 (NAAS 2018 Rating = 4.74).
- Goel, A., Bhanja, S.K., Mehra, M., Majumdar, S. and Mandal, A.B. (2017). *In ovo* silver nanoparticle supplementation for improving the post-hatch immunity status of broiler chickens. *Archives of Animal Nutrition* 71(5): 384-394 (NAAS 2018 Rating = 7.31).
- Gopi, M., Beulah, P.V., Dhinesh Kumar, R., Shanmathy, M. and Prabakar, G. (2017). Role of nanoparticles in animal and poultry nutrition: modes of action and applications in formulating feed additives and food processing. *International Journal of Pharmacology* 13(7): 724-731 (NAAS 2018 Rating = 6.75).
- Gopi, M., Dhinesh Kumar, R., Prabakar, G., Beulah, P.V., Shanmathy, M. and Purushothaman, M.R. (2017). Feed microbiology: A forsaken piece in



- animal nutrition puzzle. *Asian Journal of Animal Sciences* 11(3): 108-114. (NAAS 2018 Rating=)
- Gupta, S.L., Tyagi, Pramod, K., Tyagi, Praveen, K., Mandal, A.B., Kolluri, G., Mir, N.A. and Khan, A. (2017). The response of rice based dry distiller's grains with soluble (DDGS) feeding on gastrointestinal microbiota and immunity in layer's diet. *Indian Journal of Poultry Science* 52(2): 133-137 (NAAS 2018 Rating=4.35).
- Hazarika, R., Deo, C., Wani, M.A., Sajad, A.S., Mandal, A.B., Bhanja, S.K., Tyagi, P.K., and Tyagi, P.K. (2017). Response of supplemental methionine and choline on carcass quality traits, gut microbial count and cost economics of broiler chickens. *Indian Journal of Poultry Science* 52(2): 151-156 (NAAS 2018 Rating=4.35).
- Junaid, N., Biswas, A., Kumawat, M. and Mandal, A.B. (2018). Production performance, immune response and carcass traits of broiler chickens fed diet incorporated with probiotics. *Indian Journal of Animal Research* DOI: 10.18805/ijar.B-3420 (NAAS 2018 rating=6.15).
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c. Abstracts / Papers Presented in Conferences/Symposia**Key Note / Invited / Lead Papers**

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- Mandal, A.B. (2017). Challenges of feed industries for sustainable poultry production, Proceedings of 34th Annual Conference of Indian Poultry Science Association (IPSACON 2017), Nov. 28-30, 2017 pp 93-108.
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f. Lectures Delivered in Training Program/ Workshop

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- Tyagi, J.S. (2018). Handling, collection and sanitation of hatching eggs for healthy broiler chicks. In: Specialized training programme on *Poultry diseases and biosecurity measures* (Jan. 29- Feb. 10, 2018). ICAR-Central Avian Research Institute, Izatnagar.
- Tyagi, J.S. (2018). Role of community and mini hatcheries for backyard poultry. In: Specialized training on *Backyard Poultry Farming* (Feb. 12-24, 2018), ICAR-Central Avian Research Institute, Izatnagar.

g. Radio & TV Talks

1. Dr Raj Narayan (2017). Kukkut paalak kis tarah apne vyavasaye ko labh kari banaye, Broadcasted on Apr. 18, 2017 by All India Radio, Bareilly.
2. Dr Simmi Tomar (2017). Murgio me teekakaran avam kukkut palko ke Iya sujav. Broadcasted on June 15, 2017 by All India Radio, Bareilly.
3. Dr Sandeep Saran (2017). Kukkut palan ka aarthik drishtikon. Broadcasted on July 19, 2017 by All India Radio, Bareilly.
4. Dr Raj Narayan (2017). Bater palan labhkari vyavasaye. Broadcasted on Oct. 04, 2017 by All India Radio, Bareilly.
5. Dr Simmi Tomar (2017). Jade me Murgio ke ucht Dekhbhal. Broadcasted on Oct. 17, 2017 by All India Radio, Bareilly.
6. Dr Raj Narayan (2018). Kukkut palan vyavasaye vaigyanik ki nazar mein. Broadcasted on Jan. 18, 2018 by All India Radio, Bareilly.
7. Dr A.B. Mandal (2018). Bhartiya kukkut udyog me Turkey utpadan ka mahtv evam sambhavnayen, Broadcasted on Feb. 14, 2018 by All India Radio, Rampur.
8. Dr Sandeep Saran (2018). Kukkut palan aur yuva varg. Broadcasted on Feb. 19, 2018 by All India Radio, Bareilly.
9. Dr Sanjeev Kumar (2018). Turkey ki vibhinn prajatiyon ki visheshtayen aur rojgar srajan me

unka mahtv”, Broadcasted on Feb. 21, 2018 by All India Radio, Rampur.

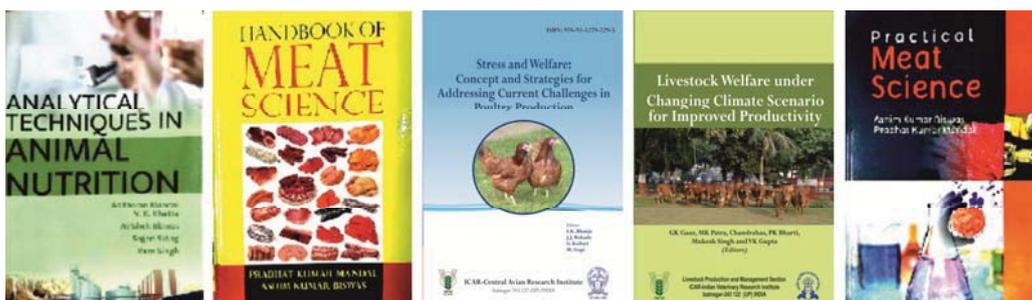
10. Dr S.K. Bhanja (2018). Turkey palan hetu aavas vyavashtha, Broadcasted on Feb. 28, 2018 by All India Radio, Rampur.
11. Dr Simmi Tomar (2017). Kukkuto ke beemaria, karan, laksan and upchar. Broadcasted on March, 06, 2018 by All India Radio, Bareilly.
12. Dr S. Majumdar (2018). Vibhinn mausamon me Turkey palan evam chujon ki dekhbhal, Broadcasted on March 07, 2018 by All India Radio, Rampur.
13. Dr C. Deo (2018). Turkey utpadan hetu sntulit aahar me vibhinn poshak tatvon ki mahatta evam santulit aahar prabhandhan. Broadcasted on March 14, 2018 by All India Radio, Rampur.
14. Dr Divya (2018). Turkey aahar me milay jaane vale samany khady padarth evam smpurak, Broadcasted on March 21, 2018 by All India Radio, Rampur.
15. Dr Sanjeev Kumar (2018). Turkey utpadan me pratyabal ka prabhv v upay. Broadcasted on March 28, 2018 by All India Radio, Rampur.
16. Dr Raj Narayan (2018). Garmiyo me murgio ki dekhbhal. AIR, Bareilly recorded on March 30, 18.
17. Dr Chandrahas delivered two TV recordings on Desi Fowl Unit, CARI, Izatnagar.

h. Hindi Articles

- डा० अजीत सिंह यादव एवं डा० असित बरन मण्डल 2018। बदलते जलवायु परिवेश में कुक्कुट स्वास्थ्य प्रबन्धन। केन्द्रीय पक्षी अनुसंधान संस्थान, इज्जतनगर, बरेली-243122
- डा० अजीत सिंह यादव, डा० चंद्रहास, डा० जयदीप रोकडे, डा० गोपीएम.एवं डा० असित बरन मण्डल 2018। कुक्कुट पालन एवं कुक्कुट उत्पाद: आमदनी बढ़ाने में योगदान। केन्द्रीय पक्षी अनुसंधान संस्थान, इज्जतनगर, बरेली-243122

i. Extra

- Mohan J., Sharma S.K., Singh J. Gautham K. and Gopi M. (2017). Economic poultry production through artificial insemination using CARI poultry semen dilutor. CARI Rajbhasha.
- Mohan, J. and Tyagi, J.S. (2018). Effect of climate change on poultry production. A Brain storming Panel Discussion on “Strategies to Combat Extreme Temperature Effects on Animal Productivity” held on Feb. 16, 2018 organized by Animal Physiology Division, ICAR- NDRI, Karnal under NICRA Project.
- Mohan, J. and Tyagi, J.S. (2018). Effect of climate change on poultry production. Brain storming session on climate change, NDRI, Karnal, Feb. 15, 2018.





10. Participation in Workshops, Conferences, Symposia and Trainings

a. Participation in workshops, conferences and symposia etc.

Sl. No.	Name of the Conference/ symposium/ workshops	Duration	Scientists participated
1.	Workshop on <i>Drafting pro-poor livestock policy for doubling farmer's income in Jharkhand</i> organized by Global Alliance for Livestock Veterinary Medicine (GALVmed), Government of Jharkhand, at Hotel Chankaya BNR, Ranchi.	April 21-22, 2017	Dr J.M. Kataria, Dr V.K. Saxena, Dr Chandrahas
2.	Workshop on <i>Reshaping agricultural research, education, extension</i> at NAARM, Hyderabad.	Aug. 31, 2017	Dr Sandeep Saran
3.	20 th World Veterinary Poultry Association Congress 2017, Edinburgh International Conference Centre (EICC), United Kingdom.	Sept. 4-8, 2017	Dr Avishek Biswas, Dr Gautham K.
4.	National seminar on <i>Opportunities, challenges of translational research in the frontier areas of animal bio-technology</i> , V annual convention of Society for Veterinary sciences, Biotechnology (SVSBT), OUAT, Bhubaneswar	Sept. 22-23, 2017	Dr M.K. Padhi Dr S.K. Mishra
5.	National Workshop on <i>Developing a roadmap for agricultural knowledge management in India</i> organized by ICAR-Directorate of Knowledge Management in Agriculture, New Delhi.	Sept. 27-28, 2017	Dr Chandrahas
6.	5 th Intestinal Health Scientific Interest Group <i>Poultry Gut Health</i> Symposium held at Bangkok.	Oct. 11-12, 2017	Dr Gopi, M.
7.	XVI Convocation cum Scientific convention at SVVU, Tirupati.	Nov. 4-5, 2017	Dr Sanjeev Kumar
8.	Regional workshop on <i>Farmers' Rights, Agro-biodiversity Exhibition</i> organized by NRRI, Cuttack in association with Protection of Plant Varieties, Farmers' Rights Authority.	Nov. 17, 2017	Dr M.K. Padhi
9.	XV Biennial conference, national symposium of Indian association of Women Veterinarians (IAWV) held at College of Veterinary Science, Rajendranagar, PVNRTVU, Hyderabad.	Nov. 21-22, 2017	Dr Simmi Tomar
10.	34 th Annual conference of Indian Poultry Science Association (IPSACON 2017), organized by ICAR-NIANP at NIMHANS Convention Centre, Bengaluru.	Nov. 28-30, 2017	Drs A.B. Mandal, Sanjeev Kumar, Sandeep Saran, Raj Narayan, M.K. Padhi, R.K.S. Bais, Simmi Tomar, C.K. Beura, Avishek Biswas, Chandrahas, J.J. Rokade, Gopi, M., P.K. Naik, S.K. Mishra, S.C. Giri, B.K. Swain
11.	XXVI Annual conference of SAPI held at Karnataka Veterinary, Animal, Fisheries Sciences University (KVAFSU), Bidar	Dec. 21-22, 2017	Dr Jag Mohan

