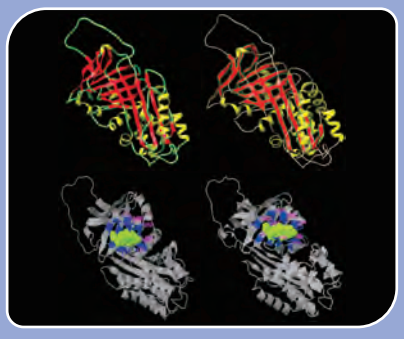
Annual Report
2018-19



ICAR - DPR

भाकृअनुप - कुक्कुट अनुसंधान निदेशालय

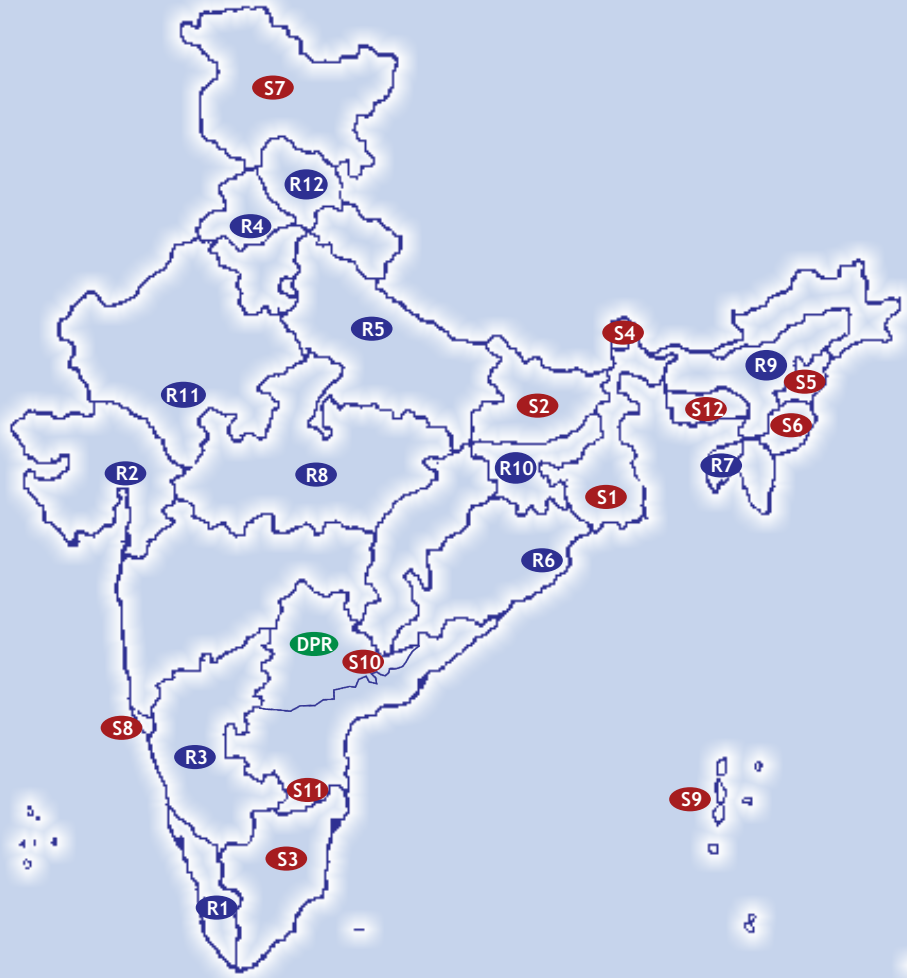
ICAR-Directorate of Poultry Research

ISO 9001 - 2015

Rajendranagar, Hyderabad - 500 030 India

AICRP on Poultry Breeding and Poultry Seed Project

Centres across the Nation



ICAR - DPR

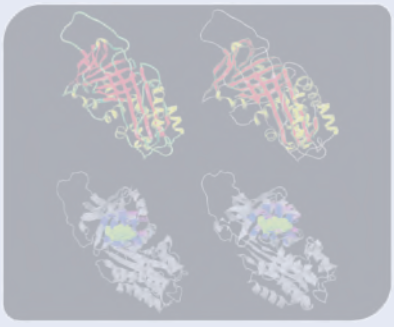
AICRP Centres

R1.	KVASU, Mannuthy
R2.	AAU, Anand
R3.	KVAFSU, Bengaluru
R4.	GADVASU, Ludhiana
R5.	ICAR-CARI, Izatnagar
R6.	OUAT, Bhubaneswar
R7.	ICAR-RC, Agartala
R8.	NDVSU, Jabalpur
R9.	AAU, Guwahati
R10.	BAU, Ranchi
R11.	MPUAT, Udaipur
R12.	CSKHPKVV, Palampur

PSP Centres

S1.	WBUAFS, Kolkata
S2.	BASU, Patna
S3.	TANUVAS, Hosur
S4.	ICAR RC, Sikkim
S5.	ICAR RC, Nagaland
S6.	ICAR RC, Manipur
S7.	SKUAST, Srinagar
S8.	ICAR-CCARI, Goa
S9.	ICAR-CIARI, Port Blair
S10.	PVNRTVU, Warangal
S11.	SVVU, Tirupati
S12.	ICAR-RC for NEHR, Barapani

Annual Report
2018-19



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Front Cover
Adult PD-2 rooster and different activities of DPR

Inside Front Cover
Location of AICRP on Poultry Breeding and Poultry Seed Project centres

Inside Back Cover
ICAR-DPR mobile App QR code

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TSP activities in Adilabad district, Telangana

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Preface

I feel privileged to present the Annual Report of ICAR-Directorate of Poultry Research for the year 2018-19. The Directorate has been serving the poultry sector for the last three decades in promoting and supporting commercial and rural poultry production in the country. The rural chicken varieties, i.e. *Vanaraja, Gramapriya* and *Srinidhi* and indigenous chicken germplasm i.e. Aseel, Ghagus and PD-4 (Vanashree) developed/improved by the Directorate have been highly popular and reached all states of the country. The birds are playing important role in providing supplementary income, besides ensuring nutritional security to the rural and tribal people in the remote under-developed areas of the country. A new two-way cross developed at the institute involving native chicken inheritance showed encouraging performance under field conditions and is in pipeline for release.

The AICRP on Poultry Breeding has been mandated to work primarily on development of location specific chicken varieties utilizing local native and elite layer, and broiler germplasm. During the year, improvement in the performance of native chickens was seen and various crosses involving native and improved exotic chickens were produced and evaluated under farm and field conditions at the centres. The Poultry Seed Project is in operation with the aim of increasing the availability of improved rural poultry germplasm across the country. I am glad that most of the centres have achieved the targeted germplasm supply during the year.

At the Directorate, the rural, broiler and layer pure lines have been constantly improved for various economic traits based on the feedback from farmers. Further, selected native chicken breeds are being conserved and used in development of newer crosses. Research is under progress in poultry genomics through functional genomics, epigenetics and gene silencing technology for augmenting poultry production.

The research conducted in the areas of nutrition, health and physiology is aiding in realization of genetic potential of pure lines and improved varieties developed by the Directorate, besides addressing the issues of the commercial poultry industry. Further, several extramural projects funded by agencies like DST-SERB, DBT, NICRA etc. and collaborative projects with the industry under PPP mode were also undertaken by the Directorate. The research output was communicated through publications in peer reviewed journals, magazines and electronic media.

Due emphasis was given for transfer of technologies and varieties developed at the institute. A total of 19.42 lakhs improved chicken germplasm was supplied during the year from the Directorate and centres of AICRP and PSP to the farmers and other stakeholders in the country. Rs. 637.8 lakhs of revenue was generated from the three components, primarily through sale of germplasm. Capacity building of entrepreneurs, farmers, veterinary officers etc. was also a priority activity

at the institute. I am glad for the first time, the Directorate organized an international training program in collaboration with MANAGE for field officers from African and Asian countries.

Under the Tribal Sub Plan, extensive field activities were carried out for promoting scientific rural poultry farming among the tribal communities in Adilabad district of Telangana. Other priority programmes such as, Mera Gaon Mera Gaurav, Swacch Bharath and SC Sub Plan were implemented.

I am extremely grateful to Dr. Trilochan Mohapatra, Secretary, DARE and Director General, ICAR for all the support and encouragement extended to the Directorate during the period. I am thankful to the Secretary, ICAR and Financial Adviser, ICAR for their continuous support to the Directorate.

I am thankful to Dr. J.K. Jena, DDG (AS) for his constant support and valuable guidance in delivering the mandated responsibilities of the Directorate. I am also thankful to Dr. R.S. Gandhi, ADG (AP&B); Dr. Ashok Kumar, ADG (AH); Dr. Vineet Bhasin, Principal Scientist (AG&B) and other scientific and administrative staff of the ICAR (HQ) for extending help from time to time. I am thankful to the scientists at the Directorate and different centres of AICRP and Seed Project, whose hard work was instrumental for the overall research progress achieved during the year. I also thank all other staff for supporting the scientists in their research endeavor. At the end, I thank the editorial committee in bringing out this report in an appreciable manner.

29th June 2019

(R.N. Chatterjee)
Director

Abbreviations

AAU	Anand Agricultural University/Assam Agricultural University
AICRP	All India Coordinated Research Project
ARS	Agriculrural Research Service
ASM	Age at Sexual Maturity
BW	Body Weight
CARI	Central Avian Research Institute
CBH	Cutaneous Basophile Hypersensitivity
CP	Crude Protien
CPCSEA	Committee for the Purpose of Control and Supervision on Experiments on Animals
CPDO	Central Poultry Development Organization
CRIDA	Central Research Institute for Dryland Agriculture
d	Day(s)
DARE	Department of Agricultural Research and Education
DBT	Department of Biotechnology
DNA	Deoxyribonucleic Acid
DPR	Directorate of Poultry Research
DST	Department of Science and Technology
EP	Egg Production
EW	Egg Weight
FCR	Feed Conversion Ratio
g	Gram(s)
GP	Glutathione Peroxidase
GR	Glutathione Reductase
H:L ratio	Heterophyl : Lymphocyte Ratio
HDEP	Hen Day Egg Production
HHEP	Hen Housed Egg Production
IAEC	Institute Animal Ethics Committee
IBSC	Institute Bio-safety Committee
ICAR	Indian Council of Agricultural Research
IMC	Institute Management Committee
IPSA	Indian Poultry Science Association
IRC	Institute Research Committee
IU	International Unit(s)
IVRI	Indian Veterinary Research Institute
KVK	Krishi Vignan Kendra
LP	Lipid Peroxidase

MANAGE	National Institute of Agricultural Extension Management
MD	Marek's Disease
ME	Metabolizable Energy
mm	Millimeter(s)
NAARM	National Academy of Agricultural Research Management
NAIP	National Agricultural Innovation Project
NCBI	National Center for Biotechnology Information
NDV	Newcastle Disease Virus
NGO	Non-Governmental Organization
NIRDPR	National Institute of Rural Development & Panchayat Raj
No.	Number
NPP	Non-Phytate Phosphorus
NRC	National Research Centre
OUAT	Orissa University of Agriculture and Technology
PCR	Polymerase Chain Reaction
PDP	Project Directorate on Poultry
PHA-P	Phytohemagglutinin-P
PJTSAU	Professor Jayashankar Telangana State Agriculture University
ppm	Parts Per Million
QRT	Quinquennial Review Team
RAC	Research Advisory Committee
RBC	Red Blood Cell
SAU	State Agricultural University
SL	Shank Length
PVNRTVU	P.V. Narasimha Rao Telangana Veterinary University
SERB	Science and Engineering Research Board
SVU	State Veterinary University
SVVU	Sri Venkateswara Veterinary University
TSA	Total Sulfur-containing Amino Acids
U	Unit(s)
wks	Weeks

Contents

Executive summary

The ICAR-Directorate of Poultry Research, a premier Institute under Indian Council of Agricultural Research,is mandated to carryout basic and applied research to enhance productivity of poultry, develop new germplasm for rural poultry husbandry and impart capacity building. The Directorate also undertakes short term research projects sponsored by other funding agencies and contract research programs under PPP mode. The salient achievements for the year 2018-19 are summarized below.

Research at the Directorate

Genetics and Breeding

The research in genetics and breeding focuses on improvement of pure lines and development of varieties for rural poultry production, maintenance and evaluation of pure line layer and broiler, and conservation of native chicken germplasm.

Germplasm for rural poultry farming

Two male lines, PD-1 (*Vanaraja* male line) and PD-6 (*Gramapriya* male line) and two female lines, PD-2 (*Vanaraja* female line) and PD-3 (Brown egg layer line) have been improved and used in developing rural chicken varieties. The egg production upto 40 weeks in PD-1 (S-12 generation) was 43.2 and the egg weight was 56.9g. The S-13 generation of PD-1was regenerated and a total of 2859 chicks were hatched. The chicks recorded 747.6g of body weight and 80.2mm of shank length at 6 weeks of age. The variance component analysis using robust restricted maximum likelihood (REML) animal model on 5-generations data indicated that the selection is quite effective with significant genetic gains in each generation for primary trait of selection.

The PD-6 (*Gramapriya* male line) population (S-8 generation) was regenerated and total of 2771 chicks were hatched. The body weight and shank length at 6weeks of age were 777.2g and 85.3mm,respectively, which were higher than in the previous generation. The egg production and egg weight at 40 weeks of age were 72.3 and 57.2g, respectively. In PD-2 population (S-15 generation), the egg production and egg mass at 52 weeks of age were 133.2 and 7447g, respectively, which were higher compared to previous generation. The population was also evaluated for slaughter parameters at 3 months of age and egg quality traits at 40 weeks of age. The S-7 generation of PD-3 line was regenerated with a total of 3814 chicks. In PD-3 line (S-7) the body weight and shank length at 6 weeks of age were 270g and 53.6mm, respectively. The egg production (75.6) and egg mass (4157g) at 40 weeks of age increased considerably from the last generation.

Native chicken populations

In PD-4 (*Vanashree*) population, which was evolved through selective breeding of Aseel, the egg production was 192.5 up to 71 weeks of age. The body weight at 8 weeks was 570.6g, which showed an increment of 5.2g over the previous generation. The production and egg weight at 40 weeks of age were 74.3 and 48.8g, respectively. The carcass characteristics of the population were studied at 20 weeks of age. In the pure Aseel population collected from the home tract (G-5 generation), the body weight at 40 and 72 weeks was 1944 & 2540g and 2235 & 3942g in females and males, respectively. The egg production and egg weight at 72 weeks were 54.7 and 53.1g, respectively. In Ghagus breed, the egg production up to 40 weeks was 33.8, while the egg weight at 40 weeks was 46.9g. Further, the incidence of broodiness in the population was found to be the highest (65.5%) at 36 weeks of age. The polymorphism study indicated that dopamine receptor D2 gene was associated with some of the broody traits in the population. The 8 weeks body weight in Ghagus increased by 7.1g compared to previous generation. The body weight and shank length were 435.2g and 66.37mm, respectively at 8 weeks of age.

In Nicobari breed (G-5 generation), the egg production was 63.8 up to 40 weeks of age and the egg weight was 47.7g. There was an improvement of 3.54g in egg weight at 40 weeks in comparison to the last generation. The body weight and shank length at 8 weeks were 401.7 and 60.27mm, respectively. The shank length increased by 7.46mm in the current generation. In Kadaknath (base generation) population, the body weight and shank length at 6 weeks were 259.2g and 56.86mm, respectively. The

egg production and egg weight at 40 weeks were 65.1 and 44.15g, respectively. For increasing the variability and population size of Kadaknath, 720 fertile eggs were procured from Jabalpur centre and hatched.

The 2-way cross was evaluated under farm and field conditions. The cross recorded annual egg production of 185.3 and 140.6 in farm and field conditions, respectively and the corresponding 72 week body weight of hens was 2.7 and 2.2kg. Economic analysis indicated a net profit of Rs. 800-900 from a pair of birds of this cross.

Broiler populations

Multi-coloured synthetic broiler lines (PB-1, PB-2 and control) have been maintained and evaluated. The body weight, shank length and FCR at 5 weeks were 841.6g, 74.1mm and 2.2, respectively. In broiler control population (G-16), the production traits were similar to those observed in previous generation. In PB-2 population (S-27 generation),the egg production and egg weight at 40 weeks were 65.0 and 59.4g, respectively. The genetic response for the 40 week egg production over the last 12 generations was 1.12 eggs per generation. The body weight at 5 weeks was 841.5g, which showed an improvement over the previous generation. The breeding value of the population was assessed using animal model (REML) with WOMBAT employing the last 5 generations data, which indicated that the selection practised was effective for traits under selection. The S-16 generation of naked neck and dwarf gene lines was regenerated with 637 and 558 chicks, respectively. The body weight at 5 weeks was 801.6 and 640.5g, respectively in naked neck and dwarf population, which showed improvement over the previous generation.

Layer populations

Six layer lines (IWH, IWI, IWK, IWD, IWF and control) were maintained and evaluated. The annual egg production in IWH, IWI, IWK, IWD and IWF was 298.5, 298.7, 276.2, 267.3 and 291.5 eggs, respectively; while in the control population it was 256.3 eggs. The egg production increased in all the selected lines over the previous generation. The next generation of the lines was produced with selection deferential of 10.51, 6.67 and 8.14 eggs for 64 week egg production in IWH, IWI and IWK lines respectively.

Molecular Genetics

In a molecular study on genes involved in *de novo* lipid biosynthesis, the expression of stearoyl coenzyme A desaturase (SCD) gene varied significantly with age of the embryo and the genotype of birds. During the post hatch period, highest expression of SCD gene was observed on day 14 in Ghagus and on day 42 in control layer, and control broiler population. The highest expression of sterol regulatory element binding protein1 (SREBP1) gene was found on 5th day of embryo in all the three populations, while during post-hatch period, the highest expression was found on day 42 in control layer and control broiler population and on day 14 in Ghagus. Promoters of *SCD* and *SREBP1* gene were associated with body weight, serum cholesterol and triglycerides content in chicken. Out of 5 shRNA molecules studied for silencing either of the genes, shRNA1 and shRNA3 of SCD, and shRNA1 and shRNA2 of SREBP1 genes had more than 60% knock down efficiency for expression of two genes under *in vitro* system.

Optimal promoter (1034 bp) of ovalbumin was identified and its functionality was examined under *in vitro* cell culture system. The construct was found efficient for expressing GFP gene in magnum primary cell culture. The coding sequence of the ovalbumin gene was characterized, its expression profile explored and polymorphism identified in the 5'-upstream regions of the gene in IWI and IWK lines. The phylogenetic analysis revealed that the ovalbumin coding sequence from these two lines had higher percent identity with other avian species. In both the lines, an increase in expression of ovalbumin gene was observed after the onset of egg production with peak expression during 40th week of age. SNPs were identified depicting in the form of three haplotypes namely H1, H2 and H3, which were associated with egg weight and age at sexual maturity in IWI line.

The annealing temperature for exon 3, 4, 5 and 6-7-8 of Tapasin gene were found to be 46, 63, 60 and 61^{o}C, respectively. Single-strand conformation

polymorphism (SSCP) study in Ghagus, Dahlem Red and Nicobari chickens revealed that these exons of Tapasin gene were polymorphic and a total of 8 different haplotypes and 17 haplogroups were observed. In Dahlem Red, significant differences were recorded with juvenile body weight, whereas in Ghagus, the haplogroups differed with respect to immune traits (HI titre and lymphocyte count). In Nicobari breed, significant differences were observed among the haplogroups for body weight and HI titre.

Nutrition, Physiology and Health

Various nutritional strategies for mitigating adverse effects of heat stress were evaluated. Safflower protein hydrolysate and protein concentrate at 0.1 and 0.2% in diet, respectively reduced lipid peroxidation, whereas the latter increased body weight and activity of super oxide dismutase. Body weight gain and feed efficiency improved progressively with increase in digestible lysine concentration from 1.03-1.23%. Inclusion of vegetable oil (1% in diet) on *isocaloric* basis in diet during summer improved egg production and anti-oxidant status in laying chicken. Supplementation of *Chebula* fruit extract and grape seed extract significantly reduced lipid peroxidation in broilers. Improvement in body weight gain and FCR of broilers was observed with 255meq/kg dietary electrolyte balance. In a field study involving rural type chickens, Oxycure supplementation (500g/ton) increased body weight gain.

Supplementation of agents like mycotoxin binder, phytase and NSP degrading enzymes could not counter the toxic effects of rice DDGS when included at higher levels (12-15%) in the diet of *Vanaraja* chicks. On the contrary, inclusion of total sulphur containing amino acids at 10% higher level in diet significantly increased body weight of *Srinidhi* chicks fed DDGS. Various organic acids and essential oils were screened *invitro* at graded doses for their effects on growth of *E.coli* and *Lactobacillus plantarum.* A combination of 2 organic acids and 3 essential oils was found optimum. Detailed structural and functional diversity analysis of caecal bacteria in Aseel birds was carried out.

Nutritional evaluation of crop and gizzard contents from free-range chickens across 4 different agro climatic regions of the country indicated wide variation in the nutritional profile of scavenging food base among the regions and seasons. The nutrient content was lower in these backyard chickens compared to those reared under confined feeding system. Organic selenium supplementation (0.15ppm) showed beneficial effects on anti-oxidant status in broiler chickens. Quality protein maize replacing normal maize (75-100%) with less or no lysine supplementation improved performance of *Vanaraja* chicks. Supplementation of inorganic or organic Fe (100-300ppm) significantly increased egg Fe content up to 35.3 and 42.4%, respectively without affecting feed intake and egg quality traits.

The semen of PD-6 line was cryopreserved using 4% dimethyl sulfoxide and a fertility of 65% was obtained when it was inseminated in to PD-3 females, but only 7% fertility was realised with PD-6 line females. In Nicobari chicken, none of the cryoprotectants tested was useful for cryopreserving the semen. Similar observations were made with PD-4 semen. Heat stress decreased concentration of plasma leptin, ghrelin and growth hormone in Nicobari chickens, which was reversed by supplementation of fermented yeast culture along with beneficial effects on body weight and egg production. In a poultry waste management experiment suitability of various raw materials for composting poultry manure, the C : N ratio, P and K were analysed.

The ALV screening of breeding flocks before regeneration lead to considerable reduction in the percentage of carriers from previous generation. An Fe inactivated experimental vaccine developed using a field isolate of *Pasteurella multocida* A:1 gave equivalent protection as that of commercial vaccine upon challenge infection. In a comparative study involving various native chickens and *Vanaraja*, Nicobari chickens showed significantly higher survivability and longer mean death time to experimental *Pasteurella* infection. Besides, for exploring antibiotic growth promoters various formularies were prepared using different herbs/extracts and screened for *in vitro* anti-microbial activity against *E.coli*. Two phytogenic feed additives

were developed and tested *invivo* in *Krishibro* chicks. Better gut health, reduced mortality and FCR were observed in the supplemented groups compared to control.

AICRP on Poultry Breeding

The AICRP on Poultry Breeding has been operated at twelve centres viz. KVASU, Mannuthy; AAU, Anand; KVAFSU, Bengaluru; GADVASU, Ludhiana; OUAT, Bhubaneswar; CARI, Izatnagar; ICAR Research Complex for NEH Region, Agartala; MPPCVVV, Jabalpur; AAU, Guwahati; BAU, Ranchi; MPUAT, Udaipur and CSKHPKVV, Palampur. The main objectives of the project were development of location specific chicken varieties; conservation, improvement, characterization and application of local native, elite layer and broiler germplasm; and development of package of practices for village poultry and entrepreneurships in rural, tribal and backyard areas. In addition, KVASU, Mannuthy and AAU, Anand centres are mandated to maintain two elite layer germplasm (IWN and IWP). KVAFSU, Bangalore; GADVASU, Ludhiana; OUAT, Bhubaneswar, and CARI, Izatnagar have been maintaining four elite broiler germplasm (PB-1, PB-2, CSML and CSFL).

The elite strains have been duplicated at different centres for coping up with exigencies, like IWF at Mannuthy, IWD and IWK at Anand and M-1 and M-2 at Jabalpur. Two pedigreed random bred control populations (one each for layer and broiler) were maintained at DPR and supplied to centres for measuring the genetic progress. During the year, a total of 8,07,869 chicken germplasm was distributed to the farmers from different centres with a total revenue generation of Rs. 223.47 lakhs.

At Mannuthy centre, egg production upto 40 weeks was 79.2 in S-3 generation of native germplasm, recording an increase of 3.24 eggs over the previous generation. The 3-way cross produced 217.8 eggs upto 72 weeks under farm conditions. In the S-30 generation of layer purelines, the egg production upto 64 weeks increased by 3 eggs in IWN and by 4.9 eggs in IWP. A total of 1,33,829 chicks were distributed by the centre. At Anand centre, egg production upto 40 weeks in native chickens (S-2) was 66.4 eggs. The 3-way cross recorded 62 eggs upto 40 weeks under field conditions. The 40 week egg production in base population of IWN and IWP was 122.7 and 121.1, respectively. The centre supplied 46,983 chicks during the year.

At Bengaluru centre, 8 week body weight in native chickens was 464.9g in S-3 generation. The 3-way cross (F2) recorded a body weight of 1255g in males at 8 weeks. In PB-2 and control lines, the body weight at 5 weeks increased in the present generation. The genetic response of body weight at 5 weeks over the past 12/13 generations was 30.4g in PB-1 and 20.4g in PB-2. The centre supplied 1,95,795 chicks. At Ludhiana centre, the body weight of native germplasm was 765g at 8 weeks, while the egg production in the PB-2 x *desi* cross was 55.6 eggs in the field. Body weight at 5 weeks was 1,166 and 1,071g in PB-1 and PB-2, respectively. Genetic response over 11 generations for 5 week body weight was 20.7 and 11.5g in PB-1 and PB-2, respectively. A total of 1,02,049 chicks were supplied by the centre.

At CARI centre, body weight of native chickens was 504.6 and 1140g at 6 and 12 weeks, respectively. Body weight of cross (CSML x *desi*) was 1368g at 8 weeks. The genetic response for 5 week body weight was 15.1 and 15.0g in CSML and CSFL, respectively. A total of 51,388 chicks were supplied. At Bhubaneswar centre, the body weight of native chickens (*Hansli*) was 587g at 8 weeks and the egg production upto 40 weeks was 23.1. In the purelines, the body weight at 5 weeks was 1,025 and 1,129g in CSFL and CSML, respectively, which were higher than in the previous generation. At Tripura centre, the body weight at 8 weeks was 306.5, 495, 1102 and 512.9g in Tripura black, Dahlem Red, colored broiler dam line and BN cross, respectively. The BND cross chicks weighed 403g at 8 weeks and produced 82.8 eggs in the field. A total of 25,275 chicks were supplied.

At Jabalpur centre, the 6 week body weight of Kadaknath and Jabalpur color population (JBC) was 343.3 and 803.7g, respectively, while the respective egg production upto 40 weeks was 57.3 and 91.9. The *Naramadanidhi* cross recorded annual egg production of 176 under field conditions. A total of 56,432 chicks were supplied. At Guwahati centre, the native population recorded body weight of 132.5g at 5 weeks and egg production of 67.5 eggs

upto 52 weeks. In *Kamrupa* variety, 5 weeks body weight and 52 weeks egg production were 210.6g and 73.7 eggs, respectively under field conditions. The centre supplied 30,720 germplasm.

At Ranchi centre, the 20 weeks body weight and 40 weeks egg production were 989.2 & 1218g and 32.3 & 45.4 eggs in native and Dahlem Red, respectively. A total of 25,323 chicks were supplied. At Palampur centre, the 8 weeks body weight and 52 weeks egg production in native and Dahlem Red were 530.3 & 617.1g and 84.3 & 148.4 eggs, respectively. The *Himsamridhi* variety recorded annual egg production of 145.7 eggs under field conditions. The centre supplied 44,584 germplasm. At Udaipur centre, the 8 weeks body weight was 640.9g and the 52 weeks egg production was 69.2 in native (*Mewari*) population. The annual egg production in *Pratapdhan* was 166.1. A total of 76,681 chicks were supplied.

Poultry Seed Project

The "Poultry Seed Project" was initiated during the XI Five Year Plan with the main objective of production of improved chicken germplasm and their supply to various stake holders in the remote areas to target production enhancement of egg and meat for augmenting rural poultry production, socio-economic condition of the target groups and linking small scale poultry producers with organized market.