12.	XVII Biennial conference of Animal Nutrition Society of India at Junagadh Agricultural University, Junagadh, Gujarat.	Feb. 1-3, 2018	Drs Praveen Kr. Tyagi, Pramod Kr. Tyagi
13.	1 st International Extension Congress 2018 on <i>New Horizons of Extension – Challenges, opportunities</i> held at ICAR-Central Institute for Women in Agriculture, Bhubaneswar	Feb. 1-3, 2018	Dr M.K. Padhi
14.	4 th Biennial conference of PAi, international symposium on <i>Probiotic Therapy: Translating to Health, Clinical Practice</i> at AIIMS, New Delhi, India.	Feb. 17-18, 2018	Dr A.S. Yadav
15.	2 nd Asian conference on <i>Science, Technology, Medicine</i> at Dubai	March 20-22, 2018	Dr Gopi M.
16.	11 th Asia Pacific Poultry Conference-2018, held at Royal Athenee Hotel, Bangkok, Thailand.	March 25-17, 2018	Dr Avishek Biswas

b. Participation in Trainings

Sl. No.	Title & Place of Training	Duration	Officials participated
1.	<i>Working with MS-Excel</i> , ICAR-IVRI, Izatnagar	Oct. 21-23, 2017	Shri S.R. Meena (S.T.O.), Shri K.K. Verma (Assistant), Shri Prashant Panwar (LDC)
2.	<i>Working with MS-Excel</i> , ICAR-IVRI, Izatnagar	Oct. 26-28, 2017	Drs Jaydip J. Rokade, Gautham Kolluri, Gopi, M.
3.	<i>Identification, Characterization of Phytochemicals using HRMS Instruments</i> at CSIR-Central Drug Research Institute, Lucknow (UP)	Nov. 27-29, 2017	Dr Divya
4.	<i>Basic statistical computing procedure for analysis of experimental data</i> at ICAR-IVRI, Izatnagar	Jan. 27-30, 2018	Drs Chandrahas, J.J. Rokade, Gautham, K., Gopi, M.
5.	<i>Real Time PCR data analysis</i> at ICAR-IVRI, Izatnagar	March 7-9, 2018	Drs Gautham, K., Gopi, M.



11. Consultancy, Patents, Commercialization of Technology

Consultancy Services

- Consultancy was given to the farmers, some poor poultry processors in the area of Poultry Products Technology.
- Provided low-cost feed formulae to about 100 poultry farmers, small feed industries from different states (Uttar Pradesh, Karnataka, West Bengal, Uttarakhand, Haryana, Bihar, Jharkhand, Chattishgarh, MP), solving the problems of farmers from different states through personal contact, telephone call.
- Least cost feed formulation technology is being disseminated through *Makefeed Poultry*, Dairy software.

Technology Submitted to ITMC

- Technologies assigned for commercial transfer
- Processing technologies for development of functional Turkey meat loaf utilizing adult turkey.

Institute Technology Management Unit (ITMU)

The ITMU has been operational with Dr Sandeep Saran in the Institute to provide support to the IP enabled services. One patent application no. 201711007119 dated Feb. 28, 2017 is pending before the Patent Office, New Delhi. The present status of the patent is shown as "*Application awaiting examination*". Out of 8 trademark applications filed by the Institute, two are under active consideration. M/s United Overseas Trade Mark Company, New Delhi have been engaged as attorney to contest the objected cases of trademarks. Following License Agreements (LA) were prepared, signed with M/s Chaudhary & Chauhan Enterprises, Bareilly on March 01, 2018 in respect of the following technologies developed by the Institute.

- Egg Rasmalai
- Functional Chicken Meat Bites
- Quail Egg Pickle

A sum of Rs. 5500/- was charged for each of the above mentioned technologies, thus, total amounting to Rs. 16500/-.

Contract Research Project: A Contract Research Project entitled "Evaluation of Grobig® as an alternate to antibiotic growth promoters in broilers" sponsored by M/s Bayers India Pvt. Ltd. was under taken at the Institute with signing of formal MoU. The cost of project was about Rs. 10.84 lakh.

Supply of Germ plasm

Following MoUs were signed for supply of germplasm:

- Supply of (Parent Line) Fertile Eggs of Ankleshwar Chicken - Commercialized to M/s S.R.S. Country Chicken on July 21, 2017.
- Supply of (Parent Line) Fertile Eggs of Ankleshwar Chicken- Commercialized to M/s S.R.S. Country Chicken on Aug. 17, 2017.
- Supply of Pure Kadaknath Breed Growers (Germplasm) -Commercialized to Shri Anwar Ali, S/o Shri Ashraf Hussain, Balaganj, Lucknow, on Aug. 29, 2017.

Agri-Business Incubator (ABI)

The agribusiness incubation Centre has been established in the Institute as part of the NAIF funded project under Dr Sandeep Saran, PI. Having received the formal approval NAIF as part of the EFC pertaining to **ICAR Headquarters Scheme**, vide F.No. IP&TM-7(1)/2017-IPR dated 21.2.2018, one Business Manager, one Business Executive, one Office Assistant cum Computer Operator were appointed in the project w.e.f. March, 2018. For establishing ABI in the Institute, 2 additional rooms were proposed to be renovated for which as sum of Rs. 3.49 lakh has been deposited with the CPWD as per the cost estimates received. All necessary help was extended, bankable project reports were prepared for the prospective poultry entrepreneurs approaching the Institute for seeking loans from financial institutions for establishing poultry production, poultry feed making or hatchery units under various scheme of the Central /States Governments. During 2017-18 following detailed project reports were prepared for the entrepreneurs under ABI.

Purpose	Client	Date	Amount Charged	Mode of payment
Contractual broiler farming	Smt. Shakun Yadav W/o Shri MPS Yadav 84, Ashish Roral Park, Bareilly	06.12.17	Rs. 12000/-	Online payment
Broiler Farming	Shri Surender Pal Vill. Shiv Nagaria, PO- Yakobganj Bahedi, Bareilly	27.12.17	Rs. 7200/-	Cheque no. 047407
Broiler Farming	Sri Yogendra Pal Singh Vill.&PO- Bakipur, Ahmedpur, Bareilly	14.12.17	Rs. 20000/-	Debit Card

12. Workshop, Trainings/ Farm schools/ Seminar etc. organized

Specialized training Programme on “Layer Production” from July 10 to 22, 2017

Course co-ordinator:
Dr S.K. Bhanja
No. of Participants: 21



Summer School Training on “Stress, Welfare: Concepts, Strategies to Address the Current Challenges in Poultry Production” from Sept. 06-26, 2017

Dr S.K. Bhanja, Course Director, Dr J.J. Rokade, Dr Gautham, Dr Gopi, M. organized a 21-days Summer School Training from Sept. 06-26, 2017 on “Stress, Welfare: Concepts, Strategies to Address the Current Challenges in Poultry Production” for academic staffs, research Institutes. A total of 23 participants from different parts of the Country participated in the training.



On the occasion of inauguration of Summer School by Dr Nagaendra Sharma, Ex Vice Chancellor, Shere-e- Kashmir university of Agricultural Science, Technology-Jammu, was the Chief Guest.



A total of 23 participants from different parts of the Country participated in the training.

Specialized training on “Poultry feeding, quality control” from Nov. 13-24, 2017

Course co-ordinator: Dr Avishek Biswas
No. of Participants: 05

Specialized training on “Poultry Processing, Products Technology” from Jan. 15-27, 2018

Course co-ordinator: Dr Ashim Biswas
No. of Participants: 04

Specialized training on “Poultry hatchery operation” from Jan. 22 to Feb. 03, 2018

Course co-ordinator: Dr Jagbir S. Tyagi
No. of Participants: 02





Specialized training on “Backyard Poultry Farming” from Feb. 12-24, 2018 was conducted.

Course co-ordinator: Dr Chandrahas

No. of Participants: 06

Specialized training on “Broiler Farming” from 10-22 April, 2017 was conducted.

Course co-ordinator: Dr Simmi Tomar

No. of Participants: 05

Workshop on “Skill, poultry entrepreneurship development in Uttar Pradesh” on March 23, 2018

Course co-ordinator: Dr Sanjeev Kumar

Course co-coordinators: Drs Praveen K. Tyagi and Sandeep Saran

No. of Participants: 76

It was inaugurated by the chief guest, Dr Vinod Kumar Sachan, Joint Director, Poultry Disease Control, Directorate of Animal Husbandry, U.P., Lucknow. Dr Pramod Kumar Sharma, Deputy Director, Central Laboratory, Lucknow was the Guest of Honour. Poultry programme Officers, entrepreneurs from 38 districts of U.P. participated in the workshop. Dr Sandeep Saran, Co-coordinator of the workshop, in his welcome address, gave a detailed account of the growth of the poultry sector, the Institute since its inception on 2nd Nov. 1979. Workshop coordinator, Dr Sanjeev Kumar described the objectives, significance of the workshop. Dr Vinod K. Sachan detailed various poultry schemes going on in the state. Dr A.B. Mandal, Director, presented a detailed account of various productions, processing technologies developed by the Institute, encouraged the participants to adopt the same as commercial ventures. Dr Sanjeev Kumar presented various techniques of genetic improvement of layer, broiler chicken, viz., molecular breeding, genomic selection, transgenesis, etc. Dr S.K. Bhanja provided information on poultry housing, management. Dr Mandal gave a lecture on nutritional management in various seasons. Dr Saran presented a detailed account of the prospects of poultry entrepreneurship development, sources of capital, effective marketing management of poultry produce to earn better profits. The problems of entrepreneurs were also discussed, solutions were suggested. The programme was conducted by Dr Divya.



Workshop on “Skill and Poultry Entrepreneurship Development in Uttar Pradesh” on March 26, 2018

Course co-ordinator: Dr Sanjeev Kumar

Course co-coordinators: Drs Praveen K. Tyagi and Sandeep Saran

No. of Participants: 49



It inaugurated by the chief guest, Dr P.K. Pradhan, Joint Director, Poultry Disease Control, Directorate of Animal Husbandry, U.P., Lucknow. Dr Vinod Kumar, Deputy Director, Lucknow was the Guest of Honour. Poultry programme Officers, entrepreneurs from 37 districts of U.P. participated in the workshop. Guests, participants were welcomed by Dr Sandeep Saran, Co-coordinator, who also gave detailed account of the growth of this sector, the Institute. Dr Sanjeev Kumar, the coordinator described the objectives, significance of the workshop. Dr Pradhan gave detailed account of various poultry schemes. Director, Dr A.B. Mandal mentioned about various technologies developed at the Institute. Dr Sanjeev Kumar presented various techniques of genetic improvement of layer, broiler chicken. Dr S.K. Bhanja provided information on poultry housing, management, Dr A.S. Yadav gave brief account of health management. Dr Mandal discussed about nutritional management. Dr Saran explained the prospects of poultry entrepreneurship to earn better profits. There was excellent interaction between the experts, entrepreneurs.

Farm School on Air, All India Radio, Rampur

Dr Sanjeev Kumar, as Coordinator, Dr S. Majumdar as co-coordinator, organized “Farm school on air” with the help of Prasar Bharti, All India Radio, Rampur on the title “टर्की उत्पादन द्वारा रोजगार सृजन एवं आय अर्जन” (Turkey utpadan dvara rojgar srajan, aay arjan) with effect from Feb. 14, 2018.