During the year 2018-19, the project was operated at 12 centres, viz. WBUAFS, Kolkata; BASU, Patna; ICAR-RCfor NEH region, Jharnapani; ICAR-NOFRI, Gangtok; ICAR RC for NEH region, Imphal; TANUVAS, Hosur; ICAR-CCARI, Panaji; ICAR-CIARI, Port Blair; SKUAST, Srinagar; PVNRTVU, Warangal; SVVU, Tirupati and ICAR RC for NEH Region, Umiam. The Directorate acted as the coordinating unit and supplied parent chicks. The target set for supplying chicks for mainland and north-eastern centres during the year 2018-19 were between 0.3 and 1.0 lakhs chicks per annum for different centres and to collect feedback on the performance of the germplasm under backyard farm conditions. A total of 6,47,194 improved chicken varieties were distributed in their respective regions/states during the year. A total of Rs. 166.65 lakhs revenue was generated from the Project.

At Kolkata centre, 8 batches of *Vanaraja* parents were reared and the egg production of 50% was achieved at 31 weeks and maintained up to 67 weeks. Hatchability of 81.5% on total eggs set was recorded. A total of 92,848 chicks were distributed by the centre. Two batches of *Vanaraja* parents were reared at Patna centre. The hen day egg production of 51.4% was achieved at 36 weeks and the hatchability on total eggs set was 68.4%. A total of 69,179 chicks were distributed. At Jharnapani centre, 50% egg production in *Vanaraja* parents was attained at 36 weeks and the overall hatchability was 70.1 and 69.7% in *Vanaraja* and Srindhi parents, respectively. A total of 83,508 chicks were distributed. At Sikkim centre, the average egg production in *Vanaraja* parents was 51.7% and peak production of 72% was attained at 31-34 weeks. A hatchability of 78.8% on total eggs set was recorded. The centre supplied 89,495 chicks .

At Manipur centre, three batches of *Vanaraja*, *Gramapriya* and *Srinidhi* parents were reared and the hatchability on total eggs set was 58.1 and 66.7% in *Vanaraja* and *Srinidhi* parents, respectively. A total of 79,425 chicks were supplied. Four batches of *Vanaraja* and three batches of *Gramapriya* parents were reared at Hosur centre. The egg production ranged from 52-69% during 42-72 weeks of age in *Vanaraja* and the corresponding values for *Gramapriya* were 64-86% during 23-72 weeks. A total of 1,42,674 chicks were supplied by the centre. At Goa centre, one batch of *Srinidhi* parents was reared. A total of 1,357 chicks were supplied.

Two batches of *Vanaraja* parents were reared at Port Blair centre. Age at sexual maturity recorded was 178 days and a total of 21,009 chicks were supplied. At Srinagar centre, two batches of *Vanaraja* breeders were reared. The average egg production was above 60% from 56-72 weeks of age. A total of 37,630 chicks were supplied. Two batches of *Vanaraja* and Srindhi parents were reared at Barapani centre. The hatchability (TES) ranged between 61-75% in *Vanaraja* and 56-62% in *Srinidhi*. A total of 30,206 chicks were supplied. One batch of *Vanaraja* parents was reared at Tirupati centre and the centre supplied a total of 8,763 chicks. At Warangal centre, two batches of *Vanaraja* and *Gramapriya* parents

were reared. The highest egg production of 67.4% was recorded at 46 weeks of age in *Vanaraja*. A total of 10,223 chicks were supplied.

Technologies Transferred

The Directorate participated in a number of exhibitions and farmers' fairs and propagated the technologies and varieties developed at the institute. Training programmes were organized for imparting knowledge on rural and commercial poultry production to the farmers, veterinary officers and other beneficiaries from across the country. Besides, one international training program was also organised in collaboration with MANAGE for field officers from 6 African and 2 Asian countries. Consultancy and contract research services were also extended to the stakeholders in the area of nutrition and health. A total of 1,52,913 hatching eggs, 2,80,061 day-old chicks and 2,438 grown-up birds of *Vanaraja*, *Gramapriya, Srinidhi, Krishibro,* etc. were supplied by DPR to the farmers and different organizations including Government agencies across the country. In addition, 45,075 parent chicks of different varieties were also supplied. From the AICRP and Poultry Seed Project centres, another 8,07,869 and 6,47,194 number of germplasm, respectively were supplied. Through functional linkages with line departments and other agencies, the Directorate has been playing a pioneering role in promoting rural poultry production in the country.

Other activities

During the year, a total of 37 research papers, 2 review papers, 2 books/bulletins and 4 popular articles were published by the scientists of the institute. In addition, 9 invited papers and 25 research abstracts were presented in different Conferences. Under Tribal Sub Plan, extensive field activities were carried out for promoting scientific rural poultry farming among the tribal communities in Adilabad district of Telangana. Other priority programmes such as, Mera Gaon Mera Gaurav, Swacch Bharath and SC Sub Plan were implemented. The Research Advisory Committee, Institute Research Committee and Institute Management Committee continuously monitored and suggested improvement in research, administration and financial management of the Institute. The Quinquennial Review Team evaluated the institute's performance during the period 2012-17 and submitted the report to Council.

At the Directorate, the budget utilized during the period was Rs. 2206.69 lakhs and at AICRP and Poultry Seed Project centers, Rs. 619.16 and Rs. 566.31 lakhs, respectively were utilized. A total revenue of Rs. 637.8 lakhs (DPR- Rs. 247.68, AICRP- Rs. 223.47 and PSP- Rs. 166.65 lakh) was generated during the year.

1. Introduction

History

The ICAR-Directorate of Poultry Research is a premier institution in the field of poultry science research and extension in the country. The institute was established on 1st March 1988 at Hyderabad, Andhra Pradesh (now Telangana) under the aegis of Indian Council of Agricultural Research. The Institute originated from All India Coordinated Research Project (AICRP) on Poultry Breeding, an all India Network project launched by the Indian Council of Agricultural Research during IV five year plan with the objective of augmenting commercial poultry production and achieving self-sufficiency in the country. In the beginning, the coordinating unit of AICRP was located at the Poultry Research Division, Indian Veterinary Research Institute, Izatnagar till 1979, which monitored the activities of the AICRP centres located at different State Agricultural Universities (SAUs) and ICAR Institutes. Later, it functioned from Central Avian Research Institute, Izatnagar till its elevation to the Directorate status in 1988. In addition, the activities of the Directorate were expanded by introducing new research programmes in Poultry Nutrition, Housing & Management under separate network programmes in selected SAUs, where the breeding units were already in existence. The research work in these areas continued till March 1993, after which the Nutrition along with Housing and Management activities were discontinued and only the research on breeding aspect continued. Consequently, the Directorate was entrusted the task of developing germplasm suitable for rural poultry production; maintenance and improvement of elite broiler and layer purelines; maintenance of random bred control populations; and maintenance of two gene lines (naked neck and dwarf) for augmenting productivity under tropical climate. The institute was elevated from the position of Project Directorate to Directorate on 18 September 2013.

The research focus at the Institute has been towards the application of quantitative genetic principles to enhance productivity of various chicken germplasm. To support the core research programme, research in nutrition, health, physiology and molecular genetics has been made an integral component. In addition, several externally funded projects were also carried out to achieve the Institute's primary goals and objectives. Keeping in view the present needs of poultry farming in the country and to meet the challenges ahead, the Directorate has formulated a Perspective Plan, 'Vision 2050', in which thrust areas of the research programmes were identified.

The AICRP centers made sustained efforts resulting in the release of seven promising varieties of chicken for commercial exploitation and utilization for the benefit of farmers. The potential of these varieties has been regularly evaluated in Random Sample Poultry Performance Tests and found them suitable for intensive farming. Scientists at AICRP centres are continuously involved in developing new crosses incorporating various germplasm including indigenous stocks through two/more breed crosses. Till date, the most promising layer varieties released from AICRP centres are ILI-80 at CARI, Izatnagar; ILM-90 at KVASU, Mannuthy and ILR-90 at SVVU, Hyderabad, while the broiler varieties developed are B-77 and IBI-91 at CARI, Izatnagar; IBL-80 at GADVASU, Ludhiana and IBB-83 at KVAFSU, Bengaluru. In the XII Plan, the AICRP was reoriented towards development of location specific varieties for rural poultry production. Under this activity, several new varieties like *Pratapdhan, Kamrupa, Jharsim, Narmadanidhi* and *Himsamridhi* have been released at different centres. During XI plan, the activities of the Directorate were further expanded by introduction of a new network project, the "Poultry Seed Project" with six centres located in different states to increase the availability of rural chicken germplasm for rearing in remote areas of the nation. In the financial year 2014-15, six new centres were added under this project. The Directorate is coordinating the activities of the Seed Project centres for rearing parent stock of improved rural poultry germplasm and supplying hatching eggs, and day-old or grown-up chicks to meet the demand in rural and tribal areas.

At this Directorate, through research three promising chicken crosses for rural poultry farming were evolved i.e., *Vanaraja* and *Srinidhi,* dual-purpose birds and *Gramapriya*, predominantly a layer, meant for free-range and backyard farming. These chicken varieties have become extremely popular and are

being reared in every part of the country. Further research in this direction is underway for developing new crosses that could be of tailor-made for better adaptability under diversified regions in rural and tribal backyard conditions. Several user agencies in the country are involved in dissemination of the varieties covering the southern, northern, eastern and northeastern states including Jammu and Kashmir, Lakshadweep, and Andaman and Nicobar Islands. The Directorate also developed two crosses viz. *Krishibro*, a multicolored broiler and *Krishilayer*, a high yielding egg producing bird for commercial purposes.

India is a rising power in the world in every sphere right from the economy to education, science and technology to infrastructure and health care to food security. The country is basically an agrarian country where more than 60% population depends on agriculture for their livelihood. In this context, the rural backyard poultry has become one of the avenues for the landless or marginal farmers to earn their livelihood and balanced food. Thus to meet the needs of rural farmers, the Directorate has taken a lead in this direction by adopting a holistic approach to develop high performing, better adaptable and disease resistant germplasm suitable for backyard farming with low input system.

Active research is being pursued to prepare package of practices for providing optimum nutrition, management and health coverage to the pure lines as well as crosses developed by the Directorate for intensive and backyard systems of rearing. Research in nutrition resulted in development of technologies like low-cost feeds using alternate raw materials, enzymes for enhanced nutrient utilization etc., that have been adopted by the commercial and rural farmers to reduce cost of production. Besides this, the Directorate is also familiar among poultry farming community for its services in disease diagnosis, seromonitoring and health care. The nutritional and health care solutions are being offered to the stakeholders of poultry farming including through network programmes and contract research programmes. The studies on advanced molecular genetic tools like gene silencing, transgenics, SNP typing, DNA marker based selection etc. have also been undertaken in evaluating and augmenting the productivity of various chicken germplasm maintained at this Directorate. To measure population dynamics of various chicken lines used in the AICRP programme, molecular characterization has been initiated at this Directorate. The Directorate thus is actively engaged in augmenting the productivity of chicken by undertaking research in different aspects of Poultry Science to cater to the needs of the country.

Mandate

The Directorate has been striving hard to realize its *Vision* of "enhancing productivity of chicken for household nutritional security, income and employment generation" and the *Mission* of "developing and propagating improved varieties of chicken for sustainable production under intensive and extensive systems". To achieve the goals, the following mandate of this Directorate has been implemented precisely.

- Basic and applied research to enhance productivity of poultry
- Development of new germplasm for rural poultry husbandry
- Capacity building

Organogram

The Directorate is working with different wings and sections with required infrastructure and well devised functionalities. Different committees/ disciplines formulated and approved by the Council are guiding the Directorate in efficient and quick functioning of the Institute with greater transparency. The organizational set up of the Institute is shown in Fig. 1.

Financial outlay

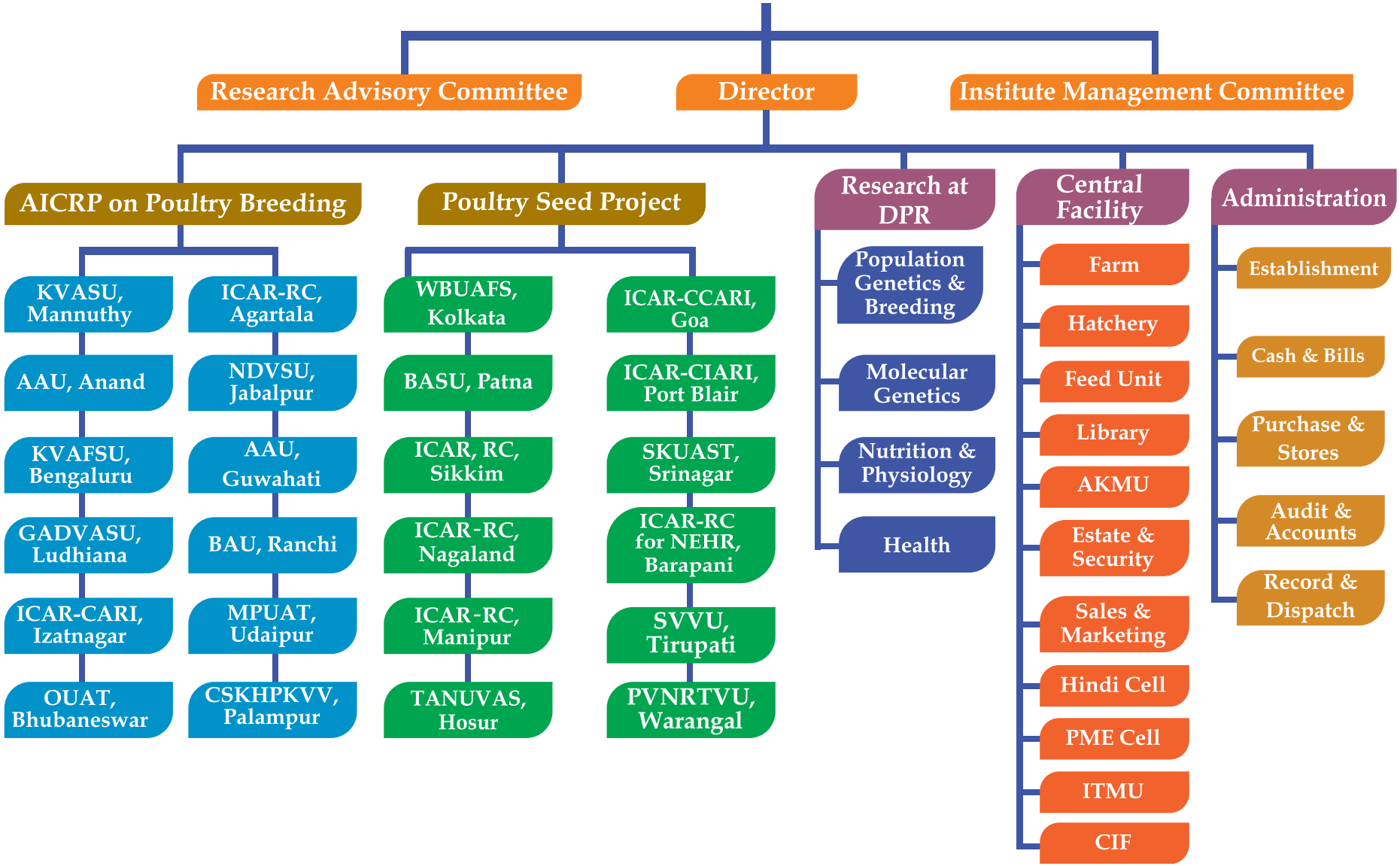
(Rs. lakhs)

Component	Budget	Expenditure	Receipts
DPR	2216.52	2206.69	247.68
AICRP	619.16	619.16	223.47
Seed Project	566.31	566.31	166.65

Staff position

Cadre	Sanctioned	Cadre in position as on March 31, 2019
RMP	01	-
Scientists	15	18
Technical	16	13
Administrative	14	11
Skilled support	15	13
TOTAL	**61**	**55**

Organogram


ICAR-Directorate of Poultry Research
Research Advisory Committee
Director
Institute Management Committee
AICRP on Poultry Breeding
KVASU, Mannuthy
AAU, Anand
KVAFSU, Bengaluru
GADVASU, Ludhiana
ICAR-CARI, Izatnagar
OUAT, Bhubaneswar
ICAR-RC, Agartala
NDVSU, Jabalpur
AAU, Guwahati
BAU, Ranchi
MPUAT, Udaipur
CSKHPKVV, Palampur
Poultry Seed Project
WBUAFS, Kolkata
BASU, Patna
ICAR, RC, Sikkim
ICAR-RC, Nagaland
ICAR-RC, Manipur
TANUVAS, Hosur
ICAR-CCARI, Goa
ICAR-CIARI, Port Blair
SKUAST, Srinagar
ICAR-RC for NEHR, Barapani
SVVU, Tirupati
PVNRTVU, Warangal
Research at DPR
Population Genetics & Breeding
Molecular Genetics
Nutrition & Physiology
Health
Central Facility
Farm
Hatchery
Feed Unit
Library
AKMU
Estate & Security
Sales & Marketing
Hindi Cell
PME Cell
ITMU
CIF
Administration
Establishment
Cash & Bills
Purchase & Stores
Audit & Accounts
Record & Dispatch

2. Research Achievements

Genetics and Breeding

Development of germplasm for backyard / free range farming for rural and tribal areas

Male lines

PD-1 line

The selected population of PD-1 was evaluated for production traits up to 52 weeks of age during S-12 generation. The ASM increased significantly from previous generation. The body weights decreased considerably from the previous generation. The part period egg production at 40 weeks of age reduced as compared to last generation. The heritability estimates for production traits were low to moderate from sire & dam components of variance (Table 1).

Regeneration

PD-1 line was regenerated in pedigreed mating with 50 sires and 250 dams in five hatches during S-13 generation. A total of 2859 chicks were produced in S-13 generation. The fertility recorded was 89.6% and hatchability on FES and TES were 88.3 and 79.2% respectively. Hatchability improved over the last generation.

The juvenile performance of PD-1 birds during S-13 generation is given in Table 2. Body weight and shank length recorded at six weeks of age decreased compared to last generation. The heritability estimates for body weight (0.21) and shank length (0.22) were moderate. The body weight and shank length were positively correlated with high degree of association.

Table 2. Juvenile traits in PD-1 (S-13)

Age	Body weight (g)	Herita-bility	Shank length (mm)	Heritabil-ity
4 wks	355.57±0.03	0.37±0.11	60.56 ±0.002	0.39±.0.12
6 wks	747.56±0.08	0.21±0.03	80.17±0.001	0.22±0.08

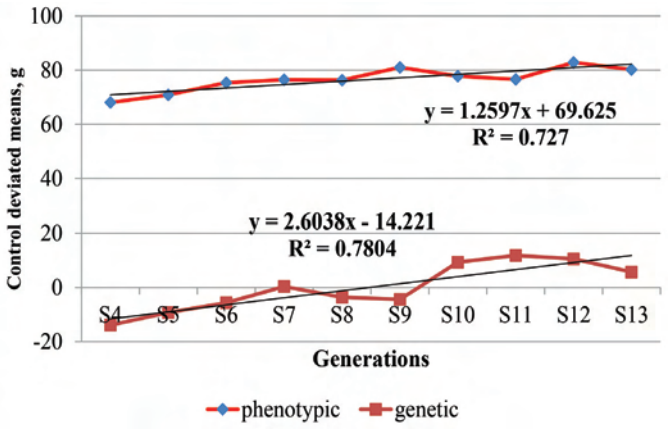


Fig. 1. Short term response for 6 week shank length in PD-1

Results of Animal Model analysis in PD-1

Variance component analysis utilizing robust restricted maximum likelihood (REML) animal model was carried out with five generations data to delineate the population status and direct additive, maternal genetic, and permanent environmental effects, besides genetic trends and performance with respect to growth and production traits in PD-1 line. The body weight (BW) and shank length

Table 1. Production performance of PD-1 line (S-12)

Traits		Means	Heritability		
			h^2_S	h^2_D	$h^2_{(S+D)}$
ASM (days)		190.17 ±0.07	0.15 ± 0.25	--	--
Body wt. (g)	20 wks	2087± 0.96	0.39 ± 0.20	0.47 ± 0.25	0.44 ± 0.17
	40 wks	2772± 0.99	0.18 ± 0.26	0.15 ± 0.29	0.16 ± 0.20
	52 wks	2781± 0.89	0.48 ± 0.31	0.05 ± 0.29	0.27 ± 0.22
Egg wt. (g)	28 wks	50.19 ± 0.05	0.43 ± 0.26	0.56 ± 0.39	0.49 ± 0.25
	32 wks	52.67 ± 0.04	0.16 ± 0.26	0.44 ± 0.36	0.28 ± 0.20
	36 wks	55.41 ± 0.11	0.29 ± 0.22	0.38 ± 0.16	0.33 ± 0.23
	40 wks	56.90 ± 0.01	0.12 ± 0.28	0.36 ± 0.31	0.24 ± 0.23
	52 wks	61.88 ± 0.07	-	0.13 ± 0.20	-
Egg prodn. (Nos.)	40 wks	43.22± 0.01	0.17 ± 0.28	0.10 ± 0.27	0.14 ± 0.20
	52 wks	66.73 ± 0.11	0.04 ± 0.16	0.17 ± 0.21	0.09 ± 0.11

(SL) varied significantly (P≤0.01) among the generations, hatches and sexes. The least squares mean (LSM) of SL at six weeks, the primary trait was 77.44±0.05 mm. All the production traits, viz., body weights, age at sexual maturity, egg production (EP) and egg weight (EW) were significantly influenced by generation. Model four with additive, maternal permanent environmental and residual effects was the best model for juvenile growth traits, except for zero day body weight (Table 3). The heritability estimates for BW and SL at six weeks (SL6) were 0.199±0.025 and 0.167±0.025, respectively. The correlation coefficients between body weight and shank length from different components were higher and significant (P≤ 0.05). The correlation between EP up to 40 weeks and BW at 40 weeks was negative from direct additive, residual and phenotypic components. The breeding value (BV) of SL6 in the population increased linearly from 0.033 to 3.62 mm due to selection for the last five generations (Fig. 2). Genetic trend was significant (P≤ 0.05) for SL6, body weight and production traits. The average genetic gain of EP40 for each generation was significant (P≤ 0.05) with an average increase of 0.38 eggs per generation. The average inbreeding coefficient was 0.017. The population is in ideal condition with negligible inbreeding and the selection is quite effective with significant genetic gains in each generation for primary trait of selection and other associated traits. The REML animal model minimized the over-estimation of genetic parameters and improved the accuracy of the BV estimates, thus enabling the breeder to select the suitable breeding strategy for genetic improvement of the populations.

A pair of PD-1 birds

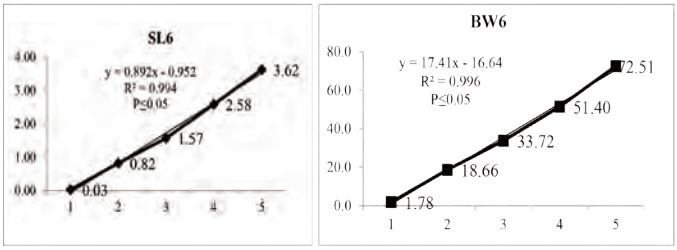


Fig. 2. Genetic trends of shank length and body weight at six weeks of age

Table 3. Estimates of (co)variance components and genetic parameters for juvenile traits in PD-1 line

Components	BW0	BW2	BW4	BW6	SL6
	Model 5	Model 4	Model 4	Model 4	Model 4
σ^2_a	1.4858	65.50	823.9	2621.53	5.371
σ^2_m	3.3605	-	-	-	-
σ_{am}	-	-	-	-	-
σ^2_c	2.3201	37.86	179.87	397.41	1.144
σ^2_e	5.750	539.39	3940.8	10179.7	25.742
σ^2_p	12.917	642.76	4944.6	13198.7	32.258
h^2	0.115 (0.025)	0.102 (0.019)	0.167 (0.024)	0.199(0.025)	0.167 (0.025)
m^2	0.260 (0.042)	-	-	-	-
r_{am}	-	-	-	-	-
c^2	0.180 (0.033)	0.059 (0.008)	0.036 (0.008)	0.030 (0.007)	0.035 (0.008)
h^2_T	0.245	0.102	0.167	0.199	0.167
logL	-21875.136	-50307.560	-62737.587	-69356.474	-29336.414

Values in the parentheses are standard errors; Column in bold represents estimates from best model as per LRT

$^{+}\sigma^2_a$, σ^2_c, σ^2_m, σ^2_e and σ^2_p are additive direct, maternal permanent environmental, maternal genetic, residual variance and phenotypic variance, respectively; h^2 is heritability; c^2 is σ^2/σ^2_p; h^2_t is total heritability and log L is log likelihood for the model obtained from WOMBAT

$^{\epsilon}$ Indicates that the approximation used to define standard errors of parameter estimates failed.

BW0: Day old body weight, BW2: 2nd week body weight, BW4:4th week body weight, BW6: 6th week body weight, SL6: 6th week shank length

PD-6 (*Gramapriya* Male Line)

GML population (S-8 generation) was regenerated with 50 sires and 250 dams in a pedigreed mating. A total of 2771 chicks were produced with 80% fertility and 90% hatchability on FES. The least squares means for body weight and shank length recorded at 4 and 6 weeks of age are given in Table 4. The 6 week body weight increased during S-8 generation. Maximum SL (85.32 mm) was recorded during this generation. The heritability estimates of body weight and shank length were moderate (Table 4).

The body weight and shank length were positively correlated with high degree of association. The genetic and phenotypic response to selection for higher shank length at six weeks of age is presented in Fig. 3.

Table 4. Juvenile traits at different weeks in GML chicken (SL-8)

Age	Body weight (g)	Herita-bility	Shank length (mm)	Heritabil-ity
4 wks	389.8± 0.08	0.17 ±0.04	63.85 ± 0.001	0.19±.0.10
6 wks	777.2 ±0.06	0.27± 0.09	85.32± 0.002	0.24±0.12

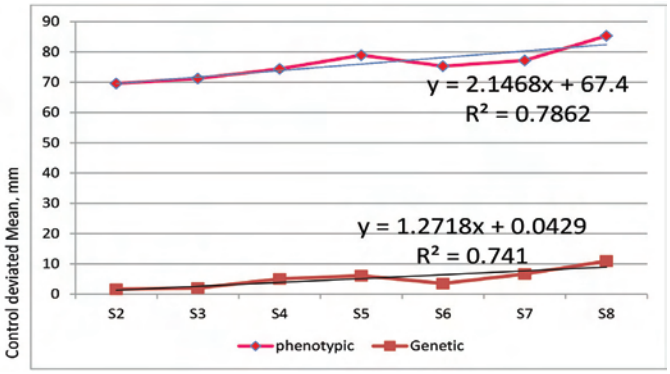


Fig. 3. Response to 6 week shank length in GML

The selected population of GML was evaluated for production traits up to 40 weeks of age (Table 5). The 20 week body weight was almost similar and maintained within the standard weight. The heritability estimates for production traits were low to medium from sire and dam components of variance.

A pair of PD-6 birds

Female lines

PD-2 (Female parent line of *Vanaraja*) and PD-3 (Female parent line of *Gramapriya*) lines along with rural and Dahlem Red control were evaluated for growth and production performance.

PD-2 line

The PD-2 population was evaluated for growth and production traits up to 52 weeks of age in S-15 generation (Table 6). The egg production and egg mass at 52 weeks of age increased significantly during this generation. The heritability estimates for egg production were low. The egg production and all other traits (Body weights, ASM and Egg weight) were negatively correlated as the magnitude of these traits increased and the egg production decreased.

S-16 generation of PD-2 line was regenerated with 50 sires and 250 dams in a pedigreed mating. A total of 3477 chicks were produced with 77% fertility and 81% hatchability on fertile eggs set.

Table 5. Production performance in PD-6 (GML)

Traits		Means	Heritability		
			h^2_S	h^2_D	$h^2_{(S+D)}$
ASM (days)		176.02 ±0.05	0.19 ± 0.11	--	--
Body wt. (g)	20 wks	1895± 0.54	0.09 ± 0.12	0.64 ± 0.33	0.39 ± 0.27
	40 wks	2931± 0.64	0.73 ± 0.26	0.39 ± 0.31	0.56 ± 0.32
Egg wt. (g)	28 wks	49.55 ± 0.01			
	32 wks	53.35 ± 0.01			
	36 wks	55.54 ± 0.01			
	40 wks	57.17 ± 0.01	0.78 ± 0.27	0.54 ± 0.48	0.66 ± 0.27
Egg prodn. (Nos.)	40 wks	72.31± 0.04	0.09 ± 0.11	0.17 ± 0.18	0.13 ± 0.24

Table 6. Production performance of PD-2 line (S-15)

Traits		Means		Heritability		
		PD-2	Rural Control	h^2_S	h^2_D	$h^2_{(S+D)}$
ASM (days)		157.0±0.01	152.7	0.29±0.14	0.46±0.18	0.37±0.12
Body wt. (g)	20 wks	2165±0.34	2092	0.39±0.17	0.55±0.19	0.47±0.13
	40 wks	2551±0.42	2723	0.45±0.20	0.32±0.15	0.39±0.20
	52 wks	2842±0.54	2885	--	0.34±0.14	--
Egg wt. (g)	28 wks	47.51±0.004	45.11	0.39±0.16	0.39±0.16	0.39±0.16
	40 wks	52.64±0.005	51.93	0.36±0.17	0.36±0.17	0.36±0.17
	52 wks	56.00±0.006	54.93	0.54±0.19	0.45±0.17	0.49±0.16
Egg prodn. (Nos.)	40 wks	80.29±0.03	66.89	0.10±0.13	0.19±0.14	0.15±0.12
	52 wks	133.2±0.05	107.4	0.19±0.11	0.05 ±0.16	0.09±0.10
Egg Mass (g)	52 wks	7447±2.98	6367	0.22±0.11	0.16±0.15	0.17±0.09

Slaughter parameters

The slaughter parameters were studied in 40 birds of PD-2 line, 20 from each sex at 3 months of age (Table 7). The live weight significantly varied between the sexes, however, there was no significant difference in carcass weight. All the slaughter traits were expressed as percentage of live weight. The dressing percentage was about 73% in both male and females. Thigh and wing proportion significantly varied between the sexes. Liver and gizzard were significantly larger in females. Immune organs were also heavier in females.

Egg quality traits

Egg quality traits were studied in PD-2 line at 40 weeks of age. The details are presented in Table 8.

Table 7. Slaughter parameters in PD-2 line expressed as percentage of live weight

Traits	Male	Female	SEM	P
N	20	20	-	-
Dressing Percentage	73.56	73.22	0.34	0.62
Breast	16.13	16.75	0.24	0.22
Thigh	22.31^a	20.39^b	0.24	0.01
Wing	10.39^a	9.69^b	0.12	0.03
Back	14.42	14.57	0.24	0.05
Neck	5.40	5.23	0.13	0.49
Heart	0.37	0.43	0.02	3.47
Liver	2.07^b	2.45^a	0.06	0.01
Gizzard	2.15^b	2.45^a	0.05	0.02
Fat	0.05^b	0.82^a	0.12	0.01
Bursa	0.06^b	0.13^a	0.01	0.01
Spleen	0.14^b	0.22^a	0.01	0.02
Live weight (g)	1497^a	1272^b	31.73	0.01
Carcass weight (g)	1102	931.6	34.93	-
Feather	9.84	11.12	0.60	-
Blood	3.82	3.46	0.30	-

Table 8. Egg quality traits in PD-2 line

Traits (N=220)	Mean ± SE.
Egg weight (g)	51.49±0.18
Shell weight (g)	4.52±0.02
Shell thickness (mm)	0.40±0.02
Haugh unit	79±0.62
Yolk colour	7.84±0.07
Shape index	75.22±0.19

The shell weight and thickness were higher in PD-2 line. The albumin quality and yolk colour were good in PD-2 line.

A pair of PD-2 birds

PD-3 line

S-7 generation of PD-3 line was regenerated using 50 sires and 250 dams by pedigree mating with a total of 3814 chicks. The fertility was 70% and hatchability on fertile egg set was 70%. The heritability estimates for growth traits were low to moderate (Table 9).

Table 9. Body weights at different weeks in PD-3 line

Age	Body weight (g)	Shank length (mm)
4 wks	143.80±0.02	42.73±0.001
6 wks	269.96±0.01	53.63±0.002

A pair of PD-3 birds

PD-3 population was selected for higher 40 week egg mass and selected population was evaluated for production traits during S-7 generation (Table 10). The egg production and egg mass at 40 weeks of age increased considerably from the last generation. The heritability estimates for production traits were low to medium from sire & dam components variance.

Native germplasm

PD-4 (Vanashree)

PD-4 is an improved native bird evolved through selective breeding of *Aseel* for higher body weight at 8 weeks of age and egg production up to 40 weeks of age through independent culling level of selection.

Egg production up to 71 weeks of age was 192.5±2.61 eggs with liveability of 96.67% during 41-71 weeks of age.

A pair of PD-4 birds

In S-9 generation, a total of 861 good chicks of PD-4 line (*Vanashree*) were hatched in two hatches by mating 50 sires with 150 dams in 1:3 ratio with the fertility of 80.16% and hatchability of 85.87 and 68.83%, respectively on FES and TES. Selection differential and intensity of selection for 8 wks body weight was 46 g and 0.52σ, respectively while those for 40 wks egg production were 10.13 eggs and 0.55σ. Effective population size and rate of inbreeding were 143.8 and 0.0035, respectively as 50 sires and 128 dams contributed progenies to the S-9 generation. Means along with their heritability estimates for growth traits on pooled sex up to 8 weeks of age are presented in Table 11. In this generation, there was an improvement of 5.2g in body weight at 8 weeks of age. Heritability estimates of growth traits were higher in magnitude. Liveability observed during 0-8, 9-20 and 0-20 weeks of age was 95.35, 98.05 and 93.50%, respectively. Liveability of males and females during 21-40 weeks of age was 92.9% and 92.2%, respectively.

Table 10. Production performance of PD-3 line (S-7)

Traits		Means		Heritability		
		PD-3	DRC	h^2_S	h^2_D	$h^2_{(S+D)}$
ASM (days)		171.47±0.01	182.37	0.07±0.07	0.24±0.11	0.16±0.07
Body wt. (g)	20 wks	1322± 0.15	1100	0.28 ±0.13	0.21 ±0.14	0.25±0.09
	40 wks	1731± 0.21	1586	0.31±0.12	0.36±0.12	0.33±0.08
Egg wt. (g)	24 wks	45.34±0.002	41.25	--	--	--
	28 wks	50.22±0.003	49.86	0.63±0.18	0.26±0.10	0.45±0.12
	32 wks	51.98±0.004	50.61	0.55±0.16	0.26±0.10	0.41±0.11
	36 wks	54.08±0.004	52.86	0.87±0.21	0.20±0.08	0.53±0.13
	40 wks	55.31±0.004	54.23	0.45±0.15	0.38±0.12	0.42±0.11
Egg prodn. (Nos.)	40 wks	75.60±0.01	57.26	0.12 ±0.08	0.24 ±0.11	0.18±0.07
Egg mass (g)	40 wks	4157±0.99	3106	0.13±0.07	0.17±0.10	0.15±0.06

Table 11. Least square means and estimates of heritability of juvenile growth traits of PD-4 birds on pooled sex

Traits		Mean ± S.E.	$h^2_{(Sire)}$
Body wt. (g)	0 day	34.22 ± 0.11	0.38 ± 0.25
	4 wks	197.8 ± 1.08	0.42 **± 0.15**
	8 wks	570.6 ± 0.21	0.45 ± 0.11
Shank length (mm)	8 wks	77.08 ± 0.18	0.40**±0.10**

Table 12. Production traits of PD-4 hens in S-9 generation

Traits		Mean ±S.E.
Age at sexual maturity (d)		164.1±0.91
Survivors' EP (Nos.)	40 wks	74.32±1.37
Hen housed EP (Nos.)	40 wks	73.74±1.40
Hen day EP (Nos.)	40 wks	74.52
Body wt. (g)	40 wks	2071 ± 14.0
Shank length (mm)	40 wks	106.3±0.24
Egg wt. (g)	28 wks	43.98±0.17
	32 wks	45.83±0.21
	36 wks	48.18±0.22
	40 wks	48.84±0.24

Production traits of PD-4 such as age at sexual maturity, survivors', hen housed (HHEP) and hen day egg production (HDEP) up to 40 weeks of age and egg weights at different ages are presented in Table 12. There was increase in ASM by 4.4 days and hence there was slight reduction in egg production compared to previous generation.

Carcass characteristic study carried out in male and female PD-4 birds at 20 weeks of age revealed that legs cut up part was significantly higher in males, while breast cut up part was significantly higher in females. Among internal organs, liver and heart were significantly higher in males, while gizzard and abdominal fat were significantly higher in females (Table 13).

Table 13. Means of growth and carcass characteristics of PD-4 birds at 20 weeks of age

Traits (%)	Male (N=20)	Female (N=20)
Body weight (g)	1797±15.99	1498±10.7
Shank length, mm	126.3±0.34	104.5±0.23
Dressing (%) w/o skin	68.63 ± 0.67	68.73 ± 0.27
Breast	15.37± 0.34^b	16.56± 0.41^a
Neck and Back	17.65± 0.33	18.25± 0.27
Legs	23.17± 0.44^a	21.10 ± 0.20^b
Wing	7.77 ± 0.19	7.40 ± 0.12
Liver	1.70±0.05^a	1.56±0.03 ^{b}
Heart	0.47±0.03^a	0.38±0.01^b
Gizzard	1.77±0.05^b	1.98±0.04^a
Giblets	3.94 ± 0.08	3.91 ± 0.05
Spleen	0.13±0.01	0.14±0.01
Abdominal fat	0.25±0.07 ^{b}	0.53±0.13^a

Evaluation of Aseel population

Aseel chicken was evaluated for growth and production traits up to 72 weeks of age in G-5 generation. The body weight at 20 and 40 weeks was 1279 and 1944 g in females and 1906 and 2540 g in males, respectively. The ASM was 207 days. The body weight at 52, 64 and 72 weeks of was 2049, 2148 and 2235 g in females and 2902, 3340 and 3942 g in males, respectively. The egg production up to 40 and 72 weeks of age was 18.23 and 54.72 eggs, respectively. The egg weight at 40 and 72 weeks was 47.42 and 53.09 g.

The population was regenerated in G-6 generation. A total of 651 chicks were produced in three hatches. The fertility was 68.15% and hatchability was 82.44% (FES) and 56.19% (TES).

Adult Aseel rooster

Characterization of Ghagus breed

Ghagus, an indigenous chicken breed in G-6 generation was evaluated for production traits up to 40 weeks of age and results are presented in Table 14. Average body weight and shank length of male birds recorded at 40 weeks of age were 2883±40.9 g and 127.3±0.67 mm, respectively. Liveability of Ghagus female and male birds during 21-40 weeks of age was 94.93 and 92.94%, respectively.

Results of different egg quality traits studied in Ghagus breed at 40 weeks of age are presented in Table 15. Higher values for albumen index, yolk index and shell thickness were observed and were desirable from egg quality point of view. The yolk to albumen ratio was also on higher side.

Broodiness in Ghagus breed

Ghagus hens were characterized for broody traits such as age at first broody cycle (222.7±2.2 d), duration of first broody cycle (36.33±2.5) and total days of broodiness (38.31±2.43). The incidence of broodiness was studied from 26th week (2.39%) to 40 weeks of age (40.97%) and the highest incidence of broodiness (65.53%) was noticed during 36th week of age.

A pair of Ghagus chicken

Table 14. Production traits in G-6 generation in Ghagus breed

Traits		Mean ± S.E.
ASM (d)		176.1 ± 0.94
Age at 50% production (d)		179.5
Age at peak production (d)		185.8
Survivors' EP (Nos.)	40 wks	33.80 ± 1.20
Hen housed EP (Nos.)	40 wks	33.12 ± 1.21
Hen day EP (Nos.)	40 wks	33.92
Body wt. (g)	40 wks	1662 ± 23.2
Shank length (mm)	40 wks	98.98 ± 0.34
Egg wt. (g)	28 wks	43.77±0.33
	32 wks	45.56±0.33
	40 wks	46.86±0.47

Table 15. Egg quality traits of Ghagus at 40 weeks of age

Traits		Mean ± S.E
Egg wt. (g)	28 wks	43.77±0.33
	32 wks	45.56±0.33
	40 wks	47.43±0.29
Shape index		76.03±0.02
Haugh Unit		77.00±0.73
Albumen index		0.084±0.002
Yolk colour		7.15±0.09
Yolk index		0.44±0.001
Albumen weight (g)		24.34±0.2
Yolk weight (g)		14.76±0.10
Shell weight (g)		4.54±0.037
Shell thickness (mm)		0.35±0.002
Albumen (%)		51.25±0.22
Yolk (%)		31.15±0.15
Shell (%)		9.59±0.05
Yolk to albumen ratio		0.61±0.005

Various other parameters such as total clutch duration, number of clutches, average clutch size, total pause duration, number of pauses and average pause size were also studied and compared among broody and non-broody hens. The polymorphisms of SNP marker and In/Del marker located at 5' regulatory region of dopamine receptor D2 (DRD2) gene, In/Del marker located at -377 to 354bp of prolactin gene, and a SNP marker in intron 2 of vasoactive intestinal peptide receptor 1 were studied and the association of these markers with production and broody traits was studied. Polymorphisms in DRD2 gene seem to be associated with some of the broody traits in Ghagus breed.

A total of 1014 good chicks of Ghagus were hatched in S-1 generation in two hatches with the higher fertility of 91.5% and hatchability of 90.8 and 83.8%, respectively on fertile egg and total egg set. There was improvement in fertility and hatchability (TES) in this generation compared to previous generation. Growth performance evaluation of S-1 generation birds was completed up to 20 weeks of age during the reporting period. Growth traits recorded on pooled sex up to 8 weeks of age are presented in Table 16. There was improvement of 7.1g in 8 weeks body weight compared to previous generation. Higher estimates of heritability of juvenile growth traits of Ghagus on sire+dam component basis were observed in S-1 generation. Body weight of male and female birds at 20 weeks of age was 1900±27.0

Table 16. Juvenile growth traits of Ghagus breed in S-1 generation on pooled sex

Traits		Mean ± S.E.	h^2 (Sire+Dam)
Body wt. (g)	0 day	32.93±0.10	-
	4 wks	144.9±1.20	0.34±0.07
	6 wks	255.9±2.46	0.64±0.11
	8 wks	435.2±4.29	0.57±0.10
Shank length (mm)	8 wks	66.37±0.29	0.56±0.09

and 1346±12.8 g, respectively. Shank length of male and female birds at 20 weeks of age was 127.1±0.75 and 101.4±0.33 mm, respectively.

Maintenance and evaluation of Nicobari breed

Random bred Nicobari population is being maintained at the institute farm as resource population for experimental purposes. G-5 generation was evaluated for production traits up to 40 weeks of age (Table 17). Body weight and shank length of females at 40 weeks of age were 1541±22.0g and 83.37±0.87 mm, respectively while those of male birds were 2240±33.4 g and 102.6±1.37 mm, respectively. There was improvement of 3.54g in egg weight at 40 weeks. Higher liveability was observed in male (96.67%) and female (96.67%) birds of Nicobari during 21-40 weeks of age. Phenotypic characterization of both male and female birds of Nicobari was carried out as per the breed descriptor of NBAGR.

Table 17. Production performance of Nicobari birds

Traits		(Mean± S.E.)
ASM (d)		172.2±1.06
Survivors' EP (Nos.)	40 wks	63.8 ± 2.34
Hen housed EP (Nos.)	40 wks	62.5 ± 2.35
Hen day EP (Nos.)	40 wks	67.12
Body wt. (g)	40 wks	1541±22.0
Shank length (mm)	40 wks	83.37±0.87
Egg wt. (g)	28 wks	41.99±0.41
	32 wks	44.04±0.38
	36 wks	45.89±0.38
	40 wks	47.71±0.39

Table 18. Growth performance of Nicobari birds in G-5 on pooled sex

Traits		Mean ±S.E
Body wt. (g) 0 day		31.34±0.15
	4 wks	101.05±1.68
	8 wks	401.7±6.62
Shank length (mm)	8 wks	60.27±0.51

A total of 440 good chicks of Nicobari were produced in a single hatch in G-6 generation by random mating using pooled semen. The fertility was 82.39%, while hatchability on fertile and total egg set was 92.54 and 76.25%, respectively. Higher hatchability on fertile egg set was observed in G-6 generation. Growth performance of Nicobari breed was evaluated on pooled sex up to 8 weeks of age (Table 18).

There was an improvement in shank length at 8 weeks of age by 7.46 mm as compared to previous generation. Body weight and shank length of female birds at 20 weeks of age were 1115±15.6 g and 85.54±0.77 mm, respectively. Body weight and shank length of male birds at 20 weeks of age were 1584±26.8 g and 104.3±1.19 mm, respectively.

A pair of Nicobari chicken

Kadaknath

Kadaknath population was evaluated up to 40 weeks of age in base generation. The body weight at 4 and 6 weeks of age was 130.59±2.07 and 259.21±3.90 g, respectively. The SL at 6 weeks of age was 56.86 ±0.42 mm. The ASM was 181.58±3.28 days. The egg production up to 40 weeks of age was 65.12±3.26 eggs with an egg weight of 44.15±0.070 g. The population was regenerated randomly. To increase the variability and population size, a total of 720 fertile eggs were procured from Jabalpur centre. The fertility was 91.95% and the hatchability was 72.75% (FES) and 66.89% (TES).

Kadaknath chicken

Table 19. Evaluation of 2-way cross in farm and field at Bhavoji Thanda, Mahabubnagar, Telangana (Third evaluation)

		Farm	Nos.	Field	Nos.
Body wt. (g)	4 wks	213.7±2.62	339		
	6 wks	505.10±5.14	326		
	14 wks	1486±10.42 (F)	90	1231±24.47	140
		1826±22.27(M)	20	1610±33.41	78
	20 wks	1833 ± 14.58	87	1306 ±22.27	131
	40 wks	2392 ±18.92	84	1788± 25.17	118
	52 wks	2384±15.07	80	2031±24.97	114
	64 wks	2489±16.41	80	2103±28.92	110
	72 wks	2695±17.39	79	2194±28.71	108
ASM, d		157.8±2.84	86	200 ±3.2	128
Egg prodn. (Nos.)	40 wks	71.25±1.65	84	44.21±2.12	118
	52 wks	118.57±2.58	80	76.78±3.54	114
	64 wks	153.80±4.12	80	105.64±7.04	110
	72 wks	185.26±4.78	79	140.57±7.58	108
Egg wt. (g)	40 wks	54.54±0.71	84	51.87±1.54	118
	52 wks	55.98±0.77	80	54.15±1.89	114
	64 wks	56.22±0.89	80	54.52±2.34	110
	72 wks	58.42±0.88	79	56.02±2.77	108

Evaluation of 2-way cross

The 2-way cross was evaluated from 53 to 72 weeks of age in farm and field during the reporting period. The annual egg production was 185.26±4.78 in farm and 140.57±7.58 in field conditions, respectively. The 72 week body weight of hens was 2.7 kg in farm and 2.2 kg in field conditions (Table 19).

Economic evaluation of the input and output cost of the birds based on the enquiry and current prices revealed that a farmer can earn an amount of Rs. 5000/- per a unit of 10 birds. A pair of these birds will provide a net profit of Rs. 800-900/- which is an additional income for the family (Table 21).

Advantages of this cross are presence of native Aseel inheritance, attractive plumage colours, higher growth and production, stronger and longer shanks, incidence of broodiness, higher survivability and less predation and higher acceptability by the farmers and consumers.

Table 20. Field evaluation of 2-way cross at Bhavoji Thanda, Mahaboobnagar District, Telangana

Particulars/Traits		Figures
No of birds evaluated		233
No of farmers		21
Body weight	(About 3 months) (kg)	
	Male	1.6
	Female	1.2
Body weight of hens (kg)	20 wks	1.3
ASM (days)		200
Egg production (Nos.)	40 wks	44
Annual egg production (Nos.)	72 wks	141
Mortality (%)		
	Up to 6 weeks (farm)	6.2
	Up to 72 weeks (Field)	20.0

Table 21. Economics of 2-way cross under farmer's backyards per pair of birds

Input			Out-put		
Sex	Age of the bird	Cost (Rs.)*	Particulars/details of the bird	Receipts (Rs.)	Profit (Rs.)
Male	12-15 wks (3 months)	80	1.5-2.0 kg @ Rs. 150/kg	225-300	145-220
Female	72 wks	220	Eggs: 140-150 @ Rs. 5/egg Birds: 2.0kg @ Rs. 100/ kg Total	700-750 200 900-950	680-730
Total profit from a pair of birds		300		1125-1250	825--950

**Includes cost of day old chick (Rs. 20), feed, medicines, healthcare, etc.*

The egg production up to 72 weeks of age of the cross was higher than *Vanaraja* (100 eggs), similar to *Srinidhi* (150 eggs) and less than *Gramapriya* (160 eggs). The body weight of cocks at 3 months of age was about 1.8-2.0 kg in *Vanaraja*; 2.0 kg in Srinindhi and 1.5-1.8 kg in *Gramapriya*. The predominant brown plumage with shining glossy black tail feathers is an added attraction in the cocks. The mortality varied between 12-20%, which was significantly lower than the other varieties under the field conditions. However, the acceptability of new cross is very good among the farmers and survivability is better than all the varieties due to the presence of native Aseel inheritance.

The expected profit from a pair of birds at the current prices taking barest minimum price for meat and eggs is shown in Table 21.

Coloured broiler populations for intensive and semi intensive broiler farming

Synthetic Coloured Broiler Male Line (PB-1)

The production performance of PB-1 line in S-27 generation is presented in Table 22. As compared to last generation, lower adult body weights were recorded. ASM was higher. Egg weights were stable.

S-28 generation of PB-1 line was reproduced with 70 sires and 350 dams. The summary of selection records are presented in Table 23. Incubation and hatching records are presented in Table 24. A total of 4173 good chicks were produced in three hatches. Both fertility and hatchability were improved in the present generation as compared to previous generation. Performance of juvenile traits is presented in Table 25. As compared to last generation, juvenile traits were marginally decreased.

Table 22. Performance of production traits in PB-1 (S-27 generation)

Trait		Mean± S.E (S-26)	Mean±S.E (S-27)
ASM (days)		188±0.04	175±0.10
BW (g)	20 wks	2461±0.67	2432±0.72
	40 wks	3262±0.73	3030±0.89
Egg wt. (g)	32 wks	53.98±0.08	55.50±0.06
	40 wks	61.62±0.04	58.94±0.09
EP (Nos.)	40 wks	56.90±0.09	52.24±0.10

Table 23. Summary of selection records in PB-1 (S-28 Generation)

Particulars	Magnitude
No of sires	70
No of Dams	350
No of Sires Contributed	70
No of Dams Contributed	350
Effective number	233.33
Rate of Inbreeding	0.0021
Average selection differential (5WK BW) (g)	145
Intensity of selection	1.23
Expected response, (g) in 5WK BW	59.20

Table 24. Incubation and hatching performance in PB-1 line (S-28 generation)

S. No.	Fertility (%)	Hatchability (%)		Total No of chicks
		TES	FES	
1	88.68	81.84	92.28	1591
2	88.73	84.07	94.75	1336
3	86.52	80.69	93.26	1246
Total	**88.04**	**82.19**	**93.36**	**4173**

Table 25. Performance of juvenile traits in PB-1 (S-28 generation)

Traits		Mean ± S.E (S-27)	Mean ± S.E (S-28)
Body weight (g)	4 wks	688.7±0.60	595.3±0.71
	5 wks	982.2 ±0.90	841.6±0.85
	6 wks	1171±0.80	1020±0.92
Breast angle (°)	5 wks	76.32±0.08	83.20±0.06
Shank length (mm)	5 wks	84.10±0.09	74.10±0.08
Feed efficiency up to	5 wks	2.22	2.20

A pair of PB-1 chicken

Pedigreed Random bred Broiler Control population

In G-16 generation of the pedigreed random bred broiler control population, ASM, 20 week body weight, 40 week body weight, 32 week egg weight, 40 week egg weight and 40 week egg production respectively were 180 days, 2274 g, 2848 g, 52.68 g, 58.42 g and 56.99 eggs. Production traits were similar to those observed in previous generation. A total of 1892 chicks were reproduced with 50 sires and 250 dams in G-17 generation in two hatches. The fertility recorded was 88.64% and hatchability on total eggs set and fertile eggs set respectively was 79.86 and 90.10%. Both fertility and hatchability were higher as compared to previous generation. Incubation and hatching performance is presented in Table 26. Performance of juvenile traits is presented in Table 27. As compared to last generation, juvenile traits were stable (Fig. 4).

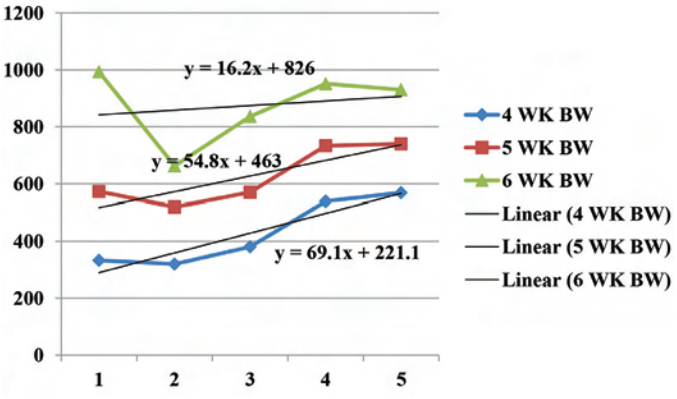


Fig. 4. Trend of Juvenile body weights of control broiler over five generations

Genetic improvement of a synthetic coloured broiler female line (PB-2)

During the period under evaluation, the PB-2 line completed production traits for S-27 generation and juvenile traits for S-28 generation (Table 28). The average ASM has decreased by four days compared to the last generation. The egg weight and egg production at 40 weeks remained stable compared to the last generation. The phenotypic and genetic responses to selection for the 40 week part period egg production over the last twelve generations were 0.63 and 1.12 eggs per generation, respectively (Fig. 5). The layer house mortality up to 62 weeks of age was 8.5%.

The mating plan was prepared and 60 sires and 300 dams were selected for regeneration of S-28 generation. Selection differential for 5th week body weight was 147.2g and egg production up to 40 weeks was 4.99 eggs. A total of 3444 eggs were set, of which 2776 healthy chicks were obtained in three hatches. The fertility and hatchability on TES and FES were 89.5, 82.9 and 92.3%, respectively. The improved fertility and hatchability parameters were maintained during last two generations.

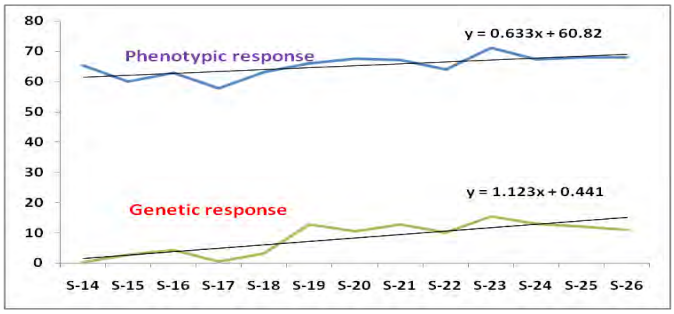


Fig. 5. Phenotypic and genetic response of 40 week egg production in PB-2 line

Table 26. Incubation and hatching performance of Broiler control population (G-17 generation)

S. No.	No.of eggs set	No. of eggs transferred	Fertility (%)	Hatchability (%)		Total No. of chicks
				TES	FES	
1	1102	953	86.48	78.86	91.19	869
2	1267	1147	90.53	80.74	89.19	1023
Total	2369	2100	88.64	79.86	90.10	1892

Table 27. Performance of juvenile traits in Broiler control population (G-17 generation)

Traits		Mean ± S.E (G-16)	Mean ± S.E (G-17)
Body weight (g)	4 wks	539±0.62	569±0.59
	5 wks	734±0.83	740±0.72
	6 wks	951±1.20	930±1.31
Breast angle (°)		68.67±0.05	72.18±0.08
Shank length (mm)		70.68±0.09	71.32±0.06

Table 28. Production parameters in PB-2 (S-27 generation)

Trait		Mean ± S.E
ASM (days)		174.68±0.89
Egg Prodn. (Nos.)	32 wks	31.86± 0.62
	40 wks	65.02± 0.95
Egg wt. (g)	28 wks	51.49±0.25
	32 wks	55.27±0.23
	36 wks	57.07±0.23
	40 wks	59.39±0.26
Body wt. (g)	20 wks	2262±11.79
	40 wks	2934±17.05

The least square means for day old, two and four weeks body weight were 41.68±0.07, 241.22±0.82 and 614.63±2.22 g, respectively. Body weight, shank length and breast angle at five weeks of age were 841.53±3.51 g, 79.66±0.14 mm and 77.22±0.09°, respectively. There is improvement in body weights at 4 and 5 weeks of age compared to previous generation. The overall mortality up to 5 weeks of age was 6.69%, which was lower than last generation.