Sl. No.	Topic	Date	Guest
1.	भारतीय कुक्कुट उद्योग में टर्की उत्पादन का महत्व एवं सम्भावनाएं	14.02.18	डॉ० ए०बी० मण्डल
2.	टर्की की विभिन्न प्रजातियों की विशेषताएं एवं रोजगार सृजन में उनका महत्व	21.02.18	डॉ० संजीव कुमार
3.	टर्की पालन हेतु आवास व्यवस्था	28.02.18	डॉ० सुब्रत कुमार भांजा
4.	विभिन्न मौसमों में टर्की पालन एवं चूजों की देखभाल	07.03.18	डॉ० समीर मजूमदार
5.	टर्की उत्पादन हेतु संतुलित आहार में विभिन्न पोषक तत्वों की महत्ता एवं संतुलित आहार प्रबंधन	14.03.18	डॉ० चन्द्र देव
6.	टर्की आहार में मिलाये जाने वाले सामान्य खाद्य पदार्थ एवं सम्पूरक	21.03.18	डॉ० दिव्या
7.	टर्की उत्पादन में प्रत्याबल का प्रभाग व उपाय	28.03.18	डॉ० संजीव कुमार

Specialized Trainings Organized at ICAR-CARI, Izatnagar

Sl. No.	Name of the courses	Duration	Number of trainee
1.	Broiler Production	April 10-22, 2017	05
2.	Poultry Hatchery Operation	June 12-24, 2017	05
3.	Layer Production	July 10-22, 2017	21



4.	Poultry Hatchery Operation	Nov. 08-12, 2017	02
5.	Poultry Feeding & Quality Control	Nov.13-24, 2017	05
6.	Poultry Processing & Products Technology	Jan.15-27, 2018	02
7.	Poultry Hatchery Operation	Jan. 22 - Feb. 03, 2018	02
8.	Poultry Diseases & Biosecurity Measures	Jan. 28- Feb.10, 2018	02
9.	Backyard Poultry Farming	Feb. 12-24, 2018	06

Total training organized = 09, Total trainees appeared = 50

In all 285 persons were trained in the following programmes.

- i. Regular training programme on poultry production management for 66 farmers / unemployed youths from various states w.e.f. June 19-24, 2017
- ii. Regular training programme on poultry production management for 70 farmers, unemployed youths from various states w.e.f. Oct. 03-08, 2017
- iii. Regular training programme on poultry production management for 70 farmers, unemployed youths from various states w.e.f. Dec. 18-23, 2017.
- iv. Regular training programme on poultry production management for 69 farmers, unemployed youths from various states w.e.f. March 19-24, 2018.
- v. Sponsored training programme on poultry production management for 10 farmers of Pithauragarh (Uttarakhand) w.e.f. Jan. 15-20, 2018.

Trainings/ Exhibitions Organized by ICAR-CARI, Regional Centre, Bhubaneswar

Sl.No.	Name of the courses	Duration	Number of trainee
1.	Training on duck production, exposure visit of RC CARI campus at RC CARI	15.06.17	50 students of NDRI, Regional Centre, Kalyani, West Bengal
2.	Display of CARI technology, interaction of farmers on the eve of "World Food Day". In the premises of Institute of Engineers, Unit-IV, Bhubaneswar	16.10.17	~ 700 farmers
3.	Farmers fair on the eve of Regional workshop on PPV & FR Act, Exhibition on Agro-Biodiversity (Inaugurated by DG ICAR) at ICAR-NRRI, Cuttack	17.11.17	~ 300 farmers

Student Seminar Organized

Outline of Research Work (ORW)

Sl. No.	Speaker	Topic	Date
1.	Dr Vinay Singh PSc/PhD/1541	Feeding value of sun dried rice based brewers dried grain in diets of broiler chickens, laying hens.	17.4.2017
2.	Dr SK Jaiswal PSc/PhD/1846	Metagenomic analysis of gut microbiome of red jungle fowl for identification, characterization, evaluation of lactobacillus sp. As probiotic candidate.	29.4.2017
3.	Dr Hishey Ongmoo PSc/PhD/1446	Feeding value of rice gluten meal in white leghorn layers.	03.5.2017
4.	Dr Meesam Raza PSc/PhD/1921	Effect of dietary supplementation of certain antioxidants, their interactions on the performance of broiler chickens under hot-humid condition.	03.5.2017
5.	Dr PB Aswathi PSc/PhD/1687	Study on the reproductive performance of broiler parents under heat stress, improvement in performance, thermo tolerance of their progenies by applying different thermal conditioning approaches.	12.6.2017
6.	Dr Syed Shahid Navi PSc/MVSc/5625	Effect of feeding of <i>kappaphycus alvarezii</i> red sea weed based formulations on production performance, meat quality traits of broiler.	12.6.2017



7.	Dr Sarada Tarai PSc/PhD/1892	Genetic analysis of immunity to new castle disease virus in broiler, native chicken.	24.7.2017
8.	Dr Jagdhane Vinay M. PSc/MVSc/5816	Physiological responses to acute heat stress in Aseel, Kadaknath chicken.	09.10.2017
9.	Dr Inderjit Bera PSc/MVSc/5725	Effect of dietary soapnut shall powder on growth performance of meat quality in broiler chicken.	13.11.2017
10.	Dr Pritam Biswas PSc/MVSc/5741	Development of <i>kappaphycus alvarezii</i> , red sea weeds incorporated chicken bites, sausages.	13.11.2017
11.	Dr Balraj S. PSc/MVSc/5703	Effect of phytoestrogen supplementation on productive, reproductive traits in Guinea fowl.	13.11.2017
12.	Dr Jai Prakash PSc/PhD/5720	Comparative analysis of production traits in reciprocal crosses of Aseel x CARIRED, Kadaknath x CARIRED.	16.11.2017
13.	Dr Mukhtar Ahmad PSc/MVSc/5794	Semen characteristics, fertility in desi fowl.	16.11.2017
14.	Dr Sajid Ayaz PSc/MVSc/5802	Effect of vitamin E, selenium on reproductive traits of Guinea fowl.	16.11.2017
15.	Dr Dayanada Jadhav PSc/MVSc/5813	Development of functional egg based spiral rolls.	24.11.2017
16.	Dr Kausal Thapa PSc/MVSc/5740	Diallel cross in broiler.	23.12.2017
17.	Dr Junai N. PSc/PhD/2009	Feeding value of corn died distiller's grain with solubles (C-DDGS) in Broilers.	30.01.2018
Pre-thesis submission seminar			
1.	Dr P.Ravichanderan PSc/MVSc/5495	Development of storage quality of chicken sauces powder.	29.4.2017
2.	Dr Awachat Vaibhav B. PSc/PhD/1441	Peri-natal nutritional intervention for post hatch performance in broiler chicken.	24.5.2017
3.	Dr Sudeep Kumar PSc/MVSc/5585	Development, quality assessment of selected health oriented poultry meat products for their nutritional profiles consumer acceptability, functional activity.	19.7.2017
4.	Dr Vispute Mayur PSc/MVSc/5631	Effect of dietary inclusion of hemp (<i>Cannabis sativa</i>), (<i>Dill Anethum grandlens</i>) on growth performance, immunity, meat quality in broiler chickens.	24.05.2017
5.	Dr Beulah Pearlina V. PSc/MVSc/5602	Effect of different semen extenders on fertility of chicken spermatozoa during short term preservation.	23.06.2017
6.	Dr Mitam Kr. Halder PSc/MVSc/5613	Evaluation of functional attributes of chicken sausages prepared after fermentation of minced chicken meat with <i>Lactobacillus plantarum</i> , supplemented with malted oat flour.	23.06.2017
7.	Dr Namit Mohan PSc/MVSc/5587	Production performance, immune response, meat quality traits of broiler chickens fed diet incorporated with prebiotics.	12.07.2017
8.	Dr Akash Uniyal PSc/MVSc/5588	Evaluation of production performance, immune response, gut health status of Turkey poults fed diet supplemented with <i>Tinospora Cordifolia</i> (Giloy)	12.07.2017
9.	Dr G. Prabakar PSc/PhD/1820	Effect of seasonality diluents, national intervention on reproductive efficiency of Turkey chicken.	19.07.2017
10.	Dr Moh. Nawaj Shurfuddin PSc/MVSc/5623	Effect of dietary inclusion of leaf powders containing essential oils as growth promoters in broiler chicken.	19.07.2017
11.	Dr Rupjyoti Hazarika PSc/PhD/1745	Studies of dietary supplementation of choline, betaine on methionine spraying effect in broiler chickens.	21.08.2017



12.	Dr Sajad Ahmad PSc/PhD/1757	Growth performance, expression of heat stress related genes in broiler chicken as influenced by stress alleviating agents during hot dry, hot humid conditions.	21.08.2017
13.	Dr Manzoor Ahmad PSc/PhD/1758	Evaluation of feeding value of rice gluten meal in broiler chickens.	26.08.2017
14.	Dr Santosh Pal PSc/MVSc/5572	Comparative analysis of growth, immune competence traits in reciprocal crosses of Aseel x CARIREC, Kadaknath x CARIREC.	09.10.2017
15.	Dr Faneshwar Kumar PSc/PhD/1769	Dietary manipulations for effective, economic production of functional poultry meat.	24.03.2018
Major Credit Seminar			
1.	Dr Inderjit Bera PSc/MVSc/5725	Role of flaxseed in human health, poultry meat quality.	25.05.2017
2.	Dr Mukhtar Ahmad PSc/MVSc/5794	Artificial insemination in poultry.	25.05.2017
3.	Dr Jagdhane V.M. PSc/MVSc/5816	Physiological response to heat stress in poultry.	25.05.2017
4.	Dr Anita Rai PSc/MVSc/5716	Use of polyphenolic compounds in chicken diet.	26.05.2017
5.	Dr Dayanada Jajdhav PSc/MVSc/5813	Conservation of poultry wastes into value added products.	26.05.2017
6.	Dr Jai Prakash PSc/MVSc/5720	Economic traits in egg type chicken.	26.05.2017
7.	Dr Balraj PSc/MVSc/5703	Potential of probiotics in boosting poultry industry.	27.05.2017
8.	Dr Sajid Ayaz PSc/MVSc/5802	Lean meat production in poultry.	27.05.2017
9.	Dr Pritam Biswas PSc/MVSc/5741	Traceability of meat, meat products.	27.05.2017
10.	Dr Kaushal Thapa PSc/MVSc/5740	Overview of broiler breeding.	27.05.2017
11.	Dr Geeta PSc/PhD/1984	Biogenic amines in poultry meat: Effects on human health, its reducing strategies.	29.05.2017
12.	Dr Junaid N. PSc/PhD/2009	Air emissions from poultry houses in particular ammonia, its mitigation methods.	29.05.2017
13.	Dr T. Tamilmani PSc/PhD/2032	Recent advances in control of mycotoxins in broilers.	29.05.2017
Minor Credit Seminar			
1.	Dr Harshit Kumar AGB/MVSc	Epigenetics in poultry production, a new challenge in post genomic era.	25.10.2017
2.	Dr Vani A. AGB/MVSc	Transgenesis in poultry, past, present, future perspectives.	26.10.2017
3.	Dr Pooja GS AGB/MVSc	Genetic markers, their applications in poultry breeding.	26.10.2017
4.	Dr Dhawal Kant Yadav LPM/MVSc/5850	Biosecurity measures in poultry.	27.10.2017
5.	Dr Sheikh Mohd. Usman LPM/MVSc/5879	Organic poultry Farming.	27.10.2017
6.	Dr Nripendra Pratap Sing LPM/MVSc/5876	Backyard poultry Farming.	28.10.2017
7.	Dr Gurdeep Singh LPM/MVSc/5826	Brooding management in broiler chicks.	28.10.2017

13. Distinguished Visitors



Dr R. Prabakaran, Chairman & Members, QRT, April 08, 2017



Mr. R. P. Singh, Member, Governing Body, ICAR, May 09, 2017



Dr S.C. Gupta, JD (Disease Control & Administration), UP AH, Nov. 02, 2017



Ms Pooja, District Horticulture Officer, Bareilly, Dec. 03, 2017



Dr Abha Dutt, Deputy Chief Veterinary Officer, Bareilly Dec. 03, 2017



Dr Manish Raj Singh alongwith Dr V.K. Gupta, Joint Director (CADRAD), IVRI, Izatnagar, Jan. 01, 2018



Dr Vinod Kumar Sachan, JD, Poultry Disease Control, Dr Pramod Kumar Sharma, DD, Central Laboratory, Directorate UP AH, March 23, 2018



Dr P.K. Pradhan, Joint Director, Poultry Disease Control, Dr Vinod Kumar, DD, Directorate UP AH, March 26, 2018



Visitors' Quotes

"It was very nice to see the history of CARI, its achievements organized very neatly so that every visitor understands the contributions of the Institute. Best wishes to everyone concerned"

..... Dr R. Prabakaran
Former VC, TANUVAS & Chairman, QRT

"Interesting, worth the visit. Excellently maintained"

..... Col. Vinod Kumar

"CARI is a leader Institute in research, extension, teaching in poultry. Their vision, hard work will answer the challenges of present day poultry industry. I wish them good luck in future."