Breeding value estimation for growth and production traits using animal model

The h^2 of juvenile growth traits was estimated by utilizing data of last five generations using animal models (REML) by WOMBAT. Maternal heritability estimate (m2) for body weight at hatch (BW0) was 0.32. Negligible coefficients of maternal environmental effect (c2) from 0.054 to 0.086 were estimated for all the juvenile traits, other than BW0, which had an estimate of 0.17 (Table 29).

Genetic trend lines were plotted by average of breeding value of body weight at 5 weeks (Fig. 6) and egg production up to 40 weeks of age (Fig. 7) during last five generations and found positive, indicating that the selection was effective in traits under selection.

The genetic gain of 13.6 g and 1.44 eggs per generation was obtained for body weight at 5 weeks and egg production up to 40 weeks.

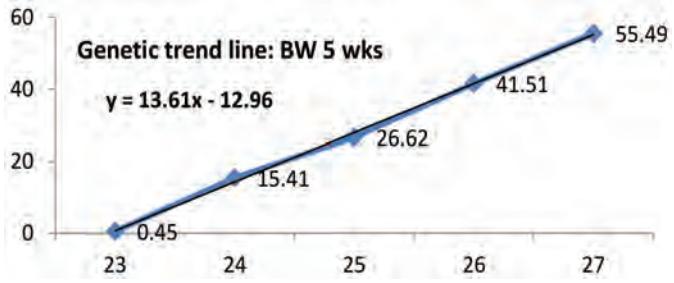


Fig. 6. Trend line of breeding values of body weight at 5 weeks in PB-2 line

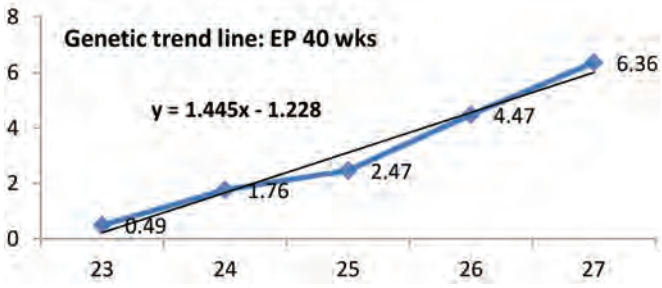


Fig. 7. Trend line of breeding values of egg production up to 40 weeks in PB-2 line

PB-2 growing chicken

Table 29. Heritability estimates in PB-2 line

Trait		h^2 (additive direct)	m^2 (Maternal genetic)	c^2 (Maternal permanent environmental)	h^2_T Total heritability
Body wt. (g)					
Day old		0.062 ±0.03	0.321±0.04	0.172 ±0.03	0.223
	2 wks	0.190 ±0.03	-	0.086 ±0.01	0.190
	4 wks	0.145 ±0.03	-	0.066 ±0.01	0.145
	5 wks	0.143 ±0.02	-	0.054 ±0.01	0.143
Shank length (mm)	5 wks	0.081± 0.02	-	0.056±0.008	0.081

Maintenance of Naked neck (*Na*) and Dwarf (Dw) gene lines

The S-16 generation of each gene line was regenerated using 30 sires and 90 dams in two hatches. Both the lines were regenerated as random bred maintenance population.

In naked neck (Na) line, 637 chicks were produced with 90.3% fertility, 77.9% hatchability on TES and 86.4% hatchability on FES where as in dwarf (Dw) line, 558 chicks were produced with 79.4% fertility, 74.0% hatchability on TES and 93.2% hatchability on FES.

The gene lines were evaluated for their juvenile growth and production traits in S-16 generation (Table 30). The fitness traits improved in both the gene lines compared to the last generation. Egg production was recorded up to 32 weeks of age in both the gene lines (Table 31).

Table 30. Juvenile growth traits of gene lines (S-16)

Trait		Naked Neck	Dwarf
Body wt. (g)	Day old	39.45±0.14	34.32±0.15
	3 wks	283.9±3.53	230.6±3.12
	6 wks	801.6±7.56	640.5±7.67
Shank length (mm)	6 wks	79.23±0.30	70.76±0.34
Breast Angle (°)	6 wks	73.68±0.21	71.26±0.19

Table 31. The production traits of gene lines (S-16)

Trait		Naked Neck	Dwarf
ASM (days)		187.29±1.33	152.62±0.96
Body wt. (g)	20 wks	2238±24.05	2080±21.09
Egg wt. (g)	32 wks	54.79±0.46	48.63±0.41
Egg prodn. (Nos.)	32 wks	28.33±0.98	45.45±1.09

Genetic evaluation of elite layer germplasm

Under layer project, three lines viz; IWH, IWI and IWK are under selection for higher egg numbers, whereas IWD, IWF and Layer Control (LC) are under random breeding programme. During reporting period, egg production up to 54, 64 and 72 weeks of age of previous generation (S-13 of IWK and LC, S-5 of IWH and IWI, G-0 of IWD and IWF) was recorded and analysed. The egg production increased across all lines, except LC which was almost static (Table 32).

Regeneration of six layer lines (S-14 of IWK and LC, S-6 of IWH and IWI, G-1 of IWD and IWF) was completed. The fertility and hatchability % increased considerably across all lines in the current generation as compared to previous generation (Table 33). The selection differential of EP64 in IWH, IWI and IWK were 10.51, 6.67 and 8.14 eggs, respectively.

In the current generation, the body weight on day of hatch (BW1) increased in all six lines except IWF, where marginal decrease was observed. The body weight at 4 weeks increased in all lines as compared to previous generation except IWF and IWD (Table 34).

A pair of White Leghorn birds

Table 32. Least square means of juvenile traits, age at sexual maturity and egg production traits in layer lines

Trait		IWH (S-5)	IWI (S-5)	IWK (S-13)	LC (S-13)	IWD (G-0)	IWF (G-0)
Egg Prodn. (Nos.)	52 wks	195 ±1.27 (215)	195 ±1.11 (246)	177 ±1.21 (246)	168 ±1.53 (100)	171 ±2.87 (156)	181 ±2.44 (133)
	64 wks	255.76 ±1.88 (199)	260.73±1.44 (215)	240±1.94 (193)	221.20±1.99 (120)	230.51± 2.37 (156)	251.50±2.24 (134)
	72 wks	298.48 ±1.88 (157)	298.71±1.44 (164)	276.24±1.94 (182)	256.27± 2.01 (111)	267.32±1.09 (157)	291.49 ±2.17 (134)
Egg wt. (g)	64 wks	54.01±2.12 (148)	53.71±4.71 (108)	55.61±3.50 (144)	57.67±0.31 (410)	52.21±5.57 (82)	53.15±4.48 (85)

Table 33. Incubation records of layer lines

Lines	Fertility (%)	Hatchability (%) (TES)	Hatchability (%) (FES)	Good Chicks (Nos.)
IWH (S-6)	86	79	91	1329
IWI (S-6)	90	81	91	1674
IWK (S-14)	92	88	96	1736
IWD (G-1)	84	79	94	773
IWF (G-1)	82	69	84	480
LC (S-14)	81	68	82	524

Body weights at 16 weeks of age decreased across all lines as compared to previous generation. However, it increased across six lines at 20 weeks of age. The age at sexual maturity (ASM) increased in all six lines as compared to previous generation. The egg production up to 20 weeks of age in all layer lines ranged from 1.42 to 4.79 eggs.

Molecular Genetics

Functional genomics, epigenetics and gene silencing technology for improving productivity in poultry

Two genes, namely stearoyl coenzyme A desaturase (*SCD*) and sterol regulatory element binding protein1(*SREBP1*) involved in de novo lipid biosynthesis were studied in native (Ghagus) and exotic chicken lines (Control broiler and control layer) to explore functional and epigenetic profile and silence the expression of these genes through RNAi under *in vitro* cell culture system.

The expression of *SCD* gene varied significantly from embryonic day 5 to embryonic day 18 during which the highest expression was observed on ED5 and the lower expression was detected in ED10, ED15 and ED18 in Control layer, Control broiler and Ghagus breeds, respectively. During post hatch period, expression of *SCD* gene varied significantly (P>0.05) among the post-hatch periods where the highest expression was observed on Day 14 in Ghagus, on Day 42 in Control layer and Control broiler population.

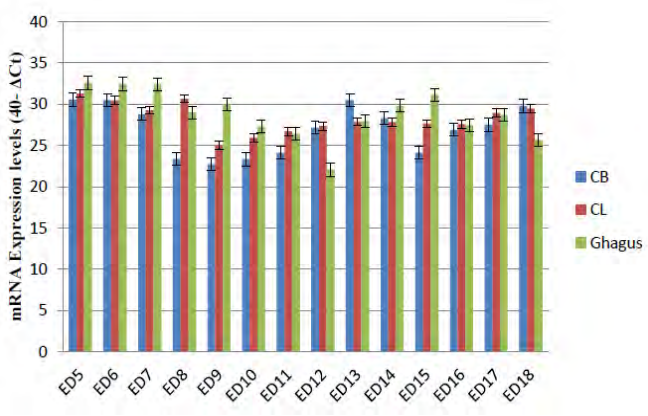


Fig. 8. Expression of SREBP1 gene during embryonic period

Table 34. Least square means of juvenile traits in layer lines

Traits	IWH (S-6)	IWI (S-6)	IWK (S-14)	LC (S-14)	IWD (G-1)	IWF (G-1)
Body wt. (g) 1 wk	34.7±3.66 (980)	34.9±3.28 (1344)	37.1±3.40 (1288)	35.4±7.72 (703)	33.9±3.37 (474)	34.8±3.18 (471)
4 wks	153.9±34.25 (1259)	168.6±35.08 (553)	152.1±39.37 (1014)	132.5±37.62 (712)	119.0±29.82 (460)	128.2±36.58 (335)
16 wks	930.8±3.66 (358)	861.5±3.28 (373)	923.7±3.40 (434)	885.1±7.72 (215)	893.3±3.37 (123)	922.4±3.18 (161)
20 wks	1251±34.25 (314)	1154±35.08 (368)	1132±39.37 (432)	1147±37.62 (210)	1166±29.82 (121)	1185±36.58 (159)
ASM (Days)	144.6±0.59 (305)	148.9±0.42 (530)	154.9±0.44 (491)	154.9±0.44 (260)	151.1±0.92 (115)	147.2±0.83 (149)
Egg Prodn. (Nos.) 20 wks	3.77±0.28 (93)	3.65± 0.29 (115)	2.24± 0.15 (65)	1.42± 0.29 (14)	3.65±0.28 (93)	4.79± 0.34 (82)

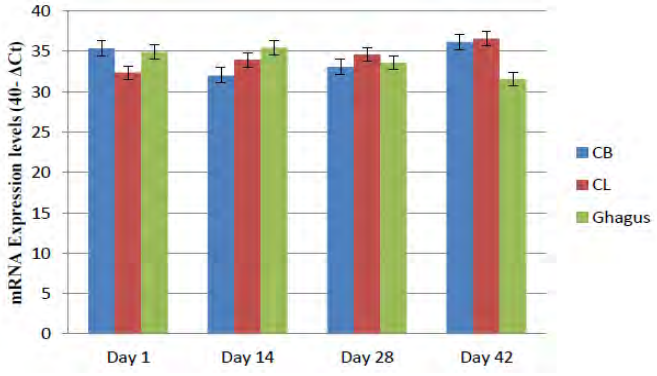


Fig. 9. Expression of SREBP1 gene during post-hatch juvenile period

A significant (P>0.05) difference in *SREBP1* gene expression was observed among different embryonic days in all three populations. The highest expression of *SREBP1* gene was found on ED5 in all the three populations (Fig. 8). The lowest expression was found on ED12 in Ghagus, ED9 in Control layer and Control broiler population. During post-hatch period, the highest expression of *SREBP1* gene was found on Day 42 in Control layer and Control broiler population and on Day 14 in Ghagus breed of chicken (Fig. 9). The lowest expression was observed on Day 42 in Ghagus, Day 1 in Control layer and Day 14 in Control broiler lines.

A smaller fragment of 505bp of *SCD* and 869bp of *SREBP1* 5'-upstream region had the potential to act as promoters to control the transcription of eukaryotic gene under *in vitro* cell culture system. Promoters of *SCD* and *SREBP1* gene were polymorphic and were found to be associated with body weight, serum cholesterol and triglycerides content in chicken.

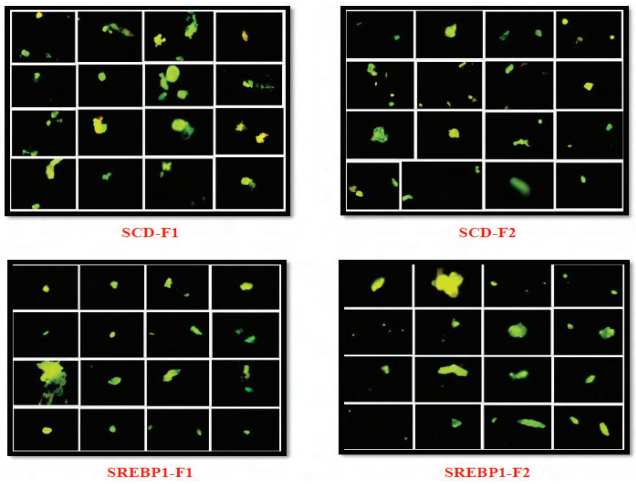


Fig. 10. GFP expression under the control of promoters of different length in SCD and SREBP1 genes

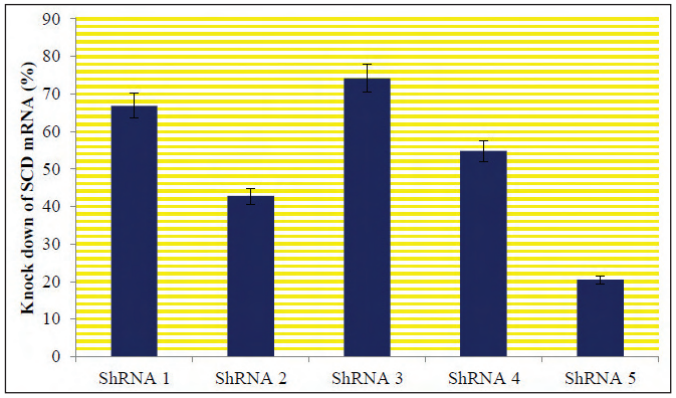


Fig. 11. Knock down efficiency (%) of anti-SCD shRNA constructs

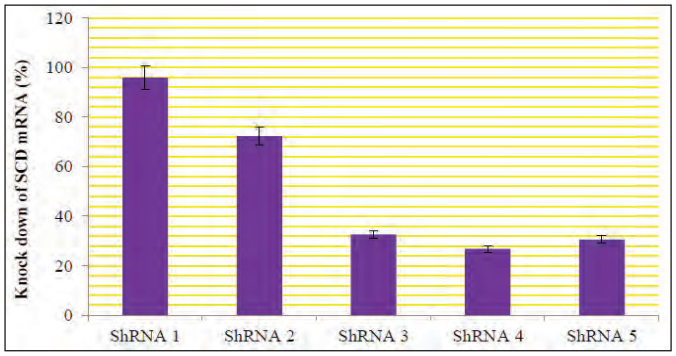


Fig. 12. Knock down efficiency (%) of anti-SREBP1 shRNA constructs

The shRNA molecules silenced the expression of *SCD* and *SREBP1* gene under *in vitro* cell culture system. Out of 5 shRNA molecules each for *SCD* and *SREBP1*, shRNA1 and shRNA3 of *SCD*, and shRNA1 and shRNA2 of *SREBP1* genes had more than 60% knock down efficiency for expression of two genes under *in vitro* system. These shRNA molecules showed potential to silence the expression of *SCD* and *SREBP1* genes without affecting immune response genes significantly under *in vitro* system. These molecules may be used for development of knock down chicken to produce low fat/cholesterol meat or egg.

Development of transgenic chicken for production of human interferon alpha 2b

The optimal promoter of ovalbumin gene has been identified for its use to express gene in chicken oviductal/magnum cells so that ultimately the gene is expressed in the chicken egg. Accordingly, 1034 bp optimal promoter of ovalbumin was identified and its functionality under *in vitro* cell culture system was examined. GFP coding frame was cloned under the regulation of ovalbumin promoter and observed the functionality of the 1034

bp promoter. Then, the cloned 1034 bp ovalbumin promoter with Poly A tail of chicken ovalbumin gene where multiple cloning site has been inserted. Again functionality of the construct was evaluated and found its efficient function for expressing GFP gene in magnum primary cell culture.

Characterization of chicken ovalbumin and growth hormone receptor genes for development of transgenic cassette

The coding sequence of the ovalbumin gene have been characterized, its expression profile was explored and polymorphism was identified in the 5'-upstream regions of the gene in IWI and IWK White Leghorn lines of chicken. Characterization of ovalbumin CDS from IWI and IWK lines revealed that the CDS were of 1161bp encoding a peptide of 386 aminoacids. In comparison with the reference sequence of Red Jungle Fowl, deletion of first 75bp sequence was observed in both the lines in which a G>A transition at 562nd position in IWI line resulted in change of amino acid, alanine to threonine at 188th position in the protein sequence. The phylogenetic analysis revealed that the ovalbumin coding sequence from IWI and IWK lines had higher percent identity with other avian species (Fig. 13).

Molecular weight of ovalbumin protein from IWI and IWK lines were 42.91 kDa and 42.88 kDa, respectively and had a ligand binding site for L-thyroxine, progesterone and HCY. Western blot analysis revealed protein expression in magnum cell culture. In both the lines, an increase in expression of the gene was observed after onset of egg production with peak expression during 40th week of age and then, declined afterwards during egg laying cycle. Ovalbumin gene in ovary and infundibulum tissues of both the lines was not expressed. The 5-upstream region of the gene showed presence of SNPs depicting in the form of three haplotypes namely H1, H2 and H3. In the haplotype H1, a G>A transition was found at 119 position (119G>A). Likewise, in the H2 haplotype, a T>C transition at 160th position (160T>C) and in the H3 haplotype, a T>C at 216 position (216T>C) were observed. The identified polymorphisms

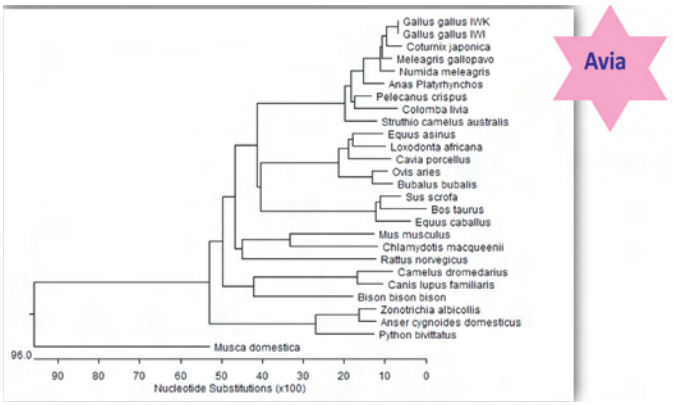


Fig. 13. Phylogenetic tree constructed from ovalbumin gene sequence of different species

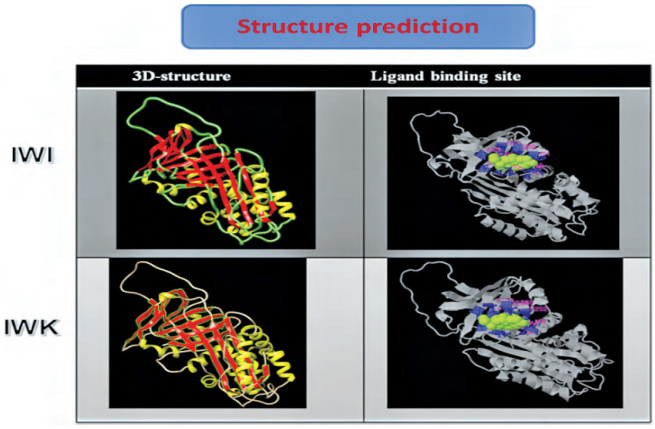


Fig. 14. 3D structure of ovalbumin protein of IWI and IWK White Leghorn lines

were associated with the egg weight and age at sexual maturity in IWI line. It is concluded that chicken ovalbumin open reading frame has been characterized, and polymorphism at the ovalbumin promoter and its association with egg quality trait has been explored.

Genotyping MHC class I loading complex genes (TAP1, TAP2 and Tapasin) for their association with immunocompetence traits in chicken

Peptide assembly with class I molecules is coordinated by several molecular chaperones including tapasin, which help in binding MHC class I molecules with the TAP and which is very crucial for efficient Ag presentation. PCR conditions were standardized for different exons of the Tapasin gene. The annealing temperature for exon 3, 4, 5 and 6-7-8 were 46°C, 63°C, 60°C and 61°C, respectively. Single-strand conformation polymorphism (SSCP) for Ghagus, Dahlem Red and Brown Nicobari breeds were carried out. SSCP results revealed that these exons of Tapasin gene were polymorphic

and a total of 8 different haplotypes were observed in all the three breeds. A total of 17 haplogroups were observed and the cumulative frequency of haplogroups h1h5 was found to be highest (0.386). For TAP2 gene coding region exon 1 to 9 were PCR optimized and SSCP was carried out for all the three breeds. Haplotype h3 frequency was observed to be highest (0.348) followed by h1 (0.332). A total of 15 haplogroups were observed and the cumulative frequency of haplogroup h3h3 was found to be highest (0.175).

In Tapasin gene, in Dahlem Red breed out of a total 13 haplogroups, seven haplogroups *viz.* h1h2, h1h4, h1h5, h1h6, h2h4, h2h5 and h3h5 (which were having ≥ 5 birds) were used for association studies and found significantly different with body weight at 2 weeks and 6 to 13 weeks of age. Other parameters *viz.* CBH response, HI titre and haematological parameters showed only numerical differences. In Ghagus breed, out of 11 haplogroups, four haplogroups viz. h1h2, h1h4, h1h5 and h1h6 (which were having ≥ 5 birds) were used for association studies and h1h2 haplogroup was found to be significantly different with haplogroups h1h5 and h1h6 in HI titre whereas, haplogroup h1h2 was found to be significantly different ($P < 0.05$) with haplogroups h1h4 and h1h5 with lymphocytes at 11th week of age. Other parameters *viz.* CBH response, HI titre, haematological and body weight parameters showed only numerical differences. In Nicobari breed, out of 11 haplogroups, four haplogroups viz. h1h2, h1h5, h1h6 and h1h7 (which were having ≥ 5 birds) were used for association studies. Haplogroup h1h5 differed significantly with haplogroups h1h6 and h1h7 in body weight at 1 to 3 and 7 to 9 weeks of age. Same trend was observed in HI titre. Other parameters *viz.* CBH response and haematological parameters showed only numerical difference.

Nutrition

Management and nutritional strategies to ameliorate thermal stress in poultry production (NICRA)

In a way to find out various dietary means to ameliorate the adverse effects of heat stress on chickens, seven experiments were conducted during the period of report. One experiment on WL layers and three experiments each on broilers, and rural chicken varieties (*Vanaraja* / *Gramapriya*) were conducted in open sided poultry house.

Safflower protein hydrolysate (SPH) and safflower protein concentrate (SPC) in *Vanaraja* chick diet

An experiment was conducted with *Vanaraja* chicken (1 to 42d of age) to study the effects of supplementing safflower protein hydrolysate (SPH, 0.05 and 0.10%) and safflower protein concentrate (SPC, 0.1 and 0.2%) on performance and anti-oxidant variables. A practical diet containing 2800 kcal/kg and 20% protein with all other essential nutrients was prepared without supplementing the additives which served as the control. Each diet was offered to 15 replicates of 5 birds in each, which were housed in battery brooders. The mean maximum and minimum temperature and humidity were 29.8 & 18.5 ^{o}C; 65.1 & 56.2%, respectively during the experimental period. BWG of *Vanaraja* was significantly ($P<0.05$) higher at SPC 0.2% compared to the control group, while the growth in other groups was intermediate (Table 35).

The FCR and immune responses were not affected. Both SPH and SPC at higher concentrations (0.1 and 0.20%, respectively) significantly reduced lipid peroxidation and the SPC at 0.20% significantly improved the activity of superoxide dismutase (Fig. 15).

Table 35. Performance and immune responses in *Vanaraja* chicken (1 to 42d of age) fed safflower protein hydrolysate (SPH) and safflower protein concentrate (SPC)

Treatment	BWG (g)	FCR	HI, log2	CMI Response (%)
Control	651.7^{b}	2.22	7.07	82.0
SPH-0.05%	680.4^{ab}	2.24	7.33	95.4
SPH-0.1%	640.8^{b}	2.25	7.20	88.2
SPC-0.1%	674.3^{ab}	2.26	6.93	92.3
SPC-0.2%	699.9^{a}	2.23	6.93	86.5
P	0.001	0.569	0.515	0.491
N	15	15	15	15
SEM	3.547	0.2455	0.085	2.48

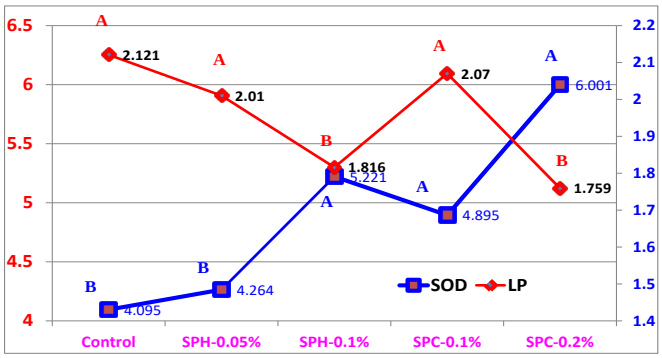


Fig. 15. Effect of supplementing safflower protein hydrolysate and safflower protein concentrate on activity of SOD and lipid peroxidation in *Vanaraja* chicken (1 to 42d of age)

Digestible lysine in diet of broiler starter chickens during summer season

Reduced protein level in diet was known to reduce the heat increment and improve the performance of chicken during summer season. However, optimum levels of critical amino acid like lysine are essential to sustain the performance of commercial broilers even during summer season. Therefore, an experiment was conducted with commercial broiler chicken to study the effect of supplementing graded concentrations of digestible lysine (dLys). Maize-soybean meal based diet was formulated with four graded concentrations of dLys (1.02, 1.13, 1.23 and 1.33%) and each diet was fed to 20 replicates of 25 birds each, which were reared on litter floor pens in open sided poultry house. The trial was conducted during April and May months, where the mean maximum and minimum temperatures and humidity were 36.9 & 28.1 °C; 46.9 & 20.1%, respectively during the 6 weeks experimental period.

BWG and feed efficiency improved progressively with increase in dLys concentrations from 1.03 to 1.23% and these performance variables were not improved with further increase in concentrations of the amino acid in diet (Table 36). Similarly, the FI improved with increase in dLys concentration from 1.03 to 1.13% and the FI was not improved at higher concentrations of dLys in diet. Activity of antioxidant enzymes and lipid peroxidation were not affected (P>0.05) by the variation in concentrations of dLys in diet.

Vegetable oil in diet of WL layers fed graded concentrations of energy during summer season

Considering the possible benefits of oil supplementation on chickens during summer, an experiment was conducted with WL layers fed graded concentrations of ME with and without oil (1%) supplementation.