.... Dr Mandeep Singh
COVS, GADVASU, Ludhiana

"Very very nice briefing, well maintained establishment with systematic scientific manner. It is very good exposure to our trainees. Thanks a lot."

....Dr E. Chaoba Singh
Dog Training & Breeding Centre, SSB, DERA
Alwar, Rajasthan





14. Personnel

Director (A)
Dr A.B. Mandal

Heads

Division of Avian Nutrition, Feed Technology	Dr A.B. Mandal
Division of Avian, Genetics, Breeding	Dr V.K. Saxena
Division of Avian Physiology, Reproduction	Dr Jag Mohan
Division of Post-Harvest Technology	Dr A.S. Yadav
Poultry Housing, Management section	Dr S. Majumdar
Technology Transfer Section	Dr M.P. Sagar
Prioritization, Monitoring, Evaluation Section	Dr Sandeep Saran
Poultry Economics, Agribusiness Research Section	Dr Sandeep Saran
Post-Graduate Education, Training Section	Dr Praveen Kr. Tyagi
Avian Medicine Section	Dr A.S. Yadav
In charge, Regional Centre, Bhubaneswar	Dr M.K. Padhi / Dr S.K. Mishra

Administration

Administrative Officer	Shri Hartesh Kaushik (till 13.12.2017) Shri Panchoo Lal (w.e.f. 20.12.2017)
Assistant Administrative Officer	Shri Irfan Ali Khan
Finance, Account Officer	Shri Raj Kumar
Assistant Finance & Account Officer	Shri Kailash Chand

Scientific Staff (Main Campus, Izatnagar)

Name	Designation	Qualification
Dr A.B.Mandal	Pr. Scientist	Ph.D.
Dr S.Majumdar	Pr. Scientist	Ph.D.
Dr Jagmohan	Pr. Scientist	Ph.D.
Dr Praveen K. Tyagi	Pr. Scientist	Ph.D.
Dr Jagbir Singh Tyagi	Pr. Scientist	Ph.D.
Dr Sanjeev Kumar	Pr. Scientist	Ph.D.
Dr V.K.Saxena	Pr. Scientist	Ph.D.
Dr Sandeep Saran	Pr. Scientist	Ph.D.
Dr C.K.Beura	Pr. Scientist	Ph.D.
Dr Raj Narayan	Pr. Scientist	Ph.D.
Dr Pramod K. Tyagi	Pr. Scientist	Ph.D.
Dr A.S.Yadav	Pr. Scientist	Ph.D.
Dr Chandra Deo	Pr. Scientist	Ph.D.
Dr S.K.Bhanja	Pr. Scientist	Ph.D.
Dr M.P. Sagar	Pr. Scientist	Ph.D.
Dr Simmi Tomar	Pr. Scientist	Ph.D.
Dr Divya	Pr. Scientist	Ph.D.
Dr Asim Kumar Biswas	Sr Scientist	Ph.D.
Dr Avishek Biswas	Sr Scientist	Ph.D.
Dr Chandrahas	Sr Scientist	Ph.D.
Dr M. Sirajuddin	Scientist	M.V.Sc
Dr Gautham Kolluri	Scientist	M.V.Sc
Dr Rokade Jaydip Jaywant	Scientist	Ph.D.
Dr Gopi M.	Scientist	Ph.D.



Scientific Staff (Regional Centre, Bhubaneswar)

Dr S.K.Mishra	Pr. Scientist	Ph.D.
Dr R.K.S.Bais	Pr. Scientist	Ph.D.
Dr S.K.Sahoo	Pr. Scientist	Ph.D.
Dr B.K.Swain	Pr. Scientist	Ph.D.
Dr K.V.H.Sastri	Pr. Scientist	Ph.D.
Dr M.K.Padhi	Pr. Scientist	Ph.D.
Dr S.C.Giri	Pr. Scientist	Ph.D.
Dr P.K.Naik	Pr. Scientist	Ph.D.
Dr Dhirendra Kumar	Scientist	Ph.D.

Technical Staff (T-6 and above)

Dr A. Mishra	T-9 Medical Officer	MBBS
Shri P.N.Yadav	T-7-8 Assistant Chief Technical Officer	MA
Shri S.P.Singh	T-7-8 Sr Technical Officer	MA
Shri A.K.Singh	T-7-8 Sr Technical Officer	MA
Shri M.W.Raza	T-7-8 Sr Technical Officer	MA
Shri Shafiq Ahmad	T-6 Sr Technical Officer	Diploma Elect. Eng.
Shri Sharad Kumar Johri	T-6 Sr Technical Officer	MSc
Shri S.R. Meena	T-6 Sr Technical Officer	MSc
Shri Lalit Kumar Mishra	T-6 Sr Technical Officer	MSc
Shri Ravi Prakash	T-6 Sr Technical Officer	MSc
Shri Anoop Kumar Johari	T-6 Sr Technical Officer	MSc
Shri Virendra Kumar	T-6 Sr Technical Officer	MSc
Shri A.K. Nanda	T-6 Sr Technical Officer (RC)	MSc
Shri R.K. Bharti	T-6 Sr Technical Officer	MA
Shri Harish Kumar Sagar	T-6 Sr Technical Officer	BA

Administrative Staff

Name	Designation
Shri Panchoo Lal	Administrative Officer
Shri Raj Kumar	F&AO
Shri I.A. Khan	Asstt. Admn. Officer
Shri Kailash Chand	A.F&A.O
Shri G.K.Bisaria	Personal Secretary
Shri G.D. Mainali	Assistant
Shri Jagdish Prasad	Assistant
Shri H.C.Saxena	Assistant
Shri K.K.Verma	Assistant
Shri A.K.Saxena	Assistant
Shri C.S.Bisht	Assistant
Shri Anwar Alam Khan	Assistant
Shri Pawan Kakkar	U.D.C
Shri P.K.Sarkar	U.D.C
Smt. Reeta Adhikari	U.D.C
Smt. Prema Joshi	U.D.C
Smt. Rekha Rani	U.D.C
Shri A.K.Sharma	U.D.C
Shri Ajay Kumar	L.D.C
Shri Sachin Kant Sharma	L.D.C
Shri Prem Nath	L.D.C
Shri Prashant Panwar	L.D.C
Shri Vijay Kumar Gupta	L.D.C
Shri Sukul Hansda	U.D.C.(RC)



Cadre Strength, Staff Position in the Institute

Category	Sanctioned Strength	as on 1.4.2017		as on 31.03.2018	
		In-Position	Vacant	In-Position	Vacant
Scientific	40+1	33+1	07	33	08
Technical	61	33	28	29	32
Administrative	31	26	05	23	08
Skilled Support Staff	137	95	42	88	49
Total	270	188	82	173	97

Promotions / Appointments

- Shri Ajay Dass, got promoted from T-2 to T-3 w.e.f. 01.05.2017

Transfer from other Institutes

- Shri Panchoo Lal, A.O. was transferred from ICAR-IVRI, Izatnagar, joined at ICAR-CARI on 20.12.2017.
- Shri Hartesh Kaushik, A.O. was transferred from ICAR-IVRI, Izatnagar, joined at ICAR-CARI on 11.04.2017.
- Shri Raj Kumar, F&AO. Transferred from ICAR-CIAH, Bikaner, joined at ICAR-CARI on 26.04.2017.

Transfer to other Institutes

- Shri Hartesh Kaushik, A.O. was transferred to ICAR-IVRI, Izatnagar on 13.12.2017 from ICAR-CARI, Izatnagar.

Superannuation

- Shri Om Shankar, Lower Divisional Clerk, voluntarily retired from the services on 30.4.2017.
- Shri V.K. Bhasin, Technical Officer (T-5), retired from the services on 30.6.2017
- Shri Nand Kishor, Skilled Supporting Staff, retired from the services on 31.7.2017

- Shri Santosh Kumar, Technician (T-1), retired from the services on 31.8.2017
- Shri M.C. Pathak, Technical Officer (T-5), retired from the services on 30.9.2017
- Dr J.M. Kataria, Director, retired from the services on 31.10.2017
- Shri S. Bhatnagar, Chief Tech. Officer (T-9), retired from the services on 31.12.2017
- Smt. Bimla Devi, Assistant, voluntarily retired from the services on 31.12.201
- Shri Anokhey Lal, Skilled Supporting Staff, voluntarily retired from the services on 31.12.2017.
- Shri Kali Charan, Skilled Supporting Staff, retired from the services on 31.12.2017.
- Shri Babu Ram, Skilled Supporting Staff, retired from the services on 31.01.2018.
- Shri Ashok Kumar Saxena, Assistant, retired from the services on 28.02.2018.
- Shri Babu Ram, Assistant, retired from the services on 28.02.2018.
- Shri Hafizullah, Assistant, retired from the services on 31.03.2018.

Demises

- Shri Sunil Kumar, Lower Divisional Clerk, expired on 18.06.2017.
- Shri Ajay Kumar, Skilled Supporting Staff expired on 17.02.2018.