Table 36. Effect of graded concentrations of digestible lysine (dLys) on performance of commercial broilers reared during summer season

dLys (%)	BWG (g)	FI (g/b/d)	FI/BWG
1.03	810.2^{C}	1134^{B}	1.40^{A}
1.13	846.9^{B}	1164^{A}	1.38^{B}
1.23	890.4^{A}	1180^{A}	1.33^{C}
1.33	893.2^{A}	1185^{A}	1.33^{C}
P	*0.0001*	*0.003*	*0.0001*
N	*20*	*20*	*20*
SEM	*3.25*	*5.69*	*0.0125*

^{abc}means having different superscripts in a column differ significantly (P<0.05)
BWG body weight gain; FI feed intake

Three diets with graded levels of ME (2450, 2550 and 2650 kcal/kg) were prepared utilizing practical feed ingredients. Another set of 3 diets containing 1% supplemental vegetable oil with same energy was prepared. All other essential nutrients were kept constant in proportion to the dietary ME content in all the 6 test diets. Each diet was fed *ad libitum* to 10 replicates of 88 birds in each from 22 to 37 weeks of age. Egg production data indicated significant drop in the group fed the lowest ME in diet (2450 kcal/kg) compared to those fed higher levels of energy. The EP in groups fed 2550 and 2650 kcal/kg was similar. Inclusion of vegetable oil in layer diets, particularly at the lowest ME level significantly improved EP compared to those fed higher levels of ME (2550 and 2650 kcal/kg diet). Results thus indicated that supplementation (1%) of oil could able to reduce dietary requirement of ME (100 kcal/kg diet) in WL layers fed *isocaloric* and *isonitrogenous* diets during summer season without affecting egg production (Fig. 16) and egg weight. Reduction in lipid peroxidation and increase in activity of SOD, and glutathione peroxidise were observed in oil supplemented groups compared to those fed the control group.

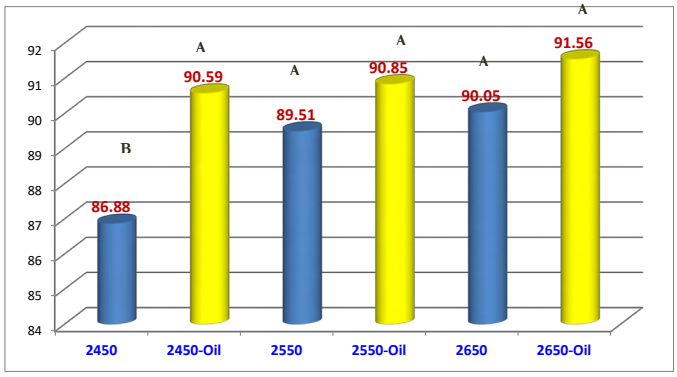


Fig. 16. Effect of supplementation of vegetable oil on egg production (%) in WL layers fed graded concentrations of energy during summer season

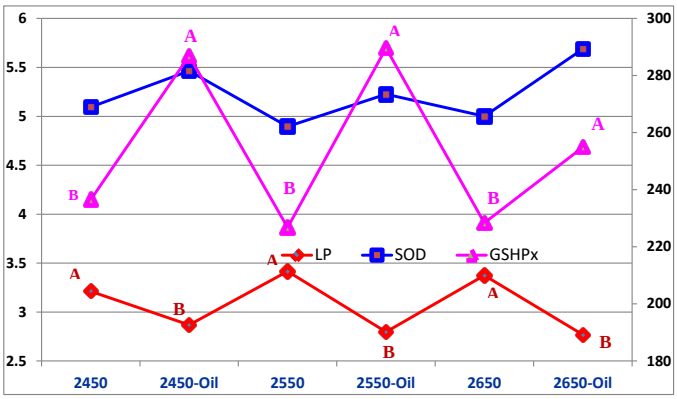


Fig. 17. Effect of supplementation of vegetable oil on anti-oxidant variables in serum of WL layers fed graded concentrations of energy during summer season

Significant reduction in lipid peroxidation was observed with supplementation of oil in layer diet (Fig. 17). The activity of anti-oxidant enzyme i.e. glutathione peroxidise (GSHPx) increased with oil supplementation compared to those fed the same energy diet without oil, except those fed the maximum ME (2650 kcal/kg). However, the activity of superoxide dismutase was not affected due to the treatments employed in the current study.

Chebula (Terminalia chebula) extract and grape *(Vitis vinifera)* seed extract in commercial broilers

Two experiments were conducted on commercial male broilers (Cobb 400) to study the effects of supplementing extracts of *Chebula* (*Terminalia chebula*) fruit (CFE) and grape (*Vitis vinifera*) seed (GSE) at graded concentrations on performance and anti-oxidant variables. Corn-soybean meal basal diet for prestarter, starter and finisher phases having the recommended concentrations of nutrients was prepared, which served as control. Both extracts were analyzed for total phenolic content (TPC) and DPPH scavenging activity which were 327 GAE/g and 62.5% in CFE and 507 GAE/g and 64.4%, respectively in GSE. The basal diet was supplemented with graded concentration of CFE (0, 70, 100, 130 and 160 GAE/kg, Experiment 4) and GSE (0, 70, 100, 130, 160 & 190 GAE/kg, Experiment 5). In both experiments, each diet was offered *ad libitum* from day 1 to 42 d of age to 10 replicates of 5 broilers housed in battery brooders.

Chebula fruit extract

BWG and FI were not affected (P≤0.05) by supplementation of CFE at graded concentrations in broiler chicken diet during summer season (Table 37). However, the FCR at day 21 in group fed 160 GAE of CFE was significantly lower compared to those fed the control diet. The FCR at lower than 160 GAE was intermediate between the control and 160 GAE fed group. The FCR at 42 d of age was not influenced by inclusion of CFE up to 130 GAE/kg diet and at the maximum inclusion level (160 GAE/kg), the FCR was significantly less compared to the control diet.

The lipid peroxidation (LP) in serum was significantly (P≤0.05) influenced by the concentration of CFE in broiler diet (Fig. 18). The LP reduced progressively with concentration of CFE in diet. At 100 GAE/kg, the LP was significantly reduced compared to the control group. At 160 GAE, the LP was significantly lower than those fed less than or equal to 100 GAE/kg diet. The anti-oxidant data suggest that CFE is effective in reducing the magnitude of stress in dose dependant manner.

Table 37. Effect of supplementing *Chebula* fruit extract (CFE) on performance of broilers reared during summer season

CFE, GAE/kg	Day 21			Day 42		
	BWG (g)	FI (g)	FCR	BWG (g)	FI (g)	FCR
0	652.6	857.1	1.31^{A}	1729	2966	1.719^{A}
70	665.3	850.2	1.28^{AB}	1710	2954	1.727^{A}
100	652.5	841.1	1.29^{AB}	1780	3044	1.709^{A}
130	648.7	835.5	1.29^{AB}	1779	3009	1.692^{AB}
160	671.7	856.0	1.28^{B}	1817	3009	1.658^{B}
P	*0.679*	*0.632*	*0.17*	*0.341*	*0.638*	*0.051*
N	*10*	*10*	*10*	*10*	*10*	*10*
SEM	*4.47*	*4.41*	*0.005*	*19.22*	*31.64*	*0.007*

BWG body weight gain; FI feed intake; FCR feed conversion ratio

^{AB} means having different superscripts in a column differ significantly (P≤0.05)

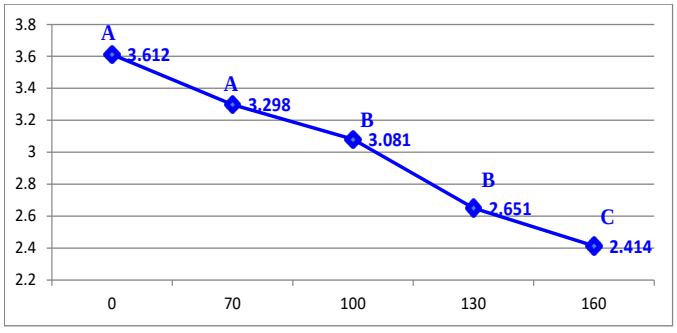


Fig. 18. Effect of *Chebula* fruit extract on serum lipid peroxidation in commercial broilers

Grape seed extract

Body weight gain, FI and FCR at 21 and 42d of age were not affected (P<0.05) with supplementation of GSE in broiler diet (Table 38).

Supplementation of GSE at graded concentrations significantly (P≤0.05) influenced the lipid peroxidation (LP) in serum (Fig. 19). The lipid peroxidation decreased progressively with increase in concentration of GSE in broiler diet.

Dietary electrolyte balance in *Vanaraja* chicken

Requirement of dietary electrolyte balance (DEB) changes during heat stress due to excretion of Na, K and Cl. Therefore, an experiment was conducted with *Vanaraja* chicks (8 to 42d of age) to study the influence of dietary variation in DEB. A practical basal diet was prepared with the required nutrient concentrations. Three concentrations of DEB (212, 233 and 255 meq/kg) were prepared by altering the levels of $NaHCO_3$, NaCl and KCl in the basal diet. Each diet was fed *ad libitum* to 10 replicate groups containing 5 *Vanaraja* chicks from day 8 to 42d of age.

Table 38. Effect of supplementing grape seed extract on performance of broilers reared during summer season

GSE, GAE/kg	Day 21			Day 42		
	BWG (g)	FI (g)	FCR	BWG (g)	FI (g)	FCR
0	766.1	992	1.30	2094	3316	1.583
70	784.8	992	1.26	2097	3304	1.576
100	788.1	1002	1.27	2084	3323	1.595
130	783.7	995	1.27	2319	3653	1.576
160	803.9	1024	1.27	2228	3535	1.586
170	808.5	1018	1.26	2486	3852	1.549
P	*0.321*	*0.327*	*0.32*	*0.796*	*0.839*	*0.306*
N	*10*	*10*	*10*	*10*	*10*	*10*
SEM	*5.75*	*5.30*	*0.005*	*132.3*	*197.2*	*0.006*

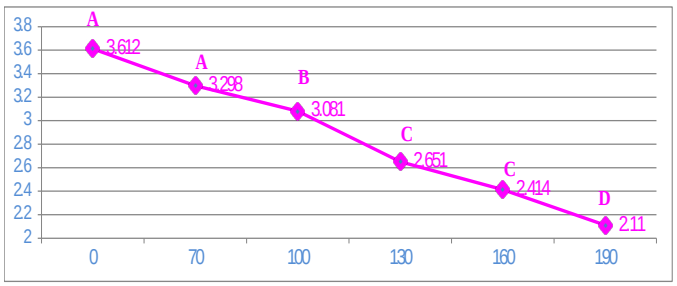


Fig. 19. Effect of grape seed extract on serum lipid peroxidation in commercial broilers

Table 39. Effect of variation in dietary electrolyte balance on performance of *Vanaraja* chicken

DEB, meq/kg	21 d			42 d		
	BWT (g)	FI (g/b)	FCR	BWT (g)	FI (g/b)	FCR
212	146.7[b]	304.9	2.11[a]	649.0	1445	2.24
233	142.3[b]	292.3	2.06[a]	645.5	1428	2.22
255	167.3[a]	313.0	1.88[b]	631.2	1455	2.32
SEM	*4.129*	*5.409*	*0.037*	*12.05*	*16.303*	*0.029*
N	*10*	*10*	*10*	*10*	*10*	*10*
P-Value	*0.024*	*0.299*	*0.025*	*0.826*	*0.801*	*0.315*

The performance data suggested significant influence of DEB on BWG and FCR at 21d of age, while such influence was not observed at day 42 (Table 39). At day 21, the body weight gain improved and FCR reduced in groups fed 255 meq/kg DEB compared to those fed 212 and 233 meq/kg DEB.

OxyCure supplementation in the diet of Rajasri birds

An on-farm feeding trial was conducted in Moola Pocharam and Rangapuram villages of Wyra Mandal, Khammam dist, Telangana with the help of KVK, Wyra. This trail was conducted to study the effect of supplementing OxyCure in diet on body weight gain of Rajasri birds in rural backyards. Layer basal diet containing all the nutrients was supplemented with OxyCure @ 500g/Ton of feed and the same diet without the product served as the control. Each diet was fed at the rate of 25g/b/d in the evening for a period of 8 weeks during January to March 2019. Each diet was provided to 5 farmers in each village and was fed to 20 Rajasri birds / farmer, which served as a replicate. Body weight was recorded at the beginning and the end of 8 weeks feeding period to calculate the body weight gain during the period. The results indicate that BWG was significantly higher in OxyCure group (538g/g) compared to those fed the Control diet (467g/b) (Fig. 20). Growth variation was considerably higher in the control (SD 199g/b) compared to the OxyCure (112.4g/b) fed birds.

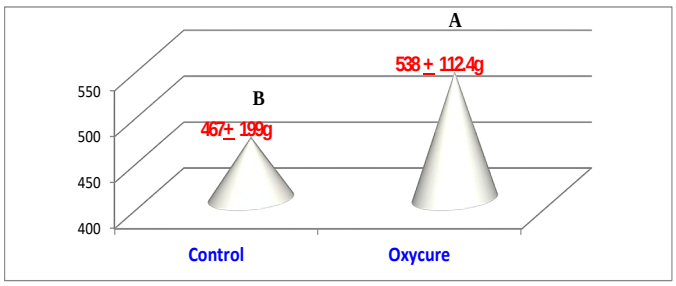


Fig. 20. Body weight gain of Rajasri birds fed OxyCure under free range backyard condition

Utilization of distillery by-products in poultry diet: the nutritional implications and strategies for improving the nutritional value

Evaluation of rice DDGS along with mycotoxin binder in *Vanaraja* chick diet

The feeding value of rice DDGS along with mycotoxin binder was evaluated in *Vanaraja* chick diet. Rice DDGS was included in diet at 0 (control) and 15% levels on *isocaloric* and *isonitrogenous* basis. The control diet was supplemented with 0 and 0.1% level of mycotoxin binder, while the DDGS diet was tested with 4 levels (0, 0.1, 0.2 and 0.3%) of mycotoxin binder. A total of 360 day-old *Vanaraja* chicks were divided into 60 replicate groups of 6 chicks each and housed in battery brooder cages. Chicks in 10 replicate groups were fed one of the six diets from 0 to 42 days of age. Body weight and FCR were significantly poor in the DDGS fed groups at 3 weeks of age (Table 40). However, no such effect was observed at 6 weeks of age. Abdominal fat was higher in the groups fed DDGS. Other slaughter variables and serum biochemical profile were not affected. Mycotoxin binder supplementation showed no effect.

Rice DDGS with phytase supplementation in *Vanaraja* chick diet

A feeding trial was conducted to evaluate DDGS at 0 and 12% level along with phytase supplementation (0, 500 and 2000 FTU/kg). A total of 360 day-old *Vanaraja* chicks were divided into 60 equal replicate groups and each of the 6 test diets was fed to 10 replicate groups till 5 weeks of age. Body weight was not affected by feeding DDGS at 12% level in diet (Table 41). Phytase supplementation at high dosage (2000 FTU/kg) significantly improved the body weight in control group, while in the DDGS groups, the improvement was marginal. Feed efficiency during early phase was significantly improved with phytase (high dose). Bursa weight was in general higher in the DDGS groups. Other parameters were not affected.

Table 40. Effect of DDGS with supplementation of mycotoxin binder on *Vanaraja* chicks

DDGS, % in diet	Mycotoxin Binder (%)	Body wt. (g)		FCR		Abd. fat (%)	DM dig. (%)
		Wk-3	Wk-6	WK-3	Wk-6		
-	0.0	332.2^{a}	757.6	1.84^{c}	2.26	0.97^{c}	61.2^{b}
-	0.1	332.0^{a}	743.1	1.80^{d}	2.25	1.16^{bc}	64.6^{ab}
15.0	0.0	315.8^{b}	753.4	1.93^{ab}	2.32	1.48^{abc}	66.4^{ab}
15.0	0.1	310.5^{b}	739.2	1.95^{a}	2.33	1.51^{abc}	73.1^{a}
15.0	0.2	308.2^{b}	738.5	1.95^{a}	2.37	1.78^{a}	72.1^{a}
15.0	0.3	329.3^{a}	751.0	1.91^{b}	2.36	1.57^{ab}	72.3^{a}
	N	*10*	*10*	*10*	*10*	*12*	*3*
	P	*0.000*	*0.929*	*0.000*	*0.381*	*0.036*	*0.041*
	SEM	*2.271*	*6.082*	*0.009*	*0.021*	*0.079*	*1.435*

Table 41. Effect of DDGS with supplementation of phytase on *Vanaraja* chicks

DDGS, 12% in diet	Phytase (FTU/kg)	Body wt. (g)		Feed intake (g)		FCR		Bursa (%)
		Wk-3	Wk-5	Wk-3	Wk-5	Wk-3	Wk-5	
-	-	274.9^{b}	579.2^{bc}	376.2	1094.7	1.55^{ab}	2.00^{ab}	0.29^{c}
-	500	278.7^{b}	602.9^{ab}	382.7	1097.5	1.58^{a}	1.93^{b}	0.31^{c}
-	2000	307.3^{a}	622.4^{a}	405.0	1181.3	1.48^{b}	2.01^{ab}	0.35^{bc}
+	-	286.5^{b}	583.3^{bc}	405.8	1108.2	1.61^{a}	2.02^{ab}	0.45^{ab}
+	500	276.7^{b}	567.1^{c}	397.3	1113.3	1.64^{a}	2.09^{a}	0.46^{a}
+	2000	288.8^{ab}	596.5^{abc}	406.3	1154.5	1.60^{a}	2.06^{a}	0.38^{abc}
	N	*10*	*10*	*10*	*10*	*10*	*10*	*10*
	P	*0.014*	*0.004*	*0.189*	*0.058*	*0.011*	*0.044*	*0.002*
	SEM	*3.002*	*4.515*	*4.374*	*9.948*	*0.014*	*0.015*	*0.015*

Table 42. Effect of DDGS with supplementation of NSP and glycoside degrading enzymes on *Vanaraja* chicks

DDGS*, 15% in diet	Enzyme	Body wt. (g)			FCR		Abd.fat (%)
		Wk-1	Wk-3	Wk-6	Wk-3	Wk-6	
-	-	110.1^{a}	328.7	760.3	1.83^{b}	2.36^{c}	1.39^{bc}
-	AGS**	110.0^{a}	339.2	747.8	1.79^{b}	2.38^{bc}	1.04^{c}
-	XYL#	110.2^{a}	325.7	755.9	1.84^{b}	2.33^{c}	1.44^{abc}
+	-	103.2^{b}	324.7	732.4	1.92^{a}	2.50^{a}	2.08^{a}
+	AGS**	104.2^{b}	322.7	726.4	1.93^{a}	2.46^{ab}	2.00^{ab}
+	XYL#	103.1^{b}	319.2	735.8	1.97^{a}	2.48^{a}	2.02^{ab}
N		*10*	*10*	*10*	*10*	*10*	*10*
P		*0.001*	*0.354*	*0.608*	*0.001*	*0.001*	*0.004*
SEM		*0.787*	*2.659*	*6.459*	*0.013*	*.013879*	*0.099*

***alpha galactosidase (250g/ton) (2 Units/kg); # Xylanase (100g/ton) (16000 BXU/kg)*

Rice DDGS with NSP and glycoside degrading enzymes in *Vanaraja* diet

A feeding experiment was conducted to evaluate the efficacy of NSP and glycoside degrading enzymes in improving nutritive value of DDGS (15% in diet). A total of 360 day-old *Vanaraja* chicks were divided into 6 experimental groups with 10 replicates of 6 chicks each. Alpha galactosidase (2 units/kg) and xylanase (16000 BXU/kg) enzymes were supplemented to the control and rice-DDGS groups and evaluated against the respective non-supplemented groups. DDGS significantly depressed body weight during initial 2 weeks of age and showed no effect thereafter (Table 42). FCR was significantly poor in the groups fed DDGS and enzymes showed no effect. Abdominal fat was higher in the groups fed DDGS. Other variables were not affected.

Rice DDGS with critical amino acid supplementation in *Srinidhi* diet

A feeding experiment was conducted to evaluate the effect of supplementation of critical amino acids on *Srinidhi* chicks fed rice DDGS. A total of 360 day-old *Srinidhi* chicks were divided into 6 experimental groups with 10 replicates of 6 chicks each. Rice DDGS was included in diet at 15% on *isocaloric* and *isonitrogenous* basis and was evaluated with normal (100%) levels of lysine and total sulphur containing amino acids (TSA) or higher levels (110 and 120% of that of normal levels). DDGS significantly depressed body weight and TSA at 110% level significantly improved body weight, which was on par with that of control group. The response in lysine supplemented groups was intermediate. Feed intake was not affected, while FCR was poor in all the groups fed DDGS, among which it was the lowest in the group fed 120% TSA (Table 43).

Development of a composite feed additive using promising organic acids and plant bioactive compounds for improving gut health and productivity in chicken

The effect of dosing 11 essential oils and 6 organic acids were evaluated on growth of *E. coli* and *L. plantarum* in pure cultures at 0, 3, 5 and 24 h. OD and or pH changes were used as indicator of growth inhibition. After individual screening of

Table 43. Effect of lysine and total sulphur containing amino acids levels in diet on *Srinidhi* chicks fed rice DDGS

DDGS, 15% in diet	AA (%)	Body wt. (g)		Feed intake (g)		FCR	
		Wk-3	Wk-6	Wk-3	Wk-6	Wk-3	Wk-6
-	Control	274.1^{a}	710.0^{a}	422.3	1467.8	1.54^{c}	2.07^{b}
+	Normal AA	247.4^{b}	643.2^{b}	401.7	1415.8	1.62^{b}	2.22^{a}
+	110 Lysine	242.4^{b}	686.1^{ab}	402.9	1449.5	1.66^{b}	2.11^{ab}
+	120 Lysine	242.2^{b}	679.3^{ab}	419.5	1438.4	1.73^{a}	2.12^{ab}
+	110 TSA	269.7^{a}	702.8^{a}	433.7	1484.0	1.61^{bc}	2.11^{ab}
+	120 TSA	260.0^{ab}	700.7^{a}	423.9	1459.9	1.63^{b}	2.09^{b}
	N	*10*	*10*	*10*	*10*	*10*	*10*
	P	*0.000*	*.035*	*0.192*	*0.514*	*0.000*	*0.083*
	SEM	*2.845*	*6.539*	*4.231*	*10.420*	*0.012*	*0.016*

Table 44. Chemical composition of crop content of grower and adult backyard chickens reared in different regions and seasons in India

Parameters		Grower				Adult			
		CP (%)	Ca (%)	P (%)	GE*	CP (%)	Ca (%)	P (%)	GE*
Regions	SAT	7.64^{d}	1.09^{c}	0.19^{c}	2169^{c}	8.14^{c}	1.74^{b}	0.34^{b}	2818^{c}
	WHT	7.54^{d}	1.19^{c}	0.20^{c}	3562^{b}	8.01^{c}	0.98^{c}	0.23^{d}	3291^{b}
	ASR	11.4^{b}	0.90^{d}	0.32^{b}	3519^{b}	9.52^{b}	1.02^{c}	0.36^{b}	4063^{a}
	CTH	9.01^{c}	1.67^{b}	0.30^{b}	3612^{b}	9.54^{b}	1.61^{b}	0.29^{c}	3361^{b}
	CFS	14.5^{a}	3.34^{a}	0.40^{a}	4006^{a}	14.8^{a}	4.18^{a}	0.42^{a}	3939^{a}
SEM		*0.38*	*0.06*	*0.02*	*123.5*	*0.36*	*0.1*	*0.02*	*181.2*
P Value		*<0.01*	*<0.01*	*<0.01*	*<0.01*	*<0.01*	*<0.01*	*<0.01*	*<0.01*
Seasons									
	Rainy	10.2^{x}	1.76^{x}	0.12^{z}	2800^{y}	10.7^{x}	1.85	0.12^{z}	2998^{z}
	Winter	10.3^{x}	1.48^{y}	0.29^{y}	3688^{x}	10.8^{x}	2.00	0.37^{y}	3482^{y}
	Summer	9.5^{y}	1.68^{x}	0.43^{x}	3633^{x}	8.48^{y}	1.87	0.49^{x}	4003^{x}
P Value		*<0.01*	*<0.01*	*<0.01*	*<0.01*	*<0.01*	*>0.05*	*<0.01*	*<0.01*
Regions × Seasons									
P Value		*<0.01*	*<0.01*	*<0.01*	*<0.01*	*<0.01*	*<0.01*	*<0.01*	*<0.01*

*CFS confined feeding system; SAT semi arid Telangana; WHT warm-humid Tripura; ASR arid or semi arid Rajasthan; CTH cool-temperate Himachal Pradesh; *GE gross energy (kcal/kg); CP crude protein; Ca calcium; P phosphorous*

$^{abcde\&xyz}$means having common superscript in a sub-column don't vary significantly(P>0.05)

the additives, different doses of combinations were tested, initially 3 best OAs + 4 best EOs followed by 2 OAs + 3 EOs through a series of *in vitro* experimentations. It was observed that combination of 2OAs+3EOs were better than 3 OA +4 EOs in terms of relative *E. coli* inhibition and *Lactobacillus* sparing ability. A suitable dose ratio has been identified which will be further validated in *in vivo* study. Primers of different gut pathogens and beneficial microbes have been tested and PCR reaction conditions have been optimized for their suitability to be used in qPCR. Standard curve for different microbes for qPCR is being developed for absolute quantification. Detail structural and functional diversity analysis of caecal bacteria of Aseel breed have been carried out. A total of 11114 major OTUs have been detected. Major phyla identified were *Bacteroidetes*, *Firmicutes* and *Proteobacteria*.

Development of nutritional package of practices for backyard chicken production

Nutritional status of grower and adult backyard chickens reared in different regions of India

To determine the nutritional status of the backyard chickens from the various regions of the country, four study regions i.e., Tripura, Himachal Pradesh, Rajasthan and Telangana were selected. From these places, crop and gizzard contents were collected from the scavenging birds and were subjected for estimation of CP, Ca, P and gross energy (GE). The CP, Ca, P and GE of the crop contents of both age groups were higher in chickens reared in confined feeding system (CFS) compared to those reared under backyard system (Table 44). Further, lower CP was recorded in backyard chickens reared in warm-humid Tripura and Semi-arid Telangana regions compared to the other regions. Similarly, lower Ca in arid or semi arid Rajasthan, and P and GE in Semi-arid Telangana were observed compared to the grower chickens reared in other regions. In adult chickens of warm-humid Tripura and arid or semi arid Rajasthan regions, crop contained lower Ca compared to those from Telangana, Himachal Pradesh and CFS. The crop of adult chickens from CFS contained higher P and GE compared to those from scavenging backyard conditions. Further, lower GE was recorded in the crop content of adult chickens reared in Telangana region compared to the samples collected from other regions.

Comparative efficacy of selenized yeast and inorganic selenium in commercial broiler chicken

An experiment was conducted to investigate the effect of graded levels of organic and inorganic selenium supplementation on performance and antioxidant activity in broilers. The birds were fed with corn soya based diets with graded levels of selenium sources at 0.15 ppm IOSe, 0.3 ppm

Table 45. Effect of feeding organic and inorganic Selenium on body weight gain (BWG), feed intake (FI) and feed conversion ratio (FCR) in broiler chickens

Treatment (in ppm)	BWG (g)			FI (g)			FCR (FI/BWG)		
	1 week	3 weeks	6 weeks	1 week	3 weeks	6 weeks	1 week	3 weeks	6 weeks
Control	108.4^{b}	647.4	2017	111.2^{c}	819.0	3231	1.03	1.27	1.61
0.15 OG Se	115.9^{a}	657.0	2023	118.9^{ab}	837.4	3244	1.03	1.28	1.61
0.3 OG Se	113.0^{ab}	651.6	2039	116.3^{bc}	839.7	3239	1.03	1.29	1.59
0.45 OG Se	117.8^{a}	668.6	2136	119.8^{ab}	845.6	3327	1.02	1.27	1.56
0.15 IOG Se	115.0^{a}	650.0	1986	119.0^{ab}	829.8	3148	1.04	1.28	1.59
0.3 IOG Se	119.6^{a}	670.5	2096	123.3^{a}	852.0	3315	1.03	1.27	1.58
0.45 IOG Se	115.1^{a}	661.1	2109	117.9^{ab}	844.0	3306	1.02	1.28	1.57
SEM	*0.86*	*5.18*	*17.74*	*0.83*	*5.52*	*22.40*	*0.003*	*0.004*	*0.01*
P-Value	*0.01*	*0.87*	*0.20*	*0.01*	*0.77*	*0.35*	*0.87*	*0.640*	*0.21*

OG organic, IOG inorganic

^{ab}means having common superscript in a sub-column don't vary significantly(P>0.05)

Table 46. Effect of dietary supplementation of organic and inorganic Se source and level on antioxidant parameters and immune response in broilers chicken

Treatment	Antioxidant parameters			Immune response	
	LPO	GP_X	RBC Catalase	HIR (log_2titer)	CMR
Control	4.272^{a}	195.2^{c}	65.13^{ab}	6.88	101.6
0.15 ppm OG Se	2.645^{c}	242.0^{abc}	58.0^{abc}	7.25	110.1
0.3 ppm OG Se	3.102^{bc}	290.67^{a}	51.14^{bc}	7.25	102.0
0.45 ppm OG Se	2.858^{bc}	274.6^{ab}	43.65^{c}	6.63	110.8
0.15 ppm IOG Se	3.677^{ab}	224.0^{bc}	63.25^{ab}	6.75	102.3
0.3 ppm IOG Se	3.331^{bc}	241.5^{abc}	64.76^{ab}	7.00	105.5
0.45 ppm IOG Se	3.426^{bc}	239.2^{bc}	69.27^{a}	7.00	103.5
SEM	*0.12*	*6.95*	*2.18*	*0.102*	*1.339*
P-Value	*0.01*	*0.01*	*0.01*	*0.614*	*0.312*

^{abc}means having common superscript in a sub-column don't vary significantly(P>0.05)

IOSe, 0.45 ppm IOSe, 0.15 ppm OSe, 0.3 ppm OSe and 0.45 ppm OSe and a control diet without any supplementation. The week wise body weight, feed intake and FCR were not affected significantly by different treatments (Table 45). Haemaglutination inhibition (HI) assay and CMI response did not differ (P>0.05) among experimental groups (Table 46). Lower lipid peroxidase and RBC catalase, and higher glutathione peroxidase activities were recorded among the groups fed organic Se compared to those fed diet with control or inorganic Se.