15. Expenditure and Revenue

BUDGET ALLOCATION AND UTILIZATION (2017-18)

		(In Rupees)	
	Head of Account	Budget Allocation	Utilization
A	Grant-in-aid Capital Works		
a)	Office Buildings	17867000	17866506
b)	Residential Buildings	0	0
	Other Capital Expenditure		
c)	Equipment	1105000	1104764
d)	Information Technology	113000	112697
e)	Library Books & Journals	0	0
f)	Vehicles, Vessels	0	0
g)	Livestock	0	0
h)	Furniture & Fixtures	1115000	1114515
	Total Capital Expenditure	20200000	20198482
B	Grant-in-aid Salary		
a)	Establishment expenses	183000000	182999049
b)	Wages	0	0
c)	Overtime Allowances	0	0
	Total Establishment Expenses	183000000	182999049
C	Grant-in-aid General		
a)	Pension & Other Retirement Benefits	51200000	51187471
b)	<i>Travelling Allowances</i>		
i)	Domestic TA/Transfer TA	1500000	1204365
ii)	Foreign TA	0	0
	Total Travelling Expenses	1500000	1204365
c)	Research, Operational Expenses		
1)	Research Expenses	35428000	35427856
2)	Operational Expenses	13372000	13367257
	Total - Research, Operational	48800000	48795113
d)	Administrative Expenses		
1)	Infrastructure	21500000	21499883
2)	Communication	325000	324091
3-a)	Repair & Maintenance-Equipment, Vehicles & Others	670000	661531
3-b)	Repair & Maintenance - Office Buildings	405000	403571
3-c)	Repair & Maintenance - Residential Buildings	0	0
3-d)	Repair & Maintenance - Minor works	0	0
4)	Others (excluding TA)	16800000	16759900
	Total Administrative Expenses	39700000	39648976
e)	Miscellaneous Expenses		
1)	HRD	1000000	946606
2)	Publicity & Exhibition	250000	232013
3)	Guest House- Maintenance	50000	27444
	Total - Misc. expenses	1300000	1206063
	Grand Total – Capital + Revenue (Salaries + General)	345700000	345239519
	Loans, Advances	1000000	542000



Revenue Receipts (Earned) - 2017-18

		<i>(In Rupees)</i>	
Sl.	Items	Target	Achievement
1.	Sale of Poultry, Poultry Products	30018000	14782617
2.	Income from Sale of Publication, Advertisement		23215
3.	License Fees		1460592
4.	Interest Earned on Loans, Advances		2899375
5.	Leave Salary, Pension Contribution		8445
6.	Analytical, Testing Fee		42165
7.	Interest Earned on Short Term Deposits		137076
8.	Income Generated from Internal Resource Generation		1284978
9.	Miscellaneous Receipts		999785
	Total Revenue	30018000	21638248
10.	Recoveries of Loans, Advances	0	1049778
11.	Sale of Assets	0	0
	Grant Total - Revenue, Receipts	30018000	22688026

ICAR-CARI NEW CAMPUS AT IZATNAGAR



Experimental Feed Processing Unit



Experimental Poltry Processing Unit

16. Important Activities and Services

Institute Research Committee Meetings

Main Campus, ICAR-CARI, Izatnagar

The annual Institute Research Committee (IRC) meeting of the Institute was held on Oct 12th, 2017 under the chairmanship of Dr J.M. Kataria, Director, CARI, Izatnagar. Dr Vineet Bhasin, Principal Scientist (AG&B), ICAR, Krishi Bhawan, New Delhi attended the meeting as expert invitee. Dr Sandeep Saran, Head PME & Secretary IRC conducted the meeting which was attended by the scientists of the Institute. Dr Saran welcomed the Chairman, Dr Bhasin and all the participants. He briefed the IRC about the ongoing research programmes, the ongoing O&M reforms at the Institute. Dr Kataria delivered his welcome address. He exhorted the scientists to apply for awards. He emphasized to submit projects for extramural funding, to be more critical while evaluating the work carried out during the period under report. The Chairman's opening address was followed by presentations by the respective divisions/sections of the Institute. The Action Taken Report (ATR) on the last year IRC general recommendations was presented by the respective heads, ATR on the project-wise recommendations, by the concern principal investigators.

Regional Centre CARI, Bhubaneswar

The annual IRC meeting for the RC, CARI Bhubaneswar was held on 20.12.2017. The meeting was chaired by Dr A.B. Mandal, Director, attended by all the scientists of the Regional Centre. Dr M.K. Padhi, PS & I/c RC welcomed the director, all the scientists to the meeting. Dr Sandeep Saran, Secretary IRC briefed the participants about the ongoing projects, the ongoing O&M reforms at the Institute. Dr Mandal, in his opening remarks, exhorted the scientists to be more proactive in responding to the queries of the Council, to submit the projects for extramural funding in order to strengthen research infrastructure at the Centre in view of the limited available resources. He also expressed his concern about regenerating the duck stock at the Centre.



The scientists presented the major findings of the ongoing projects which were critically discussed during the meeting.

Research Advisory Committee

The 11th meeting of the Common Research Advisory Committee of ICAR-Central Avian Research Institute (ICAR-CARI), Izatnagar, ICAR-Directorate of Poultry Research (ICAR-DPR), Hyderabad was held on 28th, 29th June 2017 at ICAR-DPR, Hyderabad under the chairmanship of Dr V. Prabhakar Rao, Former Vice Chancellor, Sri Venkateswara Veterinary University, Tirupati. The following RAC members attended the meeting.

1. Dr R.P. Sharma, Director (Retd.), ICAR-DPR
2. Dr M. Babu, Director (Retd.), TANUVAS
3. Dr A. Rajashekher Reddy, Former Associate Dean, SVVU, Hyderabad
4. Dr S.K. Mendiratta, Head, LPT Division, IVRI, Izatnagar
5. Dr C.G. Joshi, Prof. & Head, CVSc. & AH, AAU, Anand
6. Dr R.S. Gandhi, ADG (AP&B), ICAR, New Delhi
7. Dr J.M. Kataria, Director, Central Avian Research Institute, Izatnagar
8. Dr R.N. Chatterjee, Director, Directorate of Poultry Research, Hyderabad
9. Dr M.V.L.N. Raju, Member Secretary

Dr A.B. Mandal, Head, Avian Nutrition & Feed Technology Division, CARI, Izatnagar acted as the Nodal Officer for ICAR-CARI, Izatnagar. Following recommendations were made:

- Both the Institutes shall intensify research efforts to promote rural backyard poultry by evolving suitable varieties, packages of practices for providing food, nutritional security through efficient extension methodologies. However, more emphasis should be laid on diversified poultry species at CARI.
- The elite indigenous germplasm like Aseel etc. need to be conserved, improved by selective breeding, propagated to improve rural economy. The RAC recommended that DPR would lay emphasis on conservation, improvement of indigenous chicken germplasm, while CARI would lay emphasis on conservation, improvement of diversified poultry species as per the mandate. However, CARI can continue to work on existing chicken germplasm.



- CARI is maintaining 5 broiler strains under AICRP on Poultry Breeding. The performance of remaining layer, broiler strains need to be evaluated for further continuance. Genetic groups like Naked Neck, Frizzle to be continued in conservation mode.
 - Diversified poultry supports small scale entrepreneurs, the demand is for small variety of bird like Japanese quail. Since, CARI has been the leading center for research on Japanese quail, the RAC recommends that breeding, improvement of Japanese quail should be allowed to continue, the issue of permission pending with the ICAR should be pursued on priority.
 - Selective breeding in ducks like Khaki Campbell, indigenous ducks should be continued with the introduction of improved germplasm.
 - High throughput genotyping should be incorporated into the ongoing genetic experiments targeting contrasting traits like disease resistance, production to develop competence for genomic selection. Next Generation Sequencing (NGS) should be used for marker discovery using few numbers of genes rather than Sanger sequencing. Metagenomic analysis of gut content at diversity or gene content level should be part of feeding experiments. Research using
- obsolete technology (e.g. Microsatellite, RAPD, RFLP markers) should be stopped.
 - Research on reducing the feed cost must be pursued vigorously.
 - Research efforts to mitigate heat stress shall be continued through nutritional, management interventions like optimizing cage space for the welfare of chickens. Research on avian health should be strengthened for prevention, control of emerging, re-emerging diseases.
 - Higher research efforts are required to develop healthier, safer poultry products through nutritional manipulations, biotechnological tools, processing technologies.
- The above recommendations were approved by the Council vide F.no. AS 16/3/2013-ASR-II dated Sept. 12, 2017.

Quinquennial Review of the Institute

The Director General, Indian Council of Agricultural Research, New Delhi vide office order no. AS6/1/14-IA-I dated 24.4.2014, constituted the Quinquennial Review Team (QRT) to review the work carried out by ICAR-Central Avian Research Institute, Izatnagar (Bareilly), UP for the period April 2009 to March 2014. The Team consisted of the following members:

Name	Address	Status
Dr R. Prabakaran	Ex-Vice Chancellor, TANUVAS, Madhavanram Milk Colony Campus, Madhavaram, Chennai-600051 (TN)	Chairman
Dr D.C. Johri	Ex-Head, AG&B Division, CARI, 87-D (Part) Udaipur Khas, Near IVRI Gate#2, IVRI Road, Izatnagar-243 122, Bareilly (UP)	Member
Dr D. Narahari	Ex-Professor 31/15, 3rd Floor, First Main Road East, Shenoy Nagar, Chennai-600030	Member
Dr J. Sahoo	Professor & Former Head, LPT GADVASU, House No. MIG-36, Rajiv Nagar Colony, Aiginia, Bhubaneswar (Odisha)	Member
Dr K. Nanjappan	Professor. & Head (Retd.), Department of Vet. Physiology, Vet. College & Research Institute, Namakkal (TN)	Member
Dr S.V.N. Rao	Professor, Head (Retd.), 38, First Main Road, Kaverynagar, Reddiarpalayam, Puducherry-605010	Member
Dr Sandeep Saran	PS & Head, Prioritization, Monitoring, Evaluation & Poultry Economics, Agribusiness Research, CARI, Izatnagar, Bareilly (UP)	Member Secretary

The first meeting of the QRT was held during April 7-8, 2017, at CARI Izatnagar. The Chairman QRT, Dr R. Prabakaran, Dr K. Nanjappan member and Dr Sandeep Saran, Member Secretary QRT visited the CARI Regional Centre at Bhubaneswar on May 27, 2017. The final meeting of the QRT was held in Madras Veterinary College Campus, TANUVAS, Chennai during July 27-28, 2017 under the chairmanship of Dr R. Prabakaran. All

the members except Dr D.C. Johri attended the final meeting. The report of the QRT was presented, deliberated in the 45th Institute Management Committee meeting held on Aug. 02, 2017. The final report of the QRT was submitted to the Director General, ICAR by Dr R. Prabakaran, chairman, Dr Sandeep Saran, Secretary QRT in the presence of Dr J.M. Kataria, Director, ICAR-CARI.



Standing Finance Committee (SFC) Meeting

The meetings for finalizing the SFC proposal were held on May 8-9, 2017, June 1, 2017 at New Delhi, which were attended by Dr J.M. Kataria, Director, Dr Sandeep Saran, HD/PME. The final meeting of the SFC under the chairmanship of DG, ICAR was held on Aug. 29, 2017 at ICAR, New Delhi which was attended by the Director, CARI, Dr Sandeep Saran. The SFC of the Institute for 2017-20 was approved at a total outlay of Rs. 2880 lakh under the thematic area *Animal genetic resource management, production, improvement* comprising of NBAGR, Karnal, Network Project on Animal Genetic Resources, Karnal, Central Avian Research Institute, Izatnagar, DPR, Hyderabad, AICRP on poultry, Hyderabad, the Poultry Seed Project, Hyderabad for the period 2017-20. A sum of Rs. 1185 lakh was approved under *Capital*, Rs. 1695 under *Revenue* heads. In order to expedite construction on the new site of CARI, Rs. 414 lakh was approved as *spillover works* for making remaining payments for the ongoing works spilling into current SFC period including those going on at the Regional Centre CARI, Bhubaneswar. A semi-automatic poultry processing plant with modern facilities has also been approved for the Experimental Poultry Processing Unit of the Institute. For furnishing the newly constructed Administrative-cum-Lab building at the new site, a sum of Rs. 110 lakh have been allocated.

RTI Request, Appeal Management Information System

The ICAR-Central Avian Research Institute, Izatnagar has been made live on the RTI online portal (<https://rtionline.gov.in/RTIMIS/>) for receiving, processing RTI application/appeals online. Only two requests were received in the Institute seeking information on scientific matters whereas 21 requests were received seeking information on administrative, allied matters. All the requests were disposed off in timely manner.

Institute Management Committee Meeting

The 45th Institute Management Committee meeting was held on Aug. 02, 2017 under the chairmanship of Dr J.M. Kataria, Director. The committee consisted of Dr Praveen Kumar Tyagi, Member Secretary, Dr Satish Kumar Garg, Dean, College of Veterinary Science, Mathura (UP), Dr Vinod Kumar, Additional Director, Animal Husbandry, Bareilly, Dr M.R. Reddy, Principal Scientist, ICAR-DPR, Hyderabad, Shri. Bahnu Pratap Singh, 18, Bhagya Nagar, Agra, Dr S.V.S. Malik, Principal Scientist, Department of Veterinary Public Health, ICAR-IVRI, Izatnagar and Sh. Raj Kumar, FAO, ICAR-CARI. Dr R. Prabhakaran, Ex-Vice Chancellor, TANUVAS,

Chennai, Chairman, QRT, Dr D.C. Johari, HD/AG&B (Retd.), Member QRT and Dr Sandeep Saran, Member Secretary, ICAR-CARI, Izatnagar was special invitees. Important issues related to Institute were discussed and QRT report was presented and deliberated.

Aadhaar Enabled Biometric Attendance Systems

Aadhar Enabled Biometric Attendance System (AEBAS) is working at the Institute. The attendance marked on this system has been linked to the Central Attendance Portal (<http://attendance.gov.in>) of NIC. Employee of ICAR-CARI can verify their marked attendance on <http://cariicar.attendance.gov.in/>.

ICAR-ERP (MIS/FMS)

Management Information System (MIS) including Financial Management System (FMS) has been successfully implemented at the Institute. Various modules like Financial Management, Project Management, Material Management, Human Resource Management, Payroll are working smoothly at the Institute.

Institute Animal Ethics Committee

The Institute Animal Ethics Committee (IAEC) was reconstituted as per the instructions received from the CPCSEA, New Delhi vide F. No. 25/39/2008-AWD, dated: May 26, 2017. The IAEC comprises of Dr A.B. Mandal, Director as chairman, Drs Gautam Kolluri, Subrat Kumar Bhanja, Pramod Kr. Tyagi as its members, Chandrahas as its Member Secretary. CPCSEA nominated Dr Salaluddin Qureshi, Sr Scientist; Dr D.S. Upadhyaya, Chief Scientist & Head, Dr Amit Kumar, Scientist, Ms. Shalini Agrawal Arora as Main Nominee, Link Nominee, Scientist from outside the Institute, Socially Aware Nominee, respectively.

Experimental Hatchery

CARI Main Campus, Izatnagar: With incubation/hatching capacity of about 80,000 eggs at a time, the unit hatches out the required number of replacement stock of different pure line/pedigreed flocks pertaining to different strains of various germplasm, commercial/parent stock for supplying to various government/private poultry farms/schemes such as *Mera Gaon Mera Gaurav* etc. The hatchery also supplies embryonated eggs, day-old chicks to IVRI for preparation of vaccines, conducting experiments for academic, research purposes. Consultancies pertaining to establishing poultry hatchery and/or sorting out specific problem of government/private personnel were also provided. A total of 58711 good chicks were hatched as per following breakup.



Hatching performance of various germplasm (2017-2018)

Type of birds	Total eggs set	Fertile eggs (%)	Hatchability on total egg set (%)	Hatchability on fertile egg set (%)	Number of good chicks hatched
Layer	59599	59.301 (28.57-73.89)	51.665 (22.22-70.70)	87.12333 (67.18-95.69)	30792
Broiler	53175	77.619 (52.45-91.94)	71.611 (44.91-90.32)	92.259 (83.11-98.25)	38079
Quail	25847	75.02 (66.76-81.70)	59.85 (49.77-63.51)	79.78 (71.69-83.54)	15470
Guinea fowl	13454	53.40 (16.47-64.45)	47.95 (7.42-59.54)	89.78 (45.07-93.47)	6451
Turkey	6687	80.63 (41.54-87.36)	72.41 (40.38-79.38)	89.80 (83.74-97.22)	4842
Desi fowl	69646	64.78 (45.40-85.71)	57.80 (32.53-80.95)	89.23 (66.08-94.93)	40258
Commercial (TT section)	84123	76.26 (59.62-83.00)	69.79 (57.72-81.97)	91.52 (73.77-97.91)	58711

Figures in parentheses denote range.

RC CARI, Bhubaneswar

The Experimental Hatchery of Regional Centre, CARI, Bhubaneswar is in operation for hatching of duck eggs of different varieties for research, for supply of germplasm to the farmers. A total of 10,567 day old ducklings were hatched from, supplied to farmers, different sections of the RC for experiment purposes.

Agriculture Knowledge Management Unit

The erstwhile Agricultural Research Information System (ARIS) established in 1997 at the Institute has now been renamed as Agricultural Knowledge Management Unit (AKMU). It has been instrumental in establishment, management of Local Area Network (LAN) for providing Internet, intranet services to the scientists, officers/ staff, students in the Institute. It has established high speed network (100 Mbps) through lease line on fiber optic cable under National Knowledge Network (NKN) connectivity provided by NIC/Railtel. The Unit also has 4 mbps broadband connection of BSNL for Internet. The internet, intranet services are provided round the clock over 85 functional nodes in the Institute.

AKMU has designed, developed Institute website (www.icar.org.in/cari) in English as well as in Hindi as per the ICAR guidelines. The website provides overall research activities, achievements, other valuable information of the Institute, its Regional Centre. Its contents are updated regularly. The information related to training programs, recruitments of staff, tender notices, other circulars/news items of the Institute are also periodically uploaded on the website.

Other activities

- The AKMU also facilitates different types of software packages like SPSS, SAS for research data analysis. Support is provided to scientists and students in data compilation, analysis.
- Pay bill, pay-slips are processed for all the employees in the Institute.
- Wi-Fi connectivity are provided for the scientists, students in the library, other places.
- The maintenance of computers, software are also being managed by AKMU.
- AKMU is playing vital role of ERP-MIS-FMS System for smooth functioning of different modules.
- Internet connectivity, its management are being provided to Bio-Metric Attendance Systems installed in the Institute.

Library, Information Services

The total member of books, bound volumes of journals, theses etc. in the library was 6003 with the addition of 71 new publications during the year. In addition of these, a number of national, international serial publications, Annual Report, Newsletters were received *on gratis*.

The updated data/information pertaining to all newly added/purchased books, theses, bound journals, current issues of periodicals with complete bibliographic information is made available in the library through LIBSYS database/software. Online catalogue OPAC (Online Public Access catalogue) services are also accessible to the users. Library membership has been computerized, circulation of books, other publications were also done through LIBSYS-7 software. Wi-Fi facility has been made available in the library so that library users may use their own



laptop, other electronic devices/gadgets to access Internet. The library being a member of Consortium for e-Resources in Agriculture (CeRA), has an access to more than 2500 online full text Journals. Document Delivery Request (DDR) services are also being exchanged among the member libraries under CeRA. The library also provides Internet, e-mails, information retrieval services through CD-ROM database along with photocopying services to the scientist, students.

Feed Storage, Processing Unit

The main activity of the FS&P unit includes procurement, storage of different feed ingredients, feed formulation, quality control, ensuring balance feeds for germplasm maintained in the Institute as well as to research projects involving poultry at IVRI, Izatnagar. The Unit has prepared, supplied 10904 q of different types of poultry feed as detailed below:

Feed supplied by the FS&P Unit (2017-18)

Experimental by-products disposed off during 2017-18

Month	Eggs (Nos)		Processed poultry meat (kg)				
	Chicken	Quail	Chicken	Guinea fowl	Kadakhnath	Quail	Turkey
April 2017	100972	89800	1625.25	-	-	38.50	3.00
May 2017	116571	81700	2546.25	-	-	41.00	20.00
June 2017	105708	86500	1669.50	7.00	70.25	29.50	5.50
July 2017	126985	78800	1021.75	-	23.50	22.50	14.00
August 2017	146595	66400	1402.75	-	3.50	32.50	58.00
September 2017	95582	61800	469.75	-	2.00	18.00	5.25
October 2017	101797	48500	996.50	-	15.75	40.00	17.50
Nov., 2017	79694	44000	1210.25	96.90	17.00	129.00	26.00
December 2017	56898	37950	852.75	313.75	19.75	92.50	-
January 2018	50076	35350	1152.25	81.75	3.00	133.50	-
February 2018	53537	32750	1183.25	3.50	-	58.00	-
March 2018	91347	38450	1253.25	-	-	83.50	2.00
Total	1125762	702000	15383.50	502.90	154.75	718.50	151.25

Revenue generated from disposal of experimental poultry by-products (2017-18)

Commodity	Revenue (Rs)
Chicken eggs	3970506
Quail eggs	580275
Chicken meat	1890880
Guinea fowl meat	48765
Kadakhnath meat	18510
Quail meat	48700
Turkey meat	18110
Other poultry products	10030
Total	65,85,776

RC CARI, Bhubaneswar: A revenue of Rs. 5,09,156 was generated by the sale of 4793 day old ducklings, culled birds, table eggs.

Project/Division	Total Quantity (Quintals)
Broiler project	2565.6
Layer project	2864.5
Desi fowl	2172.9
Quail farm	1007.0
Guinea fowl unit	581.0
Turkey unit	634.4
AN&FT	77.2
P&R Div.	117.0
PHM	159.0
IVRI	88.5
TT Section	571.0
Hatchery section	35.5
FF Programme	9.5
Biotech	13.0
IVRI Mukteswar	8.0
Total	10904.1

Marketing of Poultry Products

CARI Main Campus, Izatnagar

The experimental by-products produced in the experimentation process were disposed off from the Marketing Centre of the Institute. The breakup of total sales during 2017-18 is given, hereunder.

Implementation of Official Language

For progressive use of Official Language in the Institute, the *Rajbhasha Anubhag* organized meetings of Official Language Implementation Committee from time to time. Quarterly reports for Official Language were regularly submitted online to the Council, Department of Official Language, Gol, Town Official Language Implementation Committee, Bareilly. Data regarding working knowledge in Hindi, proficiency of Hindi of the officials have been updated, individual orders/instructions were issued for doing official work in Hindi for acquiring proficiency in Hindi. A roster has been prepared for the same.

Hindi workshops were organized for the staff to increase use of Official Language in routine official works wherein the staff was acquainted with Official Languages Act, rules. Besides, circulars, instructions were issued for compliance of Official Language Act, rules. Scientific, technical, administrative documents received from various divisions/Sections, units of the Institute were translated, typed.

Hindi *saptah* was organized by Shri Paras Nath Yadav, Assistant Chief Technical Officer, *Rajbhasha Anubhag* under the guidance of Dr Praveen Tyagi, PS during Sept. 14-20, 2017 at the Institute. Use of Hindi in dissemination of technologies, publication of research, popular articles, administrative works, delivery of lectures by the scientists during training programmes for

farmers was appreciated by the director. Various competitions such as debate, typing in Hindi on computer, noting/ drafting, general knowledge, *shabdawali parichaya* were conducted during Hindi *saptah*. In the research paper writing competition, five entries were received of which three were awarded as first, second, third prize while remaining two were given consolation prizes.