QPM based *Vanaraja* chicken diet with or without synthetic lysine

The study was conducted to determine the effect of feeding QPM based diets with or without synthetic lysine on performance of *Vanaraja* chicken. A total of 240 day-old chicks were randomly divided into 4 dietary groups each having 12 replicates with 5 birds each. Four diets were formulated to contain normal yellow maize (NYM), NYM 50%+QPM 50% with 50% less of lysine, NYM 25%+QPM75% with 75% less of lysine and 100% QPM without external supplementation of lysine. The improved body weight gain and feed conversion ratio were recorded among the birds fed diets that contained NYM 25%+QPM 75% with 75% less of lysine and 100% QPM without external supplementation of lysine compared to those groups fed on diet supplemented optimum synthetic lysine (Table 47). Further, feeding the QPM based diet significantly reduced the abdominal fat and increased the breast muscle yield.

Table 47. Effect of feeding different sources of maize on performance in *Vanaraja* chicks

Treat	1 week		3 weeks		6 weeks	
	BWG	FCR	BWG	FCR	BWG	FCR
100% NM + Lysine (Lys)	46.0[b]	1.549	251.9[b]	1.778	810.5	2.104
NM 50+QPM 50 with 50% less Lys	50.7[a]	1.505	271.4[a]	1.755	808.5	2.084
NM 25%+QPM75% with 75% less Lys	53.4[a]	1.490	284.3[a]	1.755	843.7	2.095
100% QPM without Lys	51.7[a]	1.480	282.1[a]	1.713	827.5	2.095
SEM	*0.72*	*0.014*	*3.11*	*0.010*	*7.13*	*0.009*
P value	*0.01*	*0.336*	*0.01*	*0.133*	*0.22*	*0.908*

[ab]means having common superscript in a sub-column don't vary significantly(P>0.05)

Production of designer eggs enriched with critical trace minerals relevant to human nutrition

A study was conducted in 280 White Leghorn layers at 62 weeks of age to evaluate the effect of supplementing different levels of inorganic (Ferrous sulphate) and organic (Iron bioplex) iron for production of designer eggs enriched with iron. The selected birds were randomly divided into 8 treatments with seven replicates (five birds per replicate). One group was control and the seven treatment groups were supplemented with different levels of either inorganic (100, 200 or 300 ppm) or organic Fe (100, 150, 200 or 300 ppm) for 10 weeks. Two weeks after supplementation Fe content in eggs started increasing and reached peak level at 5 to 6 weeks and the levels stabilized. Inorganic Fe supplementation improved egg Fe content by 20.4% to 35.3% and organic Fe by 32.87 to 42.44% (Fig. 21). Organic Fe was more effective than inorganic Fe in increasing egg Fe content. Increasing supplementation of organic Fe more than 150 ppm did not increase egg Fe further, whereas, inorganic Fe needed 300 ppm to reach maximum egg Fe content. Supplementation of inorganic and organic Fe did not affect feed intake and most of the egg quality traits, but, improved the eggshell strength and decreased serum triglyceride and total cholesterol levels. Supplementation of inorganic Fe also significantly decreased serum calcium, phosphorus and total protein levels, whereas organic Fe did not affect these parameters. In conclusion, the results of the study indicated that the Fe content of eggs could be increased by dietary supplementation of Fe in layer diet.

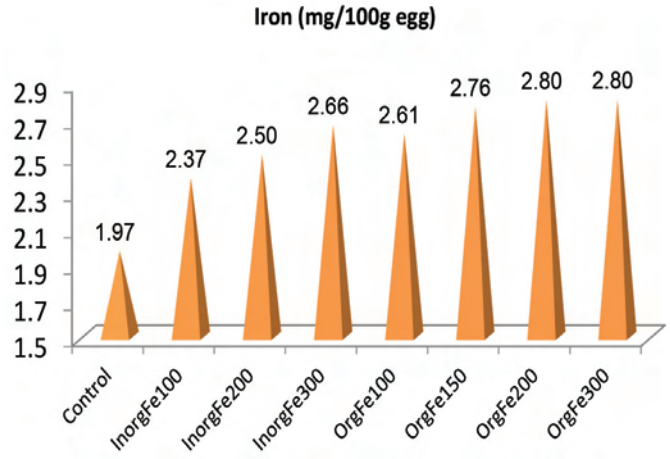


Fig. 21. Effect of supplementation of organic and inorganic iron on iron content of egg (mg/100g egg)

Physiology

Cryopreservation of PD-6 line semen

An experiment was carried out to cryopreserve PD-6 line semen using an earlier standardized protocol where 4% dimethylsulfoxide (DMSO) was used as the cryoprotectant. The semen straws were thawed at 5°C for 100 sec and inseminated in hens per vagina with a sperm concentration of 200 million/0.1 ml. All the post-thaw semen parameters were significantly lower in the cryopreserved treatments (Table 48). The cryopreserved PD-6 semen was inseminated into PD-3 females to produce *Gramapriya* chicks. A fertility of 65% was obtained and this result was on par with an earlier experiment in the same line indicating high repeatability of the cryopreservation protocol. However, when the same cryopreserved semen sample was inseminated in PD-6 line females, a fertility of 7% only could be obtained. This result indicated variation in fertility depending on the line of hens inseminated with cryopreserved semen.

Table 48. PD6 line semen cryopreservation using 4% dimethylsulfoxide (DMSO)

Parameters	Control (Fresh semen)	4% DMSO
Sperm motility (%)	60.5 ± 2.93[a]	22.5 ± 0.83[b]
Live sperm (%)	81.1 ± 2.23[a]	28.9 ± 0.94[b]
Abnormal sperm (%)	2.1 ± 0.23[b]	3.1 ± 0.35[a]
Acrosome intact sperm (%)	99.5 ± 0.17[a]	91.2 ± 0.91[b]
Fertility (%)-PD6 hen	67.6 ± 6.29[a]	6.6 ± 2.76[b]
Fertility (%)-PD3 hen	93.7 ± 2.36[a]	65.3 ± 6.62[b]

Values given are mean±SE.

Figures bearing different superscripts in a row differ significantly (P<0.05).

Evaluation of different cryoprotectants for Nicobari semen cryopreservation

A study was carried to evaluate different cryoprotectants for Nicobari chicken semen cryopreservation. Semen from adult Nicobari chicken was cryopreserved using Sasaki diluent in 0.5ml French straws using 12% methylacetamide (MA), 9% dimethylacetamide (DMA) and 4% dimethylsulfoxide (DMSO). The semen straws were thawed at 5°C for 100 sec and inseminated in hens per vagina with a sperm concentration of 200 million/0.1 ml. Post thaw sperm motility, live sperm and fertility were significantly (P<0.05) lower in cryopreservation treatments (Table 49).

Table 49. Effect of different cryoprotectants during Nicobari semen cryopreservation using Sasaki diluent

Parameters	Control (Fresh semen)	12% MA	9% DMA	4% DMSO
Sperm motility (%)	70.63 ± 1.75[a]	23.75 ± 1.25[b]	21.87 ± 0.91[b]	23.75 ± 0.82[b]
Live sperm (%)	78.61 ± 1.14[a]	34.58 ± 2.58[b]	37.13 ± 2.61[b]	31.49 ± 1.53[b]
Abnormal sperm (%)	2.56 ± 0.41	3.72 ± 0.39	4.76 ± 0.73	3.91 ± 0.67
Seminal plasma lipid peroxidation (nM MDA/ml)	4.3 ± 0.63[b]	9.11 ± 1.67[ab]	8.35 ± 1.19[ab]	9.65 ± 1.3[a]
Fertility (%)	80.92 ± 3.69[a]	3.24 ± 1.88[b]	0[b]	2.06 ± 1.41[b]

Values given are mean±SE.

Figures bearing different superscripts in a row differ significantly (P<0.05).

The seminal plasma lipid peroxidation was significantly (P<0.05) higher in 4% DMSO treatment. No fertile egg was obtained in 9% DMA treatments, whereas other two cryoprotectant treatments gave very low fertility. In conclusion, the three cryoprotectants at the tested concentrations were not useful for cryopreserving Nicobari chicken semen.

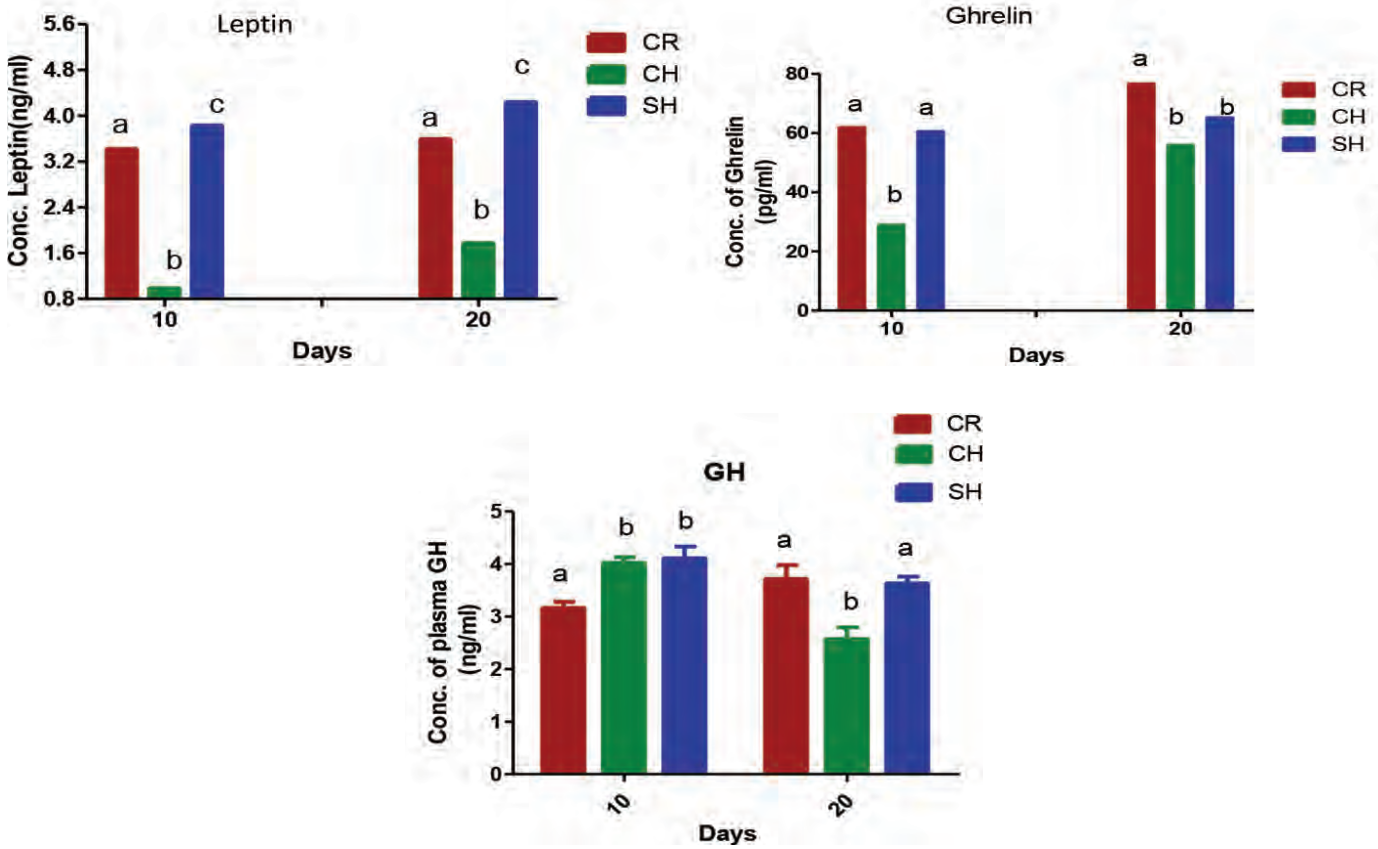
Cryopreservation of PD-4 line semen

An experiment was carried to cryopreserve PD-4 line semen using two diluents (Sasaki diluent and Lake & Ravie diluent) and two cryoprotectants (12% MA and 4% DMSO) in 0.5ml French straws. The semen straws were thawed at 5°C for 100 sec and inseminated in hens per vagina with a sperm concentration of 200 million/0.1 ml. Post thaw sperm motility, live sperm, abnormal sperm, and fertility were significantly (P<0.05) lower in cryopreservation treatments. Very low fertility of 1.3% was obtained in 4% DMSO in Lake & Ravie diluent and no fertile egg was obtained in other treatments. In conclusion, the tested diluent and cryoprotectant combinations were not useful for cryopreserving PD-4 line semen.

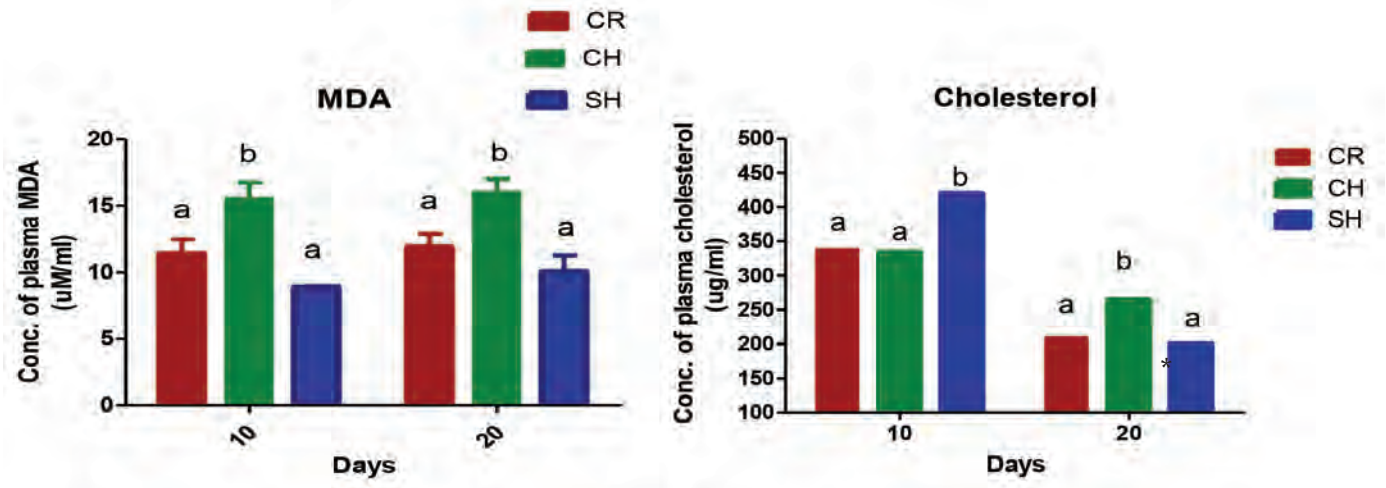
Role of plasma leptin, ghrelin and growth hormone in regulation of physiological functions of chicken during summer season

Under high ambient temperature conditions, the thermoregulatory system of the body tries to maintain homeostasis. Nicobari is an indigenous breed well adapted to tropical climate. However, when exposed to higher temperature at 39°C for four hours for three weeks, these chickens may suffer heat stress and translate it by their effect on production performance through effect on physiological parameters. Fermented yeast culture (FYC) is a source of amino acids, vitamins and minerals. Hence, supplementation of yeast culture may benefit the chickens. Three groups, heat stressed (CH), heat stressed and supplemented with FYC (SH) were tested. Birds were maintained at room temperature (CR).

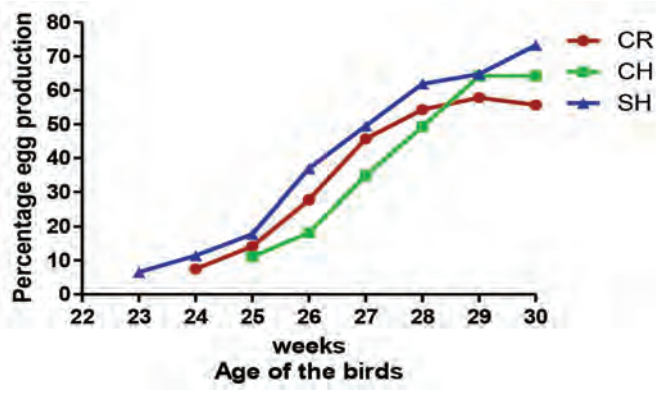
- Heat stress decreased concentration of plasma leptin, Ghrelin and GH in CH group, which was reversed by supplementation (SH group).



Mean± SEM values with different superscripts are significantly (P<0.01) different from each other. Results are at 10 and 20d interval from the beginning of the experiment. CR- Negative control, CH-Positive control, SH- supplemented group with FYC.



- Heat stress markers MDA and cholesterol decreased in supplemented group (SH) when compared to CH group.



Values with different superscripts are significantly different (P<0.05). CR-Negative control, CH-Positive control, SH- supplemented group with FYC.

- Age at sexual maturity was 161d in SH, 168 in CR and 175 in CH group of hens. Percentage of egg production was more in SH birds, post exposure to heat stress. Hen Day Egg Production (HDEP) and Hen House Egg production (HHEP), respectively were higher for SH group (48.6 and 48.7%), when compared with CH (36.2 and 36.2%) and CR (38.96%, 38.96%) groups for the 24-32 weeks of age.

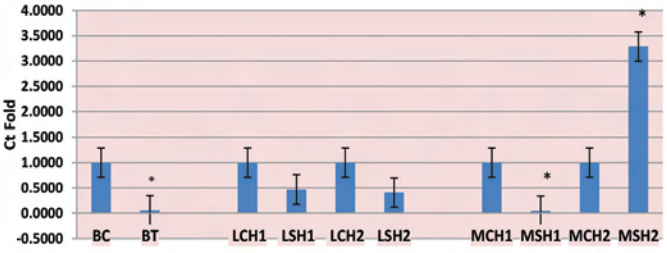


Fig. 22. Down regulated/Upregulated (P<0.01) gene expression of leptin receptor in SH group when compared to CH group at an interval of 10 (CH1, SH1) and 20d (CH2,SH2) after the beginning of the experiment

B-Brain, L-Liver, M-Magnum

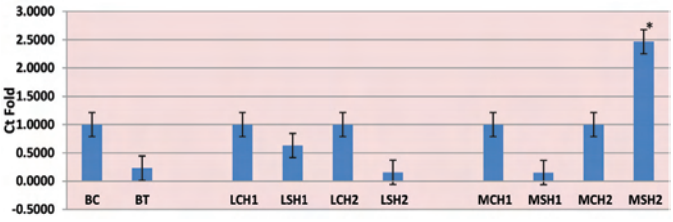


Fig. 23. Down regulated/Upregulated (P<0.01) gene expression of GHS receptor in SH group when compared to CH group at an interval of 10 (CH1,SH1) and 20d (CH2,SH2) after the beginning of the experiment

B-Brain, L-Liver, M-Magnum

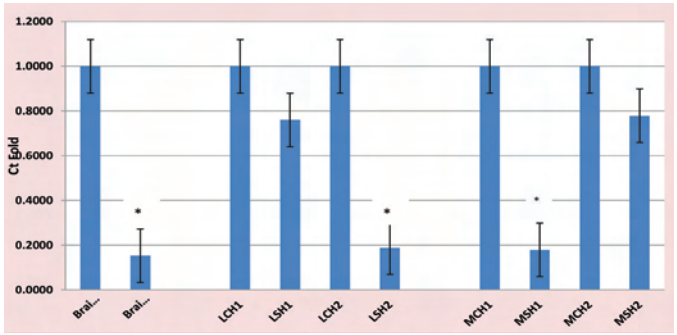


Fig. 24. Down regulated (P<0.01) gene expression of GH receptor in SH group when compared to CH group at an interval of 10 (CH1, SH1) and 20d (CH2, SH2) after the beginning of the experiment

B-Brain, L-Liver, M-Magnum

- Heat stress decreased feed intake and body weight of the birds (CH), which was reversed by supplementation of FYC (SH).

Sustainable poultry waste management through composting

The composition of the supplements was to be analyzed so that depending upon the content of supplements viz. dry leaves, straw, rice hulls and saw dust, the amount of litter is to be mixed. It was observed that organic carbon was 56% in dry leaves and total Nitrogen was 1.2%. The carbon to nitrogen ratio (C:N ratio) which is the critical factor for the formation of compost was 46.7% in dry leaves. It was also found that organic carbon (%) was 34% in rice hulls and 11% in straw. Total Nitrogen was 0.33% and 0.08% in rice hulls and straw, respectively. The carbon to nitrogen ratio (C:N ratio) was 103.03% in rice hulls whereas, it was 137.5% in straw. In saw dust, the organic carbon was 19% and total Nitrogen was 0.06%. The carbon to nitrogen ratio (C:N ratio) was 316.7% in saw dust. P (%) in dry leaves, rice hulls, straw and saw dust was 0.1, 0.07, 0.06 and 2.5. K (%) was 0.36, 0.55, 1.3 and 9.6 in dry leaves, rice hulls, straw and saw dust, respectively.

Health

Disease surveillance of DPR germplasm

Incidences of CRD, Coccidiosis, Laryngotracheitis, Colibacillosis, Marek's disease, Lymphoidleukosis and heat stress were observed. The ALV screening in breeding flocks was done by P27 antigen ELISA in seven lines. The ALV carrier status was: Naked neck-0.83%, IWI-2.60%, IWK-13.18%, IWH-4.09%, PD2-5.97%, Dwarf-0% and PD1-17.54% respectively.

The percentage of carriers decreased considerably from previous generation.

Immunogenicity and protective efficacy of Iron inactivated *Pasteurella multocida* A:1 killed vaccine against fowl cholera in chicken

The efficacy of iron inactivation upon *Pasteurella multocida* A:1 isolate in combination with different adjuvants was evaluated. Field isolate of fowl cholera was grown in BHI broth with and without iron supplementation. SDS-PAGE analysis of *Pasteurella* antigen grown with iron depleted and enriched medium showed prominent expression of outer membrane peptides (OMPs) in iron enriched medium. Scaled up culture with $5X10^8$ CFU/ml equivalent to 2.5 mg of antigen per dose was calculated and used for preparation of experimental vaccines.

Formalin inactivated and mixed with APS adjuvant (FIA), formalin inactivated-Freund adjuvant (FIF), Iron inactivated and adjuvanted with iron (III), Iron inactivated from iron supplemented media and adjuvanted with iron (ISII) and commercial oil emulsion vaccine (CV) and control were used in the study. A total of 120 birds (n=20/group) of 2 weeks age were immunized with these vaccine and booster were given at 3rd and 6th week with respective vaccine. Protective antibody titres were induced by iron inactivated vaccine from 4th week of immunization and upon booster doses, it induced significantly higher ($P<0.05$) antibody response. Specific antibody titres were assessed by iELISA in the serum at weekly intervals. The birds were challenged (n=6 /group) with 5x10 4 CFU/ml by intranasal route. The iron inactivated experimental vaccine gave equivalent protection as that of commercial vaccine upon challenge infection.

Disease resistance/tolerance and host immune response of Native chicken breeds and backyard variety to experimental infection with *Pasteurella multocida* A

Aseel, Ghagus, Nicobari and *Vanaraja* chicken breed were evaluated for the survivability/ mortality patterns and host immune response after experimental infection with *P. multocida* A1 isolate. The birds were inoculated with $1.9X10^5$ CFU/ml through intraperitoneal (I/P) and intranasal (I/N) routes at two different age groups viz., 12 weeks and 18 weeks. Symptoms, mortality rates, le^{s}ions in dead birds were observed; Serum from surviving birds of different groups from both breeds were collected at 5, 14, 21, 28, 35 and 42nd day and specific antibody titres were measured by indirect ELISA.

Fig. 25. Necrotic foci in liver

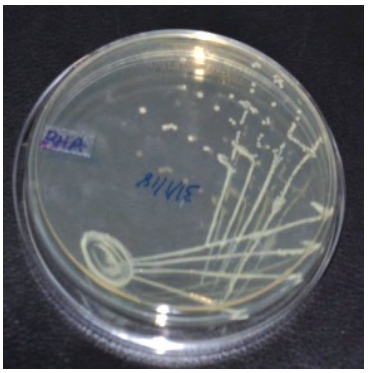


Fig. 26. Dew drop colonies on BHI agar

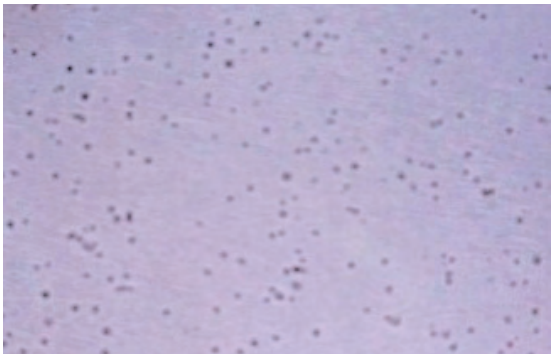


Fig. 27. Bipolar dumbell shaped G(-) Cocci

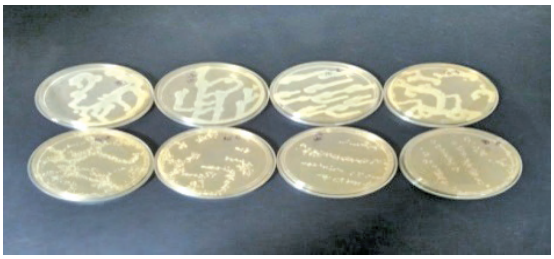


Fig. 28. Preparation of inoculum (1.9 x 10^5 CFU/ml)

At 12 weeks of age, the mortality rates were 100% and 16% for I/P and I/N routes respectively in *Vanaraja* birds; whereas the mortality rates were 50% and 16% for I/P and I/N routes respectively in Nicobari birds. Mean death time was 29.3h and 30.4 h for I/P route in Nicobari and *Vanaraja* birds, respectively. Mean death time for I/N route was 27d and 18d in Nicobari and *Vanaraja* birds, respectively. At 18 weeks of age the mortality rates were 16% and 50% in Nicobari and *Vanaraja*, respectively. The mortality rates were 16% for I/N route in both Nicobari and *Vanaraja*.

Significantly higher tolerance was observed in Aseel breed than Ghagus and Nicobari in terms of morbidity, mortality, mean death time and severity of the disease via both intranasal and intraperitoneal infection. Significantly higher levels of PM specific antibodies were induced in Aseel breed in comparison to Ghagus and *Vanaraja* chicken.

Lesions such as necrotic foci on liver and congestion in the liver were observed in dead birds. Serum titres were significantly ($P<0.05$) higher in surviving Nicobari birds inoculated through I/P route followed by I/N route. The peak titres were reached on 14th day post-infection and declined thereafter. However no significant difference was found in I/N route of inoculation between two breeds. Nicobari chicken breed showed significantly higher survivability and longer mean death time than *Vanaraja* germplasm to experimental Pasteuralla infection at both the ages, however, the survivability rate in both genotypes improved at later ages.