Swachh Bharat Abhiyan

At CARI, Izatnagar: Special *Swachh Bharat Abhiyan* was organized during May 16-31, 2017 in the Institute. Besides, *Swachhta Week* was also organized during July 24-31, 2017. Cleanliness drive was carried out at various places at the Institute campus. *Swachhta Hi Seva* programme was organized during Sept. 15 - Oct. 02, 2017. *Swachhta Rally* was flagged from New CARI Gate to Suncity Colony, Pilibhit Road, Bareilly on Oct. 01, 2017 to motivate people to keep their surroundings neat, clean.

At Village Navdia Harkisan: *Swachhta Awareness Programme* was organized at village panchayat Navdia Harkisan, Bareilly district (U.P.) in *Swachhta Phakhwara* during May 16-31, 2017. The farm women, farmers were encouraged to keep their surroundings neat, clean. Literature on tips on personal hygiene, surrounding area cleanliness was also distributed among them.





Villagers at Navadia Harkishan participating in **Swachhta Awareness Programme**

Institute Foundation Day

On the occasion of 39th Foundation day of the Institute, on Nov. 02, 2017, several programmes were organized related to poultry farming. Various poultry germplasm, production/processing technologies, other activities were displayed. Students, faculty from MJP Rohilkhand University, Delhi Public School, BBL Public School, Vishnu Inter College, Gulab Rai Inter College, several other schools/colleges, poultry farmers, entrepreneurs from Bareilly and other areas participated in the programme with great enthusiasm. Participants were given tips on important aspects of poultry business. Dr S.C. Gupta, Joint Director (Disease Control & Administration), UPAH, Lucknow, the chief guest of the function gave detailed information about various poultry schemes run by U.P. State Government. He praised the germplasm, technologies developed by the Institute, promised to help poultry farmers in the best possible manner. Dr A.B. Mandal, Director narrated the history, development of the Institute. He also exhorted the youth, students to make their career in the area of veterinary, animal, poultry sciences. Besides, he assured to provide needed technical support to prospective poultry farmers, entrepreneurs. Three progressive poultry farmers, namely, Anuj Agarwal, Afjal, Ms Yasmeen were awarded on this occasion. The program was attended by many ex-Directors, retired scientists. Dr Sanjeev Kumar, Principal Scientist convened this programme, welcomed guests. Dr Samir Majumdar proposed the vote of thanks. Sri. P.N. Yadav compared the program. All officers, staff helped in successful arrangement of the event with special mention of Drs Sandeep Saran, Praveen Tyagi, Pramod Tyagi, A.S. Yadav, S.K. Bhanja, Chandra Deo, Divya among scientists, Sri. Shafiq Ahmad, Sri. S.R. Meena among the technical staff.

World Egg Day

World Egg Day (WED) was celebrated at CARI, Izatnagar on Oct. 13th, 2017. The main objective of this event was to spread consumer awareness about the nutritional benefits of consuming poultry eggs. On this occasion, boiled eggs were distributed amongst children of Kendriya Vidhyalaya, IVRI campus, Izatnagar. They were also apprised about the role of poultry eggs in human diet. A quiz competition was organized for the PG students of Poultry Science discipline, prizes were distributed to the winners. A technical seminar was also organized highlighting various technologies developed by the Institute on value addition of poultry eggs, the ways to adopt layer farming for employment, income generation. The event was sponsored by M/s Virbac Animal Health Pvt. Ltd., Mumbai.

Agriculture Education Day

The birthday of first Indian union agriculture minister, the first President of India, Bharat Ratna, Dr Rajendra Prasad was celebrated as **Agriculture Education Day** on Dec. 03, 2017. The programme was aimed to develop interest among the school, college students in agriculture, animal science, veterinary science, other allied sciences, to choose **agriculture** as their research, professional career or engage themselves in farming as agri-entrepreneurs. Dr Sanjeev Kumar served as Organizing Secretary, Dr Sandeep Saran served as



Ms Yasmeen receiving award from the Director



Scientists celebrating the Institute Foundation Day



Agriculture Education Day Organized at ICAR-CARI

Co-Organizing Secretary of the event. Approximately, 200 participants including students from various schools/ colleges, many of them accompanied by their parents, farmers, poultry farmers from far, nearby places, agri-entrepreneurs from Baheri, Bakarganj, Bareilly, staff, their wards etc. enthusiastically participated in the programme. Ms Puja Saxena, District Horticulture Officer, Bareilly, Dr Abha Dutt, Veterinary Officer, Bareilly were special guests on this occasion. They explained the scope of agriculture, agribusiness, fisheries, veterinary sciences, pharma-industry, agro-industries, etc. various technologies, varieties developed at this Institute were demonstrated through exhibition. A quiz was also organized for students, general public, prizes were distributed to the winners. Dr A.B. Mandal, Director addressing the gathering highlighted the importance of the day, exhorted the young to take up the profession of veterinary sciences, agriculture, dairy science, fisheries etc., also to adapt agriculture, veterinary science based businesses. Dr S.K. Bhanja proposed the vote of thanks while comparing was done by Sri. P.N. Yadav.

International Yoga Day

The International Yoga Day was celebrated on June 21, 2017 with great zeal at the Institute. Drs Punit Kumar, Putan Singh, PS, IVRI were invited as yoga experts for exercising, practicing various *yogasanas*. The experts explained benefits of various yoga exercises specific to age, health of people. The event was participated by scientists, staff of the Institute in the lawns of Training Hostel cum Guest House. Dr J.S. Tyagi coordinated the event.

Vigilance Awareness Week

Vigilance Awareness Week was organized from Oct. 31-Nov. 6, 2017. Drs Gautham Kolluri, Manzoor Wani, Sagar Popat received first, second, third prizes, respectively, in the debate competition organized to mark the occasion. Dr



Agriculture Education Day exhibition at ICAR-CARI

Sanjeev Kumar delivered a lecture on awareness of vigilance rules, regulation in scientific organizations like ICAR on Oct. 31, 2017.



International Yoga Day at ICAR-CARI

Cashless Transactions

As per the Government directives, the Institute has implemented cashless transactions in respect of sale of poultry products/culled birds, poultry germplasm, training registration fee etc., all payments to the vendors of various goods and services etc. through POS machines, bank instruments, bank transfers etc.

Prioritization, Monitoring, Evaluation

While serving as Head, Prioritization, Monitoring, Evaluation Section, Dr Sandeep Saran maintained all the RPFs (now RPPs) of completed, ongoing research projects. All the project documents were compiled in digital format as per instructions of the Council. The Section also assisted, advised director in implementing the guidelines of the Council in respect of project

associations, time allocation of scientists apart from coordinating various activities within the Institute, with the other external agencies. The Section served as the central hub for providing information on various research, training, extension activities of the Institute to various government, semi-government, public sector units, private agencies besides serving as a coordinating link between the Institute, Council HQ at New Delhi.

Besides, the PME section also carried out following activities.

- Compiled, submitted Quarterly Performance report, monthly cabinet reports to the Council.
- Prepared, furnished replies to various Parliamentary questions through the Council.
- Compiled, submitted various Action Taken Report in respect of action points arising out of various meetings/conferences etc. held within, outside ICAR.
- Dr Sandeep Saran served as Nodal Officer, HYPM/ PIMS-ICAR/ PERMISNET apart from Mangement Representative, ISO.

Court Cases

At present, the Institute is having 5 cases pending in various courts. Dr Sandeep Saran served as Nodal Officer, Court Case Monitoring System (CCMS), updated information about various cases.

Public Grievance Cell

In order to address public grievances arising out of violation of the Citizen's Charter of the Institute, the Public Grievance Cell has been in place with Dr Sandeep Saran serving as its Nodal Officer. Neither any public grievances were received nor were pending in the Institute.

Zonal Sports Meet

The Institute participated in ICAR North Zone Sports Meet organized by Indian Institute of Sugarcane Research, Lucknow during Oct. 30 - Nov. 2, 2017.



CARI participants at Zonal Sports Meet, ICAR-IISR, Lucknow



17. Approved On-going Research Projects (2017-18)

Sl.	Project Code No.	Project Title	Principal Investigator	Co-Investigator
PROGRAMME-1: PRODUCTIVITY ENHANCEMENT OF SELECTED POULTRY SPECIES (25)				
<i>Sub Programme – (i) Enhancement of productivity, reproductive efficiency, immune-competence of selected diversified poultry species along with development of improved package of practices. (20)</i>				
1.	P-1/2015/1-IAV/L50/6100-6600 DOS: 09.09.2015 DOC: 08.09.2018	Improvement of reproductive efficiency of Turkey, Chicken	Dr Jag Mohan	Dr S. Majumdar Dr J.S. Tyagi Dr Gautham Kolluri Dr Gopi M.
2.	P-1/85/95/1-IAV/L10/6100/9705 (Component-AICRP-PB, Hyderabad) DOS: 01.4.1985 DOC: 31.3.9999	Development, evaluation of synthetic broiler sire line.	Dr (Mrs.) Simmi Tomar	Dr V.K. Saxena Dr Jaydip J. Rokade
3.	P-1/85/95/2-IAV/L10/6100/9705 (Component-AICRP-PB, Hyderabad) DOS: 01.4.1985 DOC: 31.3.9999	Development, evaluation of synthetic broiler dam line.	Dr V.K. Saxena	Dr (Mrs) Simmi Tomar Dr Avishek Biswas Dr Jaydip J. Rokade
4.	P-1/2015/1-IAV/L30/6000 DOS: 01.4.2015 DOC: 31.3.2018	Augmenting gut health, welfare of poultry through dietary approaches	Dr A.B. Mandal	Dr S.K. Bhanja Dr A.S. Yadav Dr Avishek Biswas
5.	P-1/2012/1-IAV/L30/3700-3755 DOS: 01.07.2012 DOC: 30.06.2017	Establishing dietary requirement of critical minerals, vitamins for poultry.	Dr Chandra Deo	Dr A.B. Mandal Dr Praveen K. Tyagi
6.	P-1/2012/1-IAV/L30/6100 DOS: 18.10.2012 DOC: 17.10.2017	Efficacy of herbs containing essential oils on performance, immunity in broiler chickens.	Dr (Mrs.) Divya	Dr A. Biswas Dr Ashim K. Biswas
7.	P-1/2014/1-IAV/6000/3745 DOS: 1.8.2014 DOC: 31.7.2017	Ochratoxicosis in poultry	Dr Avishek Biswas (w.e.f. 19.3.17)	-
8.	P-1/2015/L30/6100 DOS: 01.10.2015 DOC: 30.09.2018	Augmenting Performance of broilers through betaine supplementation	Dr Rokade J.J.	Dr Gopi M. Dr V.K. Saxena Dr S.K. Bhanja Dr Gautham Kolluri
9.	P-1/2015/1-IAV/L50/6100 DOS: 01.10.2015 DOC: 31.03.2018	Physiological interventions for addressing reproductive dysfunctions in broiler breeders	Dr Gautham Kolluri (till 31.7.2017) Dr Gopi M. (w.e.f. 01.08.17)	Dr Jag Mohan Dr J.S. Tyagi Dr Gopi M. Dr Rokade J.J.
10.	P-1/2015/1-IAV/L10/6400 DOS: 10.09.2015 DOC: 09.09.2018	Improving Pearl variety of Guinea fowl for low input climate resilient alternate to chicken	Dr SimmiTomar	Dr Gautham Kolluri



11.	P-1/2015/1-IAV/L05/6200 DOS: 01.01.2015 DOC: 31.12.2017	Reproductive, hatchery management strategies for improving fertility, hatchability in duck eggs	Dr S.C. Giri	Dr K.V.H. Sastry Dr S.K. Sahoo Dr M.K.Padhi (P) (w.e.f. 22.02.16)
12.	P-1/2015/1-IAV/L50/6200 DOS: 01.03.2015 DOC: 31.03.2020	Studies on sperm storage tubules, development of technology for short term preservation, utilization of male gametes in ducks	Dr K.V.H. Sastry	Dr S.C. Giri Dr R.K.S. Bais Dr S.K. Sahoo
13.	P-1/2014/1-IAV/L30/6200 DOS: 01.10.2014 DOC: 30.09.2018 Extended by one year in IRC-2017)	Evaluation of azolla as an alternative feed resource for economic production of duck meat, egg.	Dr B.K. Swain	Dr S.K. Sahoo Dr P.K. Naik Dr R.K.S. Bais Dr S.K. Mishra Dr Dharendra Kumar
14.	P-1/2017/1-IAV/L34/6200 DOS:11.7.2016 DOC:10.07.2020	Food-cost reduction through utilization of alternate feed resources in poultry	Dr Pramod K. Tyagi	Dr Praveen K. Tyagi Dr Chandra Deo
15.	P-1/2017/1-IAV/L36/3735 DOS: 13.10.2017 DOC: 12.10.2019	Studies on interaction of certain dietary micronutrients in poultry	Dr ChandraDeo	Dr Praveen K. Tyagi Dr Pramod K. Tyagi Dr (Mrs) Divya
16.	P-1/2017/1-IAV/L36/3940 / 6000 DOS: 13.10.2017 DOC: 12.10.2019	Exploring natural polyphenol as alternative to antibiotic growth promoters (AGP's) in poultry production	Dr (Mrs) Divya	Dr Chandra Deo Dr Gopi M.
17.	<i>Service Project</i>	Monitoring of poultry diseases, implementation of bio-security measures including vaccination for achieving better survivability, productivity in CARI birds.	Dr A.S. Yadav	Dr Gautham Kolluri
18.	<i>Service project</i>	Quality assessment of feed stuffs, poultry feed	Dr A.B. Mandal	Dr Pramod Tyagi Dr Avishek Biswas
19.	<i>Service project</i>	Development of different value added poultry products for income generation	Dr A.K. Biswas	Dr A.B. Mandal Dr A.S. Yadav Dr C.K. Beura
20.	<i>Service Project</i>	Surveillance, monitoring of duck diseases, their bio-security measures	Dr Dharendra Kumar	Dr S.K. Sahoo
<i>Sub Programme – (ii) Development of package of practices for rural poultry production system (5)</i>				
1.	P-1/2012/1-IAV/E15/6600 DOS: 01.06.2012 DOC: 31.07.2018	Evaluation of management practices to optimize Turkey production	Dr S. Majumdar (till 11.10.2017) Dr S.K. Bhanja (w.e.f. 12.10.2017)	Dr S.K. Bhanja (till 11.10.2017) Dr S. Majumdar (w.e.f. 12.10.2017) Dr Jagmohan Dr V.K. Saxena
2.	P-1/2012/1-IAV/L10/6200 DOS: 01.10.2012 DOC: 30.09.2017	Maintenance, evaluation, conservation of important breeds of ducks for augmenting duck production in rural, tribal areas.	Dr R.K.S. Bais	Dr S.K. Mishra Dr K.V.H. Sastry Dr S. C. Giri Dr B.K. Swain



3.	P-1/2013/1-IAV/L10/6100 DOS: 01.04.2013 DOC: 31.05.2018	Conservation of Elite layer stock	Dr Sanjeev Kumar	Dr S.K. Bhanja
4.	P-1/2015/1-IAV/L10/6510 DOS: 10.09.2015 DOC: 09.09.2020	Preservation of elite germplasm of Japanese quails	Dr Raj Narayan	Dr Chandrahas
5.	P-1/2015/1-IAV/L10/6100 DOS: 10.09.2015 DOC: 09.09.2020	Maintenance, Evaluation of native chicken, their utilization for family poultry production	Dr Chandrahas	Dr Raj Narayan Dr V.K. Saxena
PROGRAMME 2: CLIMATE RESILIENT POULTRY PRODUCTION SYSTEM AND WASTE MANAGEMENT (4)				
<i>Sub Programme – Impact assessment, adaptation evaluation, amelioration strategies to combat extremes of climate through genetic / molecular, nutritional, physiological, shelter management, evolving efficient technologies for utilization of poultry waste.</i>				
1.	P-1/2014/1-IAV/T00/6000/9790 DOS: 01.10.2014 DOC: 31.12.2017	Utilization of poultry waste for green energy, organic fertilizer generation	Dr Chandrahas	Dr.(Mrs.) Simmi Tomar Dr Raj Narayan Dr.(Mrs.) Divya Dr Sandeep Saran Dr A.S. Yadav (w.e.f.11.7.16)
2.	P-1/2014/1-IAV/L05/6100 DOS: 1.9.2014 DOC: 31.8.2018	Assessment, performance, welfare of chicken under different housing conditions	Dr S. Majumdar (till 11.10.2017) Dr.S.K.Bhanja (w.e.f. 12.10.2017)	Dr.S.Majumdar (w.e.f. 12.10.2017) Dr Sandeep Saran Dr G. Kolluri
3.	P-1/2015/1-IAV/L50/6000 DOS: 01.10.2015 DOC: 30.09.2018	Study of physiological responses under normal, stressed conditions in indigenous, improved varieties of poultry	Dr Jagbir Singh Tyagi	Dr Jag Mohan Dr Gautham Kolluri Dr Gopi M Dr Chandrahas
4.	P-1/2017/1-IAV/L34/6200 DOS: 01.03.2017 DOC: 28.02.2020	Arsenic toxicity, its amelioration with some herbs in ducks	Dr Dharendra Kumar	Dr S.K. Mishra Dr B.K. Swain Dr P.K. Naik
PROGRAMME 3: VALUE ADDITION, FOOD SAFETY, QUALITY ASSURANCE AND PRODUCT DEVELOPMENT (5)				
<i>Sub Programme – Development of value added poultry feed, poultry products with functional attributes, quality assurance including product development.</i>				
1.	P-1/2014/1-IAV/L34/8954 DOS: 01.09.2014 DOC: 31.08.2017	Monitoring of poultry products, feed samples for chemical residues from selected markets of northern India	Dr C.K. Beura	–
2.	P-1/2015/1-IAV/L30/9705 DOS: 10.09.2015 DOC: 09.09.2019 DOC 31.12.2018 vide OO No. No: CARI/PME/RP-PVKT//14/AL-3 dated 25.8.17	Value addition of poultry meat through dietary means	Dr Praveen K. Tyagi	Dr.Pramod K. Tyagi Dr Chandra Deo Dr.(Mrs) Divya Dr Ashim K. Biswas Dr Avishek Biswas
3.	P-1/2012/1-IAV/Q10/9705-6600 DOS: 01.11.2012 DOC: 30.04.2017	Development, shelf-life extension of functional meat products prepared from Turkey, spent chicken meat	Dr Ashim K. Biswas	Dr C.K. Beura

4.	P-1/2017/1-IAV/H-70/9600/9705 DOS: 01.10.2016 DOC: 30.09.2018	Technological interventions for exploring <i>Lactobacillus plantarum</i> for enhancement of functionality, shelf-life of poultry products	Dr A.S. Yadav	Dr Ashim K. Biswas
5.	P-1/2017/1-IAV/Q10/9705 DOS: 01.11.2017 DOC: 31.10.2019	Shelf-life extension of selected traditional meat products prepared from spent chicken using natural antioxidant, antimicrobial compounds	Dr.Ashim K. Biswas	Dr A.S. Yadav Dr C.K. Beura
PROGRAMME 4: HRD, MARKET INTELLIGENCE AND TECHNOLOGY DISSEMINATION (1)				
<i>Sub Programme – (i) Market intelligence, contingency planning, economic implications of emerging issues in poultry value chain.(1)</i>				
1.	P-1/2016/1-IAV/E70/6200* DOS: 01.01.2016 DOC: 31.03.2019	Study on acceptability of duck meat, egg along with its marketing in Odisha.	Dr M.K. Padhi	Dr R.K.S. Bais Dr K.V.H. Sastry Dr S.C. Giri
<i>Sub Programme – (ii) Skill development, capacity building for different stakeholders, transfer of technology. (0)</i>				



EXTERNALLY FUNDED PROJECTS – (9)

Sl.	Sanction order No.	Title of the project	Name of PI	Name of Co-PI
1.	BT/PR9724/AAQ/1/571/2013 dtd. 27.03.2015 DOS:27.03.2015 DOC:27.03.2018 (DBT Project)	Evaluating of probiotics, prebiotics, synbiotics supplementation in low energy, low protein feed for improved nutrient utilization, safe poultry meat production	Dr Avishek Biswas	Dr A.B. Mandal Dr S.K. Bhanja Dr A.S. Yadav
2.	No. 5/258/89/215-NMITLI dated 30.3.2016 DOS: 30.3.2016 DOC: 29.3.2018 (CSIR Project)	<i>Kappaphycusalvarezii</i> , red seaweed based formulations for improving productivity, health of dairy, poultry animals	Dr A.B. Mandal	Dr Praveen K. Tyagi Dr S.K. Bhanja Dr Ashim K. Biswas Dr Avishek Biswas
3.	No. ECR/2016/001898 dated 24.3.2017 (SERB) DOS: 24.03.2017 DOC:23.03.2020	Enhancing gut health, immunological functions in broilers through convergence of biotechnological, nutritional interventions	Dr Gopi M.	Dr Jaydip J. Rokade
4.	DST No: PDF/2015/000643 DOS: 18.04.2016 DOC: 17.04.2018	Embryonic feeding of Nanoparticles for improving the incubational, post-hatch status of egg, meat type chicken.	Dr Akshat Goel	Dr Subrat Kumar Bhanja Co-PI, Mentor
5.	No.A.Extn.-20-3/2011-AE.I dated 28.10.16 DOS: 28.10.2016 DOC: 27.10.2018	Enhancing livelihood security of farming community through livestock, crop integration using proven technologies	Dr Jagbir Singh (CCPI)	--
6.	No.NASF/Minimizat ion-6024/2016-17 dated 26.5.2017 DOS: 01.06.2017 DOC: 31.03.2020 (NASF Project)	Detection, control bacterial pathogens in poultry by developing chemical genomic strategies to combat multiple antibiotic resistance	Dr A.S. Yadav (CCPI)	--
7.	No. NASF/ABA-6022/2017-18 dated 31.03.2017 DOS: 01.04.2017 DOC: 31.03.2020 (NASF Project)	Aflatoxin-tolerant Duck production through genetic, epigenetic approaches	Dr S.K. Mishra	Dr B.K. Swain Dr P.K. Naik Dr Dharendra Kumar
8.	No.302/UAT dated 06.01.2018 DOS:01.04.2017 DOC: 31.03.2019 (RKVY Project)	Surveillance, monitoring of common diseases of ducks of Odisha	Dr Dharendra Kumar (CCPI)	Dr P.K. Naik Dr B.K. Swain Dr S.K. Mishra
9.	No.BT/PR19605/BIC /101/106/2016 DOS: 20.11.2017 DOC: 19.11.2020 (DBT Project)	Genome editing of primordial germ cells (PGCs) using CRISPR/ Cas9 system, production of myostatin knock out chicken	Dr Renu Singh	Dr V.K. Saxena CO-PI, Mentor