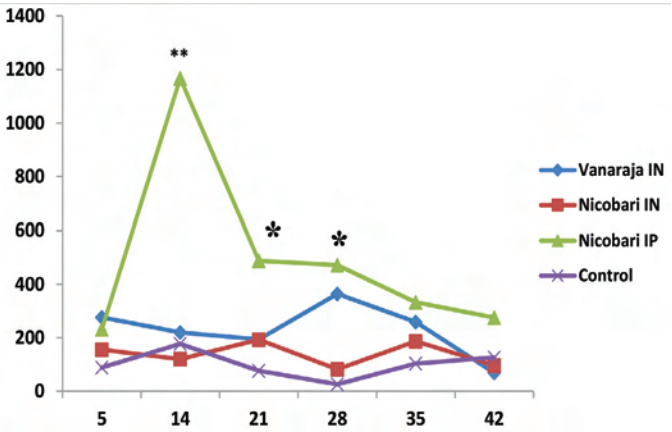
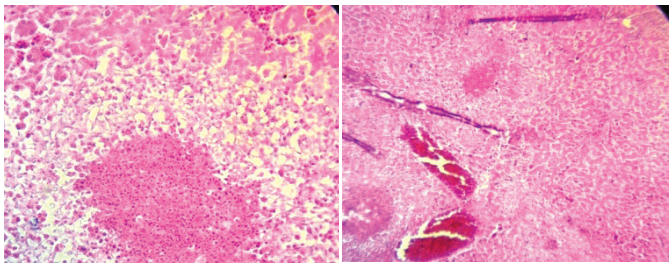


Fig. 29. Mean ELISA titre by iELISA during post infection in surviving birds



Necrotic foci in liver | Engorgement of blood vessels in liver

Fig. 30. Histopathology of lesions in liver of experimentally infected chicken

In vitro evaluation of medicinal herbs for antibacterial activity against *E. coli* isolated from poultry

Isolation and molecular identification of *E. coli*

A total of 32 pure cultures of *E. coli* showing metallic sheen colonies on Eosin Methylene Blue (EMB) agar were isolated and identified using 16S DNA technology. Genomic DNA ~1.5kb was isolated, 16S-rDNA fragment was amplified using specific primers and the PCR product (Fig. 31) was sequenced bi-directionally in ABI 3500 Genetic Analyzer.

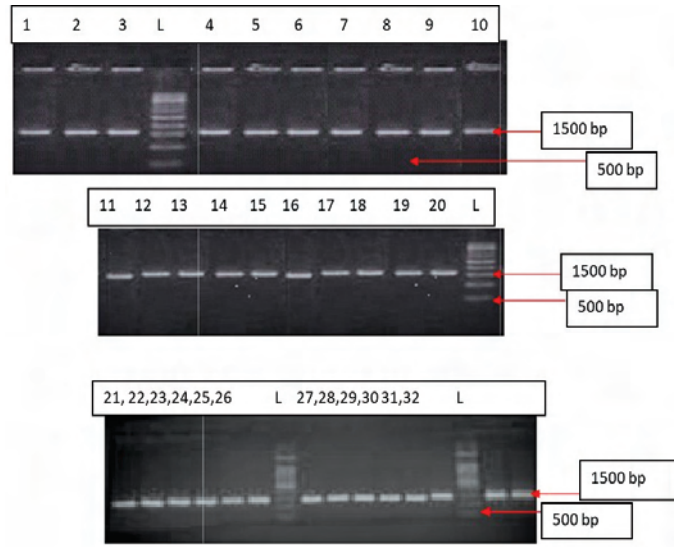


Fig. 31. PCR amplicons loaded on 1% Agarose gel, L. 500bp DNA Ladder

PCR products loaded on 1% agarose gel

The sequence data analysis was done using Seq Scape_ v 5.2. The cultures were identified as *Escherichia coli* strains with 28 isolates showing 99% match to *E. coli*. The sequences were deposited in NCBI Genbank with the following id's: MK714930, MK714932, MK716402, MK714920, MK716401, MK714848, MK714355, MK714220, MK714219,

Table 50. Medicinal herbs and extracts

S. No.	Name of Plant	Botanical name	Parts used	Type of extract
1	Basil	*Ocimum basilicum*	Leaf	M, E, P, W, EO
2	Cinnamon	*Cinnamomum zeylanicum*	Bark	M, E, P, W, EO
3	Oregano	*Origanum vulgare*	Leaf	M, E, P, W
4	Rosemary	*Rosmarinus officinalis*	Leaf	M, E, P, W, EO
5	Thyme	*Thymus vulgaris*	Leaf	M, E, P, W, EO
6	Parsley	*Pteroselinum crispum*	Leaf	M, E, P, W
7	Karanphool	*Illicium verum*	Flower	M, E, P, W, EO
8	Jaiphal	*Myristica fragrans*	Fruit	M, E, P, W, EO
9	Cardamom	*Amomum subulatum*	Fruit and seeds	M, E, P, W, EO
10	Ginger	*Zingiber officinale*	Rhizome	M, E, P, W, EO
11	Turmeric	*Curcuma longa*	Rhizome	M, E, P, W, EO
12	Garlic	*Allium sativum*	Bulb	M, E, P, W, EO
13	Clove	*Syzigium aromaticum*	Bud	M, E, P, W, EO
14	Marathi Mugga	*Ceibapen tandra*	Fruit/Seeds	M, E, P, W
15	Coriander	*Coriandrum sativum*	Seeds	M, E, P, W
16	Black Pepper	*Piper nigrum*	Fruits	M, E, P, W, EO
17	Curry Leaf	*Murraya koenigii*	Leaf	M, E, P, W
18	Kebab Chinni	*Eugenia pimenta*	seeds	M, E, P, W
19	Bay Leaf	*Cinnamomum tamala*	Leaf	M, E, P, W
20	Mint	*Mentha piperata*	Leaf	M, E, P, W

M: Methanolic; E: Ethanolic; P: Petroleum Ether; W: Aqueous; EO: Essential Oil

MK714210, MK714162, MK714083, MK714073, MK713979, MK713978, MK713966, MK713949, MK713934, MK713898, MK713895, MK713894, MK713851, MK713841, MK713838, MK713769, MK713768, MK713763, MK713759, MK719773, MK706296, MK705915, MK705892.

Antimicrobial activity of combined/poly herbal formulations

Various formularies were prepared using different herbs selected from the above list and then screened for the antimicrobial activity against *E. coli* isolates. Antimicrobial susceptibility studies revealed a zone of inhibition ranging from 12-23 mm for herbal extract combinations on various *E. coli* isolates (Fig. 32). Based on the antimicrobial activity against *E. coli* two phytogenic feed additives, PFA-1 and PFA-2 were developed for conducting *in vivo* trial in *Krishibro* broilers as alternatives to antibiotic growth promoters (AGP).

Fig. 32. Different formularies showing inhibitory effect on *E.coli* isolates

In vivo experimental trial using herbal alternatives to AGP's

An *in vivo* trial in *Krishibro* broilers was conducted utilizing two phytogenic feed additives PFA1 and PFA2, developed at ICAR-DPR. The PFA's were given at two different dose rates with and without coccidiostats. The study was conducted on 480 birds divided into 12 groups with 5 replicates having 8 birds in each replicate.

Ad lib water supply was given to the birds and routine vaccination schedule was followed. The body weight of the birds was recorded at weekly intervals (Fig. 33). The performance parameters *viz.*, body weight gain (BWG), average daily gain (ADG), average daily feed intake (ADFI) and feed conversion ratio (FCR) were recorded. The results of the production performance were shown in Table 51. The number of birds died was recorded and the percent mortality for each group was calculated (Fig. 34). Enumeration of caecal *Escherichia coli* count (log CFU/g) on Eosin Methylene Blue (EMB) agar using conventional technique was represented graphically in (Fig. 35). Clinical and production performance showed better gut health, reduced mortality and FCR in PFA's supplemented groups compared to control (P<0.05).

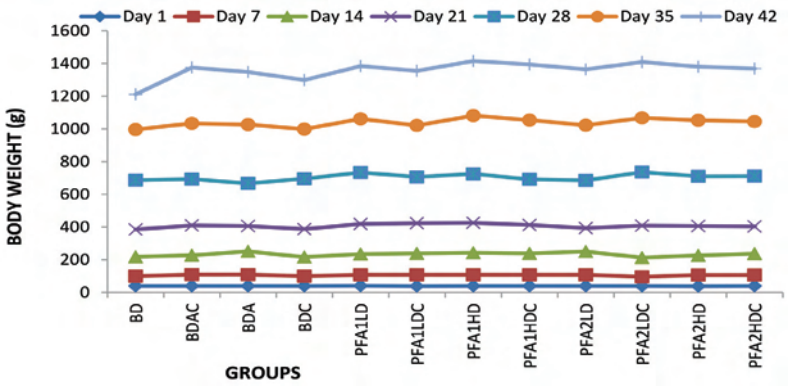


Fig. 33. Mean body weights in Krishibro chicken of different groups

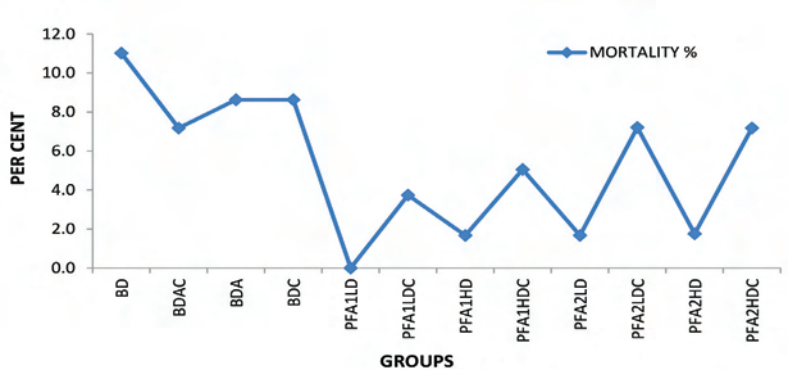


Fig. 34. Mortality rate in different groups

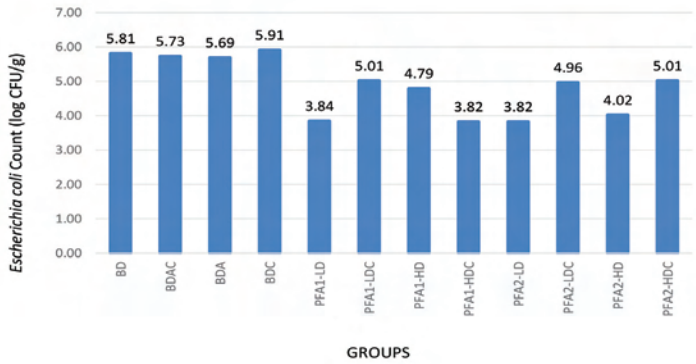


Fig. 35. Mean caecal *E.coli* count (log CFU/g) in Krishibro chicken of different groups

Table 51. Performance characteristics in Krishibro chicken of different groups

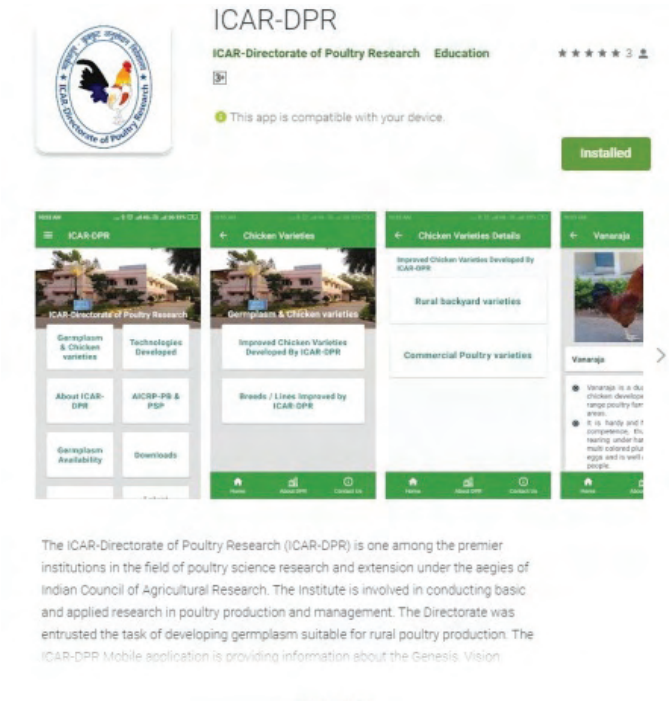
GROUPS	BWG (g)	ADG (g)	ADFI (g)	FCR
BD	1171.6^{C}	27.9^{C}	56.9	2.05^{A}
BDAC	1336.4^{A,B}	31.8^{A,B}	60.2	1.91^{B,C,D}
BDA	1308.3^{A,B}	31.2^{A,B}	59.0	1.91^{B,C,D}
BDC	1259.3^{B,C}	30.0^{B,C}	58.2	1.99^{A,B}
PFA1LD	1343.2^{A,B}	32.0^{A,B}	55.3	1.75^{D}
PFA1LDC	1316.4^{A,B}	31.3^{A,B}	56.5	1.83^{A,B,C}
PFA1HD	1376.2^{A}	32.8^{A}	57.5	1.75^{C,D}
PFA1HDC	1354.6^{A,B}	32.3^{A,B}	56.6	1.77^{C,D}
PFA2LD	1324.5^{A,B}	31.5^{A,B}	55.5	1.77^{C,D}
PFA2LDC	1369.7^{A}	32.6^{A}	58.8	1.82^{C,D}
PFA2HD	1342.1^{A,B}	32.0^{A,B}	57.6	1.83^{C,D}
PFA2HDC	1330.1^{A,B}	31.7^{A,B}	57.6	1.84^{A,B,C,}
N	40	40	42	40
P-value	0.0001	0.0001	1.000	0.0001
SEM	32.19	0.766	6.948	0.047

Note: Means with different superscripts in a column differ significantly.

3. Technologies Assessed and Transferred

ICAR-DPR Mobile App

An Android Mobile App was developed in English on "ICAR-DPR". The Mobile application provides information about Institute (History, Vision, Mission and Mandate), Director and staff, germplasm developed, breeds and lines improved, technologies developed, AICRP on Poultry Breeding, Poultry Seed Project, germplasm availability and price, latest news, downloads (pamphlets on improved varieties) and contact details.



Screenshot of ICAR-DPR app

QR code of ICAR-DPR Mobile App

Transfer of Technology

The Transfer of Technology Unit of the Directorate is engaged in propagation of technologies developed at the institute to different stakeholders of the sector. The propagation of the improved rural chicken varieties across the country is the main objective of the Unit.

The institute popularized the technologies through participation in exhibitions, Kisan Melas, Farmers' days, etc. across the country. The scientists delivered TV and Radio talks on various aspects of poultry farming. Brochures, pamphlets and bulletins on different chicken varieties were prepared for distribution to the farmers. The details of the activities are as follows.

Germpalsm supply

A total of 19,42,652 improved chicken germplasm was distributed to the farmers and other stake holders across the country during 2018-19 from DPR and different centres of AICRP on Poultry Breeding and Poultry Seed Project centres. At, ICAR-DPR, with the continuous efforts of the scientific, technical and other staff, the institute supplied 4,87,589 improved chicken germplasm during the year, out of which, 45,075 were the parents of improved chicken varieties. From the centres of AICRP and PSP, a total of 8,07,869 and 6,47,194 improved chicken germplasm, respectively was supplied during the year.

Table 1. Germplasm supplied during 2018-19

Sl. No.	Particulars	Number
I	**DPR**	
A.	**Hatching Eggs**	
	Krishibro	964
	Vanaraja	123539
	Colored *Gramapriya*	20130
	Srindhi	4604
	Aseel	616
	PD-4	139
	Ghagus	31
	Control Layer	630
	Colored broiler	1050
	Layer	1210
	Total	**1,52,913**
	Embryonated eggs	7102
B.	**Day Old Chicks**	
	Krishibro	10632
	Vanaraja	147484
	Gramapriya	89049
	Srindhi	21835
	Aseel	3218
	PD-4	5393
	Ghagus	1710

	Layer	740
	Total	**2,80,061**
C	**Parents**	
	Krishibro	531
	Vanaraja	25940
	Gramapriya	16582
	Srindhi	2022
	Total	**45,075**
D	**Grownup birds supplied in TSP and at DPR**	**2438**
	Net Total (A+B+C+D)	**4,87,589**
II	**AICRP on Poultry Breeding**	**8,07,869**
III	**Poultry Seed Project**	**6,47,194**
	Grand Total (I+II+III)	**19,42,652**

Participation in Exhibitions

Poultry India 2018

ICAR-DPR participated in Poultry India 2018 exhibition organized by IPEMA at Hitex, Hyderabad from 28 to 30 November 2018. DPR stall attracted the attention of the delegates and poultry farmers. The technologies developed by the institute, especially the improved chicken varieties ; *Vanaraja, Gramapriya* and *Srinidhi* attracted the poultry farmers. About 4-5 thousand farmers, technocrats and scientists visited the stall in 3 days.

Farmers' day at ICAR-IIRR

ICAR-DPR participated in the Farmer's day organized by ICAR-IIRR on 3 November 2018, Hyderabad. Literature on the improved chicken varieties was distributed to the farmers. DPR stall attracted the attention of the farmers and visitors at the exhibition.

Pasu Arogya Mela, Motihari

ICAR-DPR participated in the Pasu Arogya Mela from 23-25 December 2018 at KVK Pirakothi, Motihari, Bihar**.** About 2500-3000 farmers visited the stall. The technologies displayed at the exhibition attracted many farmers and visitors. Literature on the improved chicken varieties was distributed to the farmers.

Maha Pashudhan Expo 2019, Jalna

ICAR-DPR participated in the Maha Pashudhan Expo, 2019 from 2-4 February 2019 at Jalna, Maharashtra. About 4500-5000 farmers visited the stall during the 3 days of exhibition. Literature on the improved chicken varieties was distributed to the farmers. The live birds (Aseel, Kadaknath, *Vanaraja* and *Gramapriya*) and other technologies displayed at the exhibition attracted many farmers and visitors.

Agricultural Science Congress Expo 2019, New Delhi

ICAR-DPR participated in the Agricultural Science Congress Expo 2019 organized during 20-24 February 2019 at ICAR-IARI, New Delhi. Hon'ble Secretary (DARE) & DG (ICAR), and DDG (AS) along with other dignitaries visited the stall and appreciated the technologies. About 3000-3500 farmers visited the stall during the 4 days of exhibition.

Improved Chicken Farming introduced in tribal villages of Adilabad district, Telangana under Tribal Sub Plan (TSP)

The Directorate initiated TSP work in Adilabad district, which has been identified by the Govt. of India and ICAR for implementation of Tribal Sub Plan. Under this program, grownup chicks of *Vanaraja* were distributed to 57 farmers in Kolamguda and Koshagutta tribal hamlets of Pembi Mandal, Adilabad district on 21 July 2018. Each farmer was provided with 10-20 birds, feeders, drinkers, 25-40 kg feed and some essential medicines. Subsequently the activity was extended to Birsaipet and Dharmajipet

Director and staff of the Institute with TSP beneficiaries

of Utnoor mandal. A total of 137 farmers were benefited during the period.

Apart from distribution of grown up birds, a mother unit facility was established at ITDA, Utnoor to grow the day old chicks during nursery phase up to 6 weeks of age. ITDA has created this facility to rear 3000 chicks. The first batch of chicks were housed in the facility on 12 December 2018. The first batch of grown up chicks were distributed to the tribal farmers on 7 February 2019 during the Nagoba Jathara at Keshlapur by Shri G. Nagesh, MP and Shri Koneru Konappa, MLA. The District Collector, ITDA Project Officer, Director DPR and several officials attended the event.

DPR initiates Scheduled Caste Sub Plan work in Telangana

ICAR-DPR initiated the SC Sub Plan work with a training program to SC farmers from Gudur Village, Shamsabad Mandal, Ranga Reddy District. A total of 30 farmers participated in the practical oriented training program. The farmers were exposed to different activities on poultry rearing.

Skill development / Capacity Building in Poultry production

The mandate of the institute was revised and Capacity building was added from 2015-16. Accordingly, several training programs are being organized for different stakeholders like trainers, animal husbandry officers, extension functionaries, farmers etc., from across the country.

International training program

The institute has organized an International training program on "Modern Poultry Management" for executives of African and Asian countries from 1-15 May 2018 in collaboration with MANAGE under Feed the Future India Triangular Program. A total of 29 Participants from 8 countries participated in the program Africa (Botswana-1, Kenya-6, Liberia-4, Malawi-3, Uganda-5, Mozambique-1) and Asia (Myanmar-3, Mongolia-6).

The training programme was inaugurated by Dr. Joykrushna Jena, Deputy Director General

(Animal Science), ICAR in the presence of Mrs. V. Usha Rani, IAS, Director General, MANAGE and Dr. R.N. Chatterjee, Director, DPR. The training module included classroom lectures, practical sessions, group discussions, case studies and field visits. Two case studies from poultry industry highlighting growth from a small venture in to a big company were discussed. Field visits were organized to a large scale poultry processing plant, feed manufacturing plant and free range poultry of Bavoji Tanda, Mahaboobnagar district, Telangana (an adopted tribal village of ICAR-DPR).

The valedictory programme was graced by Mission Director, USAID-India, His Excellency Mark A. White and the High Commissioners of Kenya and Malawi.

Other training programs

In addition, seven training programs were organized for different stake holders during the year 2018-19. The list of the trainings organized is given in Table 2.

MGMG Program

ICAR-DPR actively involved in *Mera Gaon Mera Gaurav* program in five adopted villages. Improved chicken varieties were distributed to the farmers in the villages at subsidized rates. Required technical advises in health care and nutrition was provided as and when required.

Director and faculty with trainees

Technical advisories

Technical advisories were provided to farmers, filed veterinarians from all parts of the country on both intensive and rural/backyard poultry farming in the areas of health care, management and nutrition. A total of 880 farmers visited the institute during the year for technical advisories. Issues/ problems of poultry farmers were attended over phone and mails.

Apart from the above many graduate and post graduate students across the country visited the Directorate on their educational tours during the period.

Table 2. Training programmes conducted during 2018-19

Sl. No.	Program	Participants	Duration	Date
1.	International training program on "Modern Poultry Management"under Feed the Future India Triangular Program	Executives (29) from 6 African and 2 Asian countries	15 days	1-15 May 2018
2.	Modern poultry management for established agripreneurs (collaboration with MANAGE)	Agriprenuers (26) from different states Farmers from Institute side-4 Total - 30	4 days	26-29 June 2018
3.	Certified Livestock Advisor Programme on Poultry-Module II (Sponsored by MANAGE)	Veterinarians (13) from all over India	15 days	22 October–05 November 2018
4.	Modern poultry management for established agripreneurs (collaboration with MANAGE)	Agriprenuers (14) from different states Farmers from Institute side-15 Total - 29	4 days	24-27 November 2018
5.	Training programme on "Scientific Poultry Rearing"	Farmers (8)	3 days	22-24 January 2019
6.	Training for Tribal Farmers on Backyard Poultry Rearing under TSP	Tribal farmers from Adilabad district (17)	2 days	4-5 February 2019
7.	Training for Tribal Farmers on Backyard Poultry Rearing under TSP	Tribal farmers from Adilabad district (23)	2 days	1-2 March 2019
8.	Training on "Backyard Poultry Rearing" to Scheduled Caste farmers of Ranga Reddy district under Schedule Caste Sub Plan (SCSP)	Farmers (30) from Gudur village of Ranga Reddy district	1 day	13 March 2019

4. Training and Capacity building

In the training programmes organized by different organizations, staff of the Directorate participated to update and gather knowledge in different aspects including science and technology, administration and financial management. The details of training programmes attended by the staff have been stated in the following Table.

Table 1. Participation of DPR staff in Training and Capacity building activities

Sl. No.	Particulars of training	Official(s)	Duration	Venue
1.	Motivation, Positive thinking and communication skills for technical officers(T-5 and above) of ICAR	Sri A. Ravikumar, Technical Officer Sri A. Subramanyam, Technical Officer	21 - 27 June 2018	ICAR-NAARM, Hyderabad
2.	Poultry Production and Health	Dr. Chandan Paswan, Sr. Scientist	15 July - 25 September 2018	EICA, Egypt
3.	Training programme on AST-WHONET and launch of the Network project of ICAR-INFAAR	Dr. D. Suchitra Sena, Pr. Scientist	23-25 July 2018	ICAR-IVRI, Izatnagar
4.	Summer school on "Innovations in livestock sector for doubling farmers income: strategies and opportunities in meat value chain"	Dr. M. Shanmugam, Sr. Scientist	25 July - 14 August 2018	ICAR-NRCM, Hyderabad
5.	Intellectual property valuation and technology management	Dr. S.S. Paul, Pr. Scientist	24-29 August 2018	ICAR-NAARM, Hyderabad
6.	Training Programme on analysis of experimental data	Dr. A. Kannan, Pr. Scientist	06- 11 September 2018	ICAR-NAARM, Hyderabad
7.	Advances in Web and Mobile application development	Dr. Leslie Leo Prince, Pr. Scientist	05-10 October 2018	ICAR-NAARM, Hyderabad
8.	Training Workshop for Vigilance Officers of ICAR institutes	Dr. M.V.L.N. Raju, Pr. Scientist	31 October -1 November 2018	ICAR-NAARM, Hyderabad

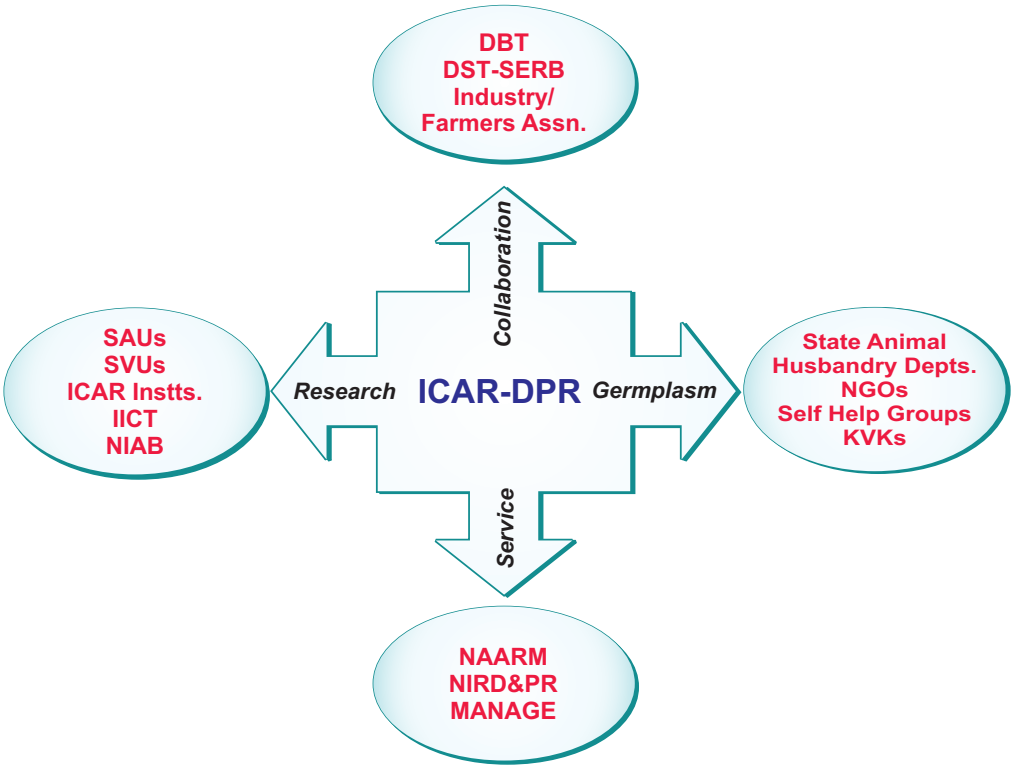
5. Awards and Recognitions

- Dr. T.R. Kannaki, Sr. Scientist received the International Veterinary Vaccinology Network Scholarship-2019 for attending the UK & IVVN Conference at London, UK during 9-10 January 2019.
- Dr. T.R. Kannaki, Sr. Scientist received the Best Oral presentation award-2018 during AAHP-2018 at Chandigarh during November 2018.
- Dr.T.R. Kannaki, Sr. Scientist received the Best oral presentation – First prize and second prize in different sessions during XXXV Annual Conference of Indian Poultry Science Association held at ICAR-CIARI, Port Blair, 15 - 17 November 2018.
- Dr. L.L.L. Prince, Pr. Scientist received the Oral Presentation award (Second prize in Technical Session-1) during XVI Annual Convention of Society for Conservation of Domestic Animal Diversity (SOCDAB), 7-8 February 2019 at ICAR-NBAGR, Karnal.
- Dr. T.K. Bhattacharya, National Fellow received the 3rd prize for oral presentation of the article "Detection of partial promoter of *ACACB* gene in Chicken" during XXXV Annual Conference of Indian Poultry Science Association held at ICAR-CIARI, Port Blair, 15 - 17 November 2018.
- Dr. A. Kannan, Pr. Scientist received "Reviewer Excellence Award" from the Editor of Indian Journal of Animal Research
- Dr. M. Shanmugam, Sr. Scientist received second best oral presentation in XVI National Symposium of Society for Conservation of Domestic Animal Biodiversity at ICAR-NBAGR, Karnal, 7-8 February 2019 for the presentation "Effect of different cryoprotectants in Nicobari chicken semen cryopreservation."
- ICAR-DPR bagged the third prize in Hyderabad for Official Language Implementation, which was awarded by the Town Official Language Implementation Committee-2, Hyderabad for the year 2018.

Dr. T.R. Kannaki receiving the best oral presentation award at AAHP, Chandigarh

6. Linkages and Collaboration

The Directorate forges collaborations with outstanding research and academic institutions of national and international repute in the field of poultry health, nutrition, breeding and biotechnology. The Directorate is a leading institution in the field of poultry research in the country and equipped with state of art facilities which are being used by the student of institutions like PVNRTVU, Hyderabad; PJTSAU, Hyderabad; KVAFSU, Bangalore; JNTU, Hyderabad; NIAB, Hyderabad etc. for carrying out their research work. The scientists of this Directorate have guided many PG and PhD students as Co-chairmen/members of their advisory committees. Two major network programs of ICAR (AICRP on Poultry Breeding and Poultry Seed Project) have been implemented at 24 centres located across the country. The institute has a special linkage with State Animal Husbandry Departments, NGOs and KVKs by involving them in dissemination of technologies like supplying of improved poultry germplasm developed at this Institute. The institute conducted training programmes in collaboration with other Institutes like MANAGE and Directorate of Extension, Govt. of India. Besides, participants/students from neighboring institutions like NAARM, PVNRTVU, PJTSAU, MANAGE, NIRD&PR etc. visited the institute to have practical exposure to the applied aspects of poultry farming and the ongoing research activities.



Collaboration of ICAR-DPR with different agencies

7. All India Coordinated Research Project on Poultry Breeding

AICRP on Poultry Breeding is being operated at twelve centres viz. KVASU, Mannuthy, AAU, Anand, KVAFSU, Bengaluru, GADVASU, Ludhiana, OUAT, Bhubaneswar, CARI, Izatnagar, ICAR RC for NEH Region, Agartala, NDVSU, Jabalpur, AAU, Guwahati, BAU, Ranchi, MPUAT, Udaipur and CSKHPKVV, Palampur. The main objectives of the project were development of location specific chicken varieties, conservation, improvement, characterization and application of local native, elite layer and broiler germplasm; development of package of practices for village poultry and entrepreneurships in rural, tribal and backyard areas. In addition, KVASU, Mannuthy and AAU, Anand centres are to maintain two elite layer germplasm (IWN and IWP). KVAFSU, Bangalore, GADVASU, Ludhiana, OUAT, Bhubaneswar and ICAR-CARI, Izatnagar are to maintain four elite broiler germplasm (PB-1, PB-2, CSML and CSFL).

Two pedigreed random bred control populations (one for layer and the other for broiler) were evaluated and reproduced at the Directorate. Samples of hatching eggs from these populations are being sent to different centres of AICRP on Poultry Breeding to measure the genetic progress. As per the decision taken by the Council, the strains maintained at different AICRP centres and ICAR-DPR were duplicated at various AICRP centres to be utilized in case of exigencies and as a resource population by the centre for production of three and four way crosses. The strains being duplicated at different AICRP centres are IWF at Mannuthy, IWD and IWK at Anand and M-1 and M-2 at Jabalpur. During the year a total of 8,07,869 chicken germplasm was distributed to the farmers from different centres with a total revenue generation of Rs. 223.47 lakhs.

KVASU, Mannuthy centre has evaluated the S-3 generation of native chicken germplasm up to 40 weeks of age. Egg production of native chicken germplasm up to 40 weeks of age was 79.2, which improved significantly by 3.24 eggs from previous generation. The NDR (three way cross) produced 217.78 eggs up to 72 weeks of age under farm condition. The centre evaluated IWN and IWP strains up to 64 weeks of age in S-30 generation along with layer control population. The hen day egg production up to 64 weeks of age in S-30 generation increased by 3 eggs in IWN and decreased by 4.9 eggs in IWP strains, respectively. The genetic response for hen housed egg production up to 64 weeks and egg weight at 64 weeks of age was negative in both IWN and IWP strains in S-30 generation. The centre has generated a revenue of Rs. 35.01 lakhs, which was 131% of the total expenditure on feed. The centre has distributed a total of 1,33,829 chicken germplasm to the farmers during the year.

AAU, Anand centre evaluated native chicken and White Leghorn lines (IWN, IWP, IWD and IWF) during the year. The egg production up to 40 weeks of age was 66.4 eggs in S2 generation of native chickens, which was lower as compared to S1 (71.29 eggs). Three way cross (IWN x Native x RIR) was evaluated under farm and field conditions up to 40 weeks of age. The 40 week egg production was 77 and 62 eggs, respectively. Egg production up to 40 weeks of age was 122.67 and 121.13 eggs in IWN and IWP strains in base generation brought from Mannuthy. The centre has supplied a total of 46,983 chicken germplasm to 1,006 farmers during the year. The centre has generated Rs. 26.16 lakhs which was 86% of the expenditure incurred on feed (30.29 lakhs).

KVAFSU, Bengaluru centre evaluated native chicken, PB-1 and PB-2 and their crosses. The average body weight of day old and 8 weeks of native chicken was 30.37 and 464.9 g, respectively in S-3 generation. The feed efficiency at 0-8 week was 3.15. The overall survivability was 97.16% in 0-8 weeks. The average eighth week body weight of the F2 (PB-1 x Native x PB-2) males and females was 1,255 and 1,106 g, respectively. The FCR (0-8 wks) was 2.72. The body weight at 5 weeks of age increased in PB-2 and control lines. The average egg production at 40 weeks of age in PB-1, PB-2 and Control lines was 63.81, 61.25 and 63.48 eggs, respectively. The average

phenotypic and genetic response of body weight at 5 weeks over 12 generations was 17.9 and 30.04g in PB-1 and 10.4 and 20.44 g, over 13 generations in PB-2, respectively. A total of 1,95,795 germplasm were supplied to 365 farmers. The centre generated a revenue of Rs. 52.34 lakhs, which was 169% of expenditure on feed cost (Rs. 30.94 lakhs).

Ludhiana centre carried out the evaluation of local native chicken (*Punjab Brown*), PB-1 and PB-2 during the year. The body weight of native germplasm at day one, 4 and 8 weeks of age was 37.74, 370.2 and 765 g, respectively. The egg production up to 40 weeks of PB2 X Desi cross was 58.74 eggs in farm and 55.62 eggs in field. Average body weight at 5 weeks of age was 1,166, 1,071 and 826 g in PB-1, PB-2 and Control lines, respectively. The body weight at 5 weeks of age increased in PB-2 line and decreased in PB-1 and control lines as compared to previous generation. Egg production up to 40 weeks in PB-1, PB-2 and control lines was 64.66, 68.61 and 55.36 eggs, respectively. Genetic response over last 11 generations for 5 week body weight was 20.65 g in PB-1 and 11.52 g in PB-2 population. A total of 1,02,049 germplasm was supplied to 300 farmers. The centre generated revenue of Rs. 25.25 lakhs, which was 121% of expenditure on feed cost (Rs. 22.80 lakhs).

ICAR-CARI centre evaluated the local native chicken, CSML and CSFL. The body weight of local native chicken germplasm at 6 and 12 weeks was 504.6 and 1,140 g, respectively. Body weight of CSML X Desi birds at 6, 8 and 12 weeks was 1,065, 1,368 and 1,847 g, respectively. The body weight at 5 weeks maintained in CSML and CSFL and decreased in control line. The FCR at 5 weeks of age in CSML and CSFL was 1.8 and 1.81. The 40 week egg production increased in CSML and CSFL and decreased in control as compared to previous generation. The phenotypic response of body weight at 5 weeks per generation was 14.77 and 14.69 g in CSML and CSFL, respectively. The genetic response was 15.13 and 15.01 g, respectively. Trademark of CARIBRODHANRAJA™ was obtained. A total of 51,388 germplasm was supplied to farmers. Revenue generation was Rs. 8.03 lakhs.

Bhubaneswar centre evaluated *Hansli*, CSML, CSFL and their crosses during the year. The average body weight at day old and 8 weeks of *Hansli* chicken was 32.34 and 587 g. The egg production up to 40 and 50 weeks in *Hansli* (S-2) was 23.14 and 33.25 eggs, respectively. In the current year, the body weight at 5 weeks was 1,025 and 1,129 g in CSFL and CSML, which improved from the last generation. Egg production up to 40 weeks in CSFL and CSML were 52.39 and 66.45 eggs, respectively. The centre has supplied 18,810 day old chicks to farmers. The centre has generated a revenue of Rs. 4.44 lakhs, which was 31% of total feed cost (Rs. 14.12 lakhs).

Tripura centre evaluated Tripura Black, Dahlem Red, broiler dam line, BN and BND cross. The body weight at 8 weeks was 306.5, 495, 1,102 and 512.9 g and at 20 weeks was 1,116, 1,601, 2,789 and 1,593 g, respectively in Tripura Black, Dahlem Red, Coloured broiler dam line and BN cross. Body weight at 8 weeks in BND cross at farm and field was 499 and 403 g, respectively. During E-3 evaluation, the 52 week egg production was 94.8 and 82.75 eggs under farm and field conditions, respectively in BND cross. A total of four training programmes on backyard poultry farming for tribal farmers were organized. A total of 25,275 germplasm was supplied to 300 beneficiaries. The centre generated a revenue of Rs. 10.26 lakhs, which was 59% of expenditure on feed cost (Rs. 17.40 lakhs).

Jabalpur centre evaluated G-9 generation of *Kadaknath* and Jabalpur colour populations up to 52 weeks of age. *Narmadanidhi* birds were evaluated in farm and field up to 52 weeks of age. The 6 week body weight was 343.3 and 803.7g in *Kadaknath* and Jabalpur colour population, respectively. The hen housed egg production up to 40 weeks of age was 91.9 eggs in JBC and 57.3 eggs in *Kadaknath*. *Narmadanidhi* produced 49, 88 and 176 eggs up to 40, 52 and 72 weeks, respectively in field conditions. The egg production increased in both farm and field conditions. A total of 56,432 germplasm was supplied to 184 beneficiaries. The centre generated a revenue of Rs. 20.67 lakhs, which was 116% of expenditure on feed cost (17.90 lakhs).

Guwahati centre evaluated native, Dahlem Red, PB-2 and *Kamrupa* populations during the year. The 5 weeks body weight was 132.5g in native, 1,165 g in PB-2 and 360.2g in Dahlem Red. The egg production up to 52 weeks was 67.5 eggs in native population. The 52 week egg production in Dahlem Red was 120.6 eggs which improved by 3.1 eggs from the last generation. In *Kamrupa*, the 5 weeks body weight was 250.5 and 210.6 g in the farm and field, respectively. The egg production up to 40 and 52 weeks of age was 49.2 and 90.4 eggs in the farm and 43.6 and 73.7 eggs in the field conditions, respectively. The centre supplied 30,720 germplasm to farmers. The centre realized receipt of Rs. 6.26 lakhs, which was 52% of expenditure on feed cost (Rs.12.09 lakhs).

Ranchi centre evaluated native chicken, Dahlem Red, PB-2 and their cross, *Jharsim*. The body weight at 20 weeks of age was 989.2 g in native and 1,218 in Dahlem Red. The 40 week egg production was 32.33 and 45.38 eggs in native and Dahlem Red birds, respectively. The body weight at 20 weeks of age was 1,791g in males and 1,554 g in females. The centre supplied 25,323 germplasm to the farmers. The centre generated a revenue of Rs. 6.70 lakhs, which was 87% of expenditure on feed cost.

Palampur centre evaluated native, *Dahlem Red* and *Himsamridhi* chicken during the year. The body weight at 8 weeks of age was 530.3 and 617.1 g in native and Dahlem Red, respectively. The egg production up to 52 weeks of age was 84.31 eggs in native and 148.35 eggs in Dahlem Red. The egg production showed improvement in native and DR populations as compared to previous year. The annual egg production (72 weeks) of *Himsamridhi* was 145.65 eggs under field conditions. During the year, the centre supplied 44,584 chicken germplasm to 631 farmers. The centre realised receipts of Rs 13.19 lakhs during the financial year, which was 70% of expenditure on feed cost (Rs. 18.90 lakhs).

Udaipur centre evaluated *Mewari,* RIR, CSFL BN and BNR populations. The eight week body weight was 640.9 in *Mewari*, which increased from the last generation. The egg production up to 52 weeks of age was 69.23 eggs in *Mewari* chicken. The egg production up to 40, 52 and 72 weeks was 62.26, 100.42 and 166.1 eggs, respectively in *Pratapdhan* during E-7. The egg production showed a decreasing trend from the last generation. A total of 76,681 chicken germplasm was supplied during the current year. The centre realized a receipt of Rs. 14.9 lakhs during the current financial year, which is 95% of expenditure on feed cost.

Table 1. Germplasm distribution and revenue generation during 2018-19

Centre	Germplasm (Nos.)	Revenue (Rs. in Lakhs)
KVASU, Mannuthy	1,33,829	35.01
AAU, Anand	46,983	26.16
KVAFSU, Bengaluru	1,95,795	52.34
GADVASU, Ludhiana	1,02,049	25.51
OUAT, Bhubaneswar	18,810	4.44
ICAR-CARI, Izatnagar	51,388	8.03
MPUAT, Udaipur	76,681	14.90
NDVSU, Jabalpur	56,432	20.67
AAU, Guwahati	30,720	6.26
CSKHPKVV, Palampur	44,584	13.19
BAU, Ranchi	25,323	6.70
ICAR-RC, Agartala	25,275	10.26
Total	8,07,869	223.47

8. Poultry Seed Project

The "Poultry Seed Project" was evolved with an objective to increase the availability of rural chicken germplasm in remote areas of our country. In this endeavour, the Indian Council of Agricultural Research has initiated "Poultry Seed Project" during the XI five year plan with six centres, three in the northeast region and three in different state veterinary/agricultural universities. The project has been strengthened during the XII plan by adding five more centres to cater to needs of the farmers in their respective regions. At present, the project is being operated at 12 centres across the country. The main objective of this project is local production of improved chicken germplasm (fertile eggs, day old chicks and grownup chicks) and supply to various stake holders in the remote areas to target production enhancement of egg and meat for augmenting rural poultry production, socio-economic condition of the target groups and linking small scale poultry producers with organized market.

The PSP centres are located at West Bengal University of Animal and Fishery Sciences, Kolkata; Bihar Animal Sciences University, Patna; ICAR Research complex for NEH region, Nagaland regional centre, Jharnapani; ICAR–National Organic Farming Research Institute, Gangtok; ICAR Research complex for NEH region, Manipur regional centre, Imphal; Tamil Nadu Veterinary and Animal Sciences University, Hosur; ICAR-Central Coastal Agricultural Research Institute, Panaji; ICAR-Central Island Agricultural Research Institute, Port Blair; Sher-e-Kashmir University of Agricultural Sciences and Technology, Srinagar; PVNR Telanagna Veterinary University, Warangal; Sri Venkateswara Veterinary University, Tirupati and ICAR Research Complex for NEH Region, Umiam.

The Directorate as a coordinating unit, supplies parent chicks, co-ordinates and monitors the activities of different centres to enable them to achieve the set targets for each centre. The target set for supplying chicks for mainland and north-east centres during the year were between 0.3 and 1.0 lakhs chicks per annum for different centres and to collect feedback on the performance of the germplasm under backyard farm conditions. A total of 6,47,194 improved chicken varieties have been distributed in their respective regions/states with a revenue receipts of Rs. 166.65 lakhs during the year.

Eight batches of *Vanaraja* parents were reared during the year at Kolkata centre, out of which, five are in laying and three batches were culled after the end of economic laying. The egg production of 50% was achieved at 31 weeks and maintained up to 67 weeks. Fertility ranged from 86.28% to 91.16%. Hatchability on total eggs set (TES) and fertile eggs set (FES) was consistent throughout the life cycle reaching up to 81.52% (TES) and 88.32% (FES). A total of 92,848 *Vanaraja* chicks were distributed to the farmers in various parts of West Bengal during the year. The total revenue generated was Rs. 17.92 lakhs.

Two batches of *Vanaraja* parents were reared at Patna Centre. The average age at sexual maturity was 180 days in *Vanaraja* female parents. The HDEP in *Vanaraja* at 36 weeks of age was 51.35% with an egg weight of 50.88 g. The average fertility percentage was 78.27 and the average hatchability on TES and FES was 68.37% and 72.54%, respectively in *Vanaraja* female line. A total of 69,179 *Vanaraja* chicken germplasm was distributed to the farmers in Bihar during the year with an amount of Rs. 12. 03 lakhs revenue.

A total of 2042 parents of *Vanaraja* and *Srinidhi* were in position at present in Jharnapani centre. The production of 50% was attained at 36 weeks of age in *Vanaraja* parents. The overall fertility rate was 73.58% and 81.9% in *Vanaraja* and *Srinidhi* female lines respectively. The overall hatchability on fertile eggs set was 70.11% in *Vanaraja* and 69.66% in *Srinidhi* parents, respectively. A total of 83,508 improved chicken germplasm was distributed to farmers of Nagaland and neighbouring states during the year. A total of Rs. 33.33 lakhs revenue was generated at Jharnapani Centre. The centre achieved the target of germplasm.

Two batches of *Vanaraja* parents were reared at ICAR-NOFRI, Gangtok, Sikkim. The average HDEP in *Vanaraja* was 51.74 (24-72 weeks) during the year. Peak production (72%) was attained at 31-34 weeks of age. The average fertility and hatchability (TES) rates in *Vanaraja* female line were 87.53 and 78.83%, respectively. A total of 89,495 improved chicken germplasm of *Vanaraja* was distributed to 3,371 farmers covering 667 village habitats in Sikkim with an amount of Rs. 16.77 lakhs revenue. The centre achieved the set target of germplasm.

Three batches of *Vanaraja, Gramapriya* and *Srinidhi* parents were reared at Manipur Centre during the year. The average HHEP was 18.57% (55-72 weeks) in *Vanaraja* and 32.7% (24-72 weeks) in *Srinidhi* parents. The average fertility was 80.65 and 86.06% in *Vanaraja* and *Srinidhi* parents, respectively. The hatchability on TES was 58.05% in *Vanaraja* and 66.73% in *Srinidhi* parents. A total 79,425 improved chicken germplasm was distributed to the farmers in Manipur. The Centre has generated Rs. 22.4 lakhs of revenue during the year. The centre achieved the targeted germplasm supply.

Four batches of *Vanaraja* and three batches of *Gramapriya* parents were reared at Hosur Centre during the reporting period. The HDEP ranged from 69 to 52% during 42 – 72 weeks of age and HHEP of 175 at 72 weeks of age in *Vanaraja* (III batch). Similarly, the HDEP ranged from 86 to 64% during 23 – 72 weeks of age with HHEP of 191 at 72 weeks of age in *Gramapriya* (III batch). The average fertility was 88.33% (42-72wks) in *Vanaraja* and 87.65% (28-72 wks) in *Gramapriya*, respectively. A total of 1,42,674 improved rural chicken (*Vanaraja* and *Gramapriya*) germplasm was distributed to 1,248 farmers in Tamil Nadu. The Centre has generated total revenue of Rs. 36.03 lakhs during the year. The centre has achieved the targeted germplasm supply.

One batch of *Srinidhi* parents were reared at Goa during the year. The body weight of female and male parent of *Srinidhi* was 1270.5 and 3042 g, respectively. A total of 1,357 improved chicken germplasm was distributed to 42 farmers in Goa with a revenue of Rs. 2,27,708.

Two batches of *Vanaraja* parents were reared under deep litter system at Port Blair. The age at sexual maturity (ASM) was 178 days in *Vanaraja* female line. HDEP was highest (37.87%) in 40th week of age. A total of 21,009 improved chicken germplasm were distributed to 246 farmers in Andaman & Nicobar Islands with revenue of Rs. 97,250 during the year.

Two batches of *Vanaraja* breeders were reared during the year at Srinagar. The age at first egg was 170 days. The average egg production was above 60% (59-62%) from 56 weeks to 72 weeks of age. The average hatchability on total egg set was 60.11% in *Vanaraja* parents. A total of 37,630 *Vanaraja* germplasm was distributed to farmers of Jammu and Kashmir.

Two batches of *Vanaraja* and *Srinidhi* parents were reared at ICAR-RC for NEH Region, Umiam, Barapani. The HDEP at 52 weeks of age was 33.5% in *Vanaraja* and 27% in *Srinidhi* parents. The fertility and hatchability (TES) ranged from 79-87 and 61-75%, respectively in *Vanaraja* parents and were 79-83 and 56-62% in *Srinidhi* parents, respectively. A total of 30,206 improved chicken germplasm was distributed to the farmers in Meghalaya with an amount of Rs. 11.61 lakhs of revenue during the year.

One batch of *Vanaraja* parents were maintained at SVVU, Tirupati, Andhra Pradesh. A total of 8,763 chicks were supplied to the farmers and generated Rs. 3.23 lakhs as revenue by sale of chicks and eggs during the period.

Two batches of *Vanaraja* and *Gramapriya* parents were reared at PVNRTVU, Warangal, Telangana during the reporting period. The ASM was 142 days (20th wk) in *Vanaraja* female line. The highest egg production (67.38%) was recorded at 46th week of age in the entire laying cycle. The average HDEP was 41.5 (28-52 weeks). The average fertility was 83.67% (24-51 wks) in *Vanaraja* parents. A total of 10,223 improved rural chicken (*Vanaraja*) germplasm was distributed to the farmers. The centre has generated total revenue of Rs. 1.81 lakh during the year.

Table 1. Centre wise distribution of germplasm under Poultry Seed Project

Sl. No.	Centre	Germplasm (Nos.)	Revenue (Rs. in lakhs)
1	WBUAFS, Kolkata	92,848	17.92
2	BASU, Patna	69,179	12.3
3	ICAR-RC, Jharnapani	83,508	33.33
4	ICAR-NOFRI, Gangtok	89,495	16.77
5	ICAR-RC, Imphal	79,425	22.41
6	TANUVAS, Hosur	1,42,674	36.03
7	ICAR-CCARI, Goa	1,220	2.27
8	ICAR-CIARI, Port Blair	21,009	0.97
9	SKUAST, Srinagar	37,630	8.00
10	ICAR-RC for NEHR, Umiam	30206	11.61
11	PVNRTVU, Warangal	10,223	1.81
12	SVVU, Tirupati	35,483	3.23
	Total	647,19,4	166.65

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10. Ongoing Research Projects

Institute projects

S. No.	Project Title	PI	Co-PIs
1.	Development and improvement of male lines for production of backyard chicken varieties for free range farming	U. Rajkumar	Santosh Haunshi Leslie Leo Prince Chandan Paswan
2.	Improvement and evaluation of female lines for backyard/ free range farming	U. Rajkumar	S.P. Yadav Leslie Leo Prince
3.	Genetic characterization and conservation of indigenous chicken germplasm	Santosh Haunshi	U. Rajkumar
4.	Genetic evaluation of elite layer germplasm	Chandan Paswan	R.N. Chatterjee T.K. Bhattarcharya
5.	Maintenance of coloured broiler populations for intensive and semi intensive broiler farming	B.L.N. Reddy	Leslie Leo Prince
6.	Genetic improvement of a synthetic coloured broiler female line (PB-2)	Leslie Leo Prince	U. Rajkumar B.L.N. Reddy
7.	Characterization of chicken ovalbumin and growth hormone receptor genes for development of transgenic cassette	T.K. Bhattarcharya	R.N. Chatterjee Chandan Paswan
8.	Genotyping MHC class I loading complex genes (TAP1, TAP2 and Tapasin) for their association with immunocompetence traits in chicken	S.P. Yadav	T.R. Kannaki
9.	Development of nutritional package of practices for backyard chicken production	B. Prakash	S. S. Paul A. Kannan
10.	Utilization of distillery by-products in poultry diet : the nutritional implications and strategies for improving the nutritional value	M.V.L.N. Raju	S.V. Rama Rao B. Prakash S.S. Paul A. Kannan
11.	Development of a composite feed additive using promising organic acids and plant bioactive compounds for improving gut health and productivity in chicken	S. S. Paul	M.V.L.N. Raju B. Prakash S.V. Rama Rao S.P. Yadav
12.	Production of designer eggs enriched with critical trace minerals relevant to human nutrition	A. Kannan	B. Prakash M.V.L.N. Raju S.V. Rama Rao
13.	Exploring medicinal plants as alternative to antibiotic growth promoters (AGP) in broiler production	D. Suchitra Sena	B. Prakash
14.	Disease resistance/tolerance in backyard chicken varieties and strategies for improving vaccine mediated immune response	T. R. Kannaki	Santosh Haunshi D. Suchitra Sena
15.	Disease diagnosis, vaccination & sero-monitoring in pureline chickens	T.R. Kannaki	S.K. Bhanja
16.	Role of plasma ghrelin, leptin and growth hormone in regulation of physiological functions of chicken during summer season	N. Anand Laxmi	M. Shanmugam R.K. Mahapatra

17.	Sustainable poultry waste management through composting	R. K. Mahapatra	N. Anand Laxmi M. Shanmugam B. Prakash S. K. Bhanja P. K. Pankaj (ICAR-CRIDA) Mohd. Osman (ICAR-CRIDA)
18.	Evaluation and standardization of protocols for cryopreserving semen of DPR purelines	M. Shanmugam	R.K. Mahapatra

Externally funded research projects

Sl. No.	Project Title	PI	Co-PIs
1.	Functional genomics, epigenetics and gene silencing technology for improving productivity in poultry (National Fellow)	T.K. Bhattacharya	-
2.	Management and nutritional strategies to ameliorate thermal stress in poultry production (NICRA)	S.V. Rama Rao	M.V.L.N. Raju U. Rajkumar B. Prakash T.R. Kannaki
3.	Production of chelated selenium, zinc and copper through yeast cells and their supplemental effect on performance and anti-oxidant status in broiler chicken (DST-SERB)	B. Prakash	-
4.	Effect of dietary supplementation of biofortified maize (QPM) on productive performance in broilers chickens (Network project)	B. Prakash	S.V. Rama Rao M.V.L.N. Raju
5.	Development of transgenic chicken for production of human interferon alpha 2b : A therapeutic protein for treatment of viral diseases in human (DBT)	T.K. Bhattacharya	R.N. Chatterjee Chandan Paswan
6.	Chicken or egg : Drivers of antimicrobial resistance in poultry in India (DBT)	S.V. Rama Rao	S.S. Paul
7.	Understanding the epigenetic methylation and miRNA mediated gene regulation of transcellular calcium transport genes in avian uterus during egg calcification (DST-SERB)	Chandan Paswan	R.N. Chatterjee M. Shanmugam

Contract Research / Consultancy Projects

S. N.	Project	Client	Duration	PI/Scientist
1.	Evaluation of sea plant extract in broiler chicken diet *(Contract research project)*	M/s Sea 6 Energy Private Limited, Bangalore	8 months, w.e.f. 7.8.2018	S.S. Paul
2.	Techno scientific advisory services to organized poultry research farm on nutrition and health care *(Consultancy)*	M/s Sri Ramadhootha Poulltry Research Farm, Ranga Reddy Dist, Telangana	36 months, w.e.f. 19.12.2015	S.V. Rama Rao

11. Consultancy, Contract Research and Commercialization of Technologies

Commercialization of Technologies

ICAR-Directorate of Poultry Research has developed three rural chicken varieties suitable for backyard farming (*Vanaraja, Gramapriya, Srinidhi*) and two varieties for intensive poultry (*Krishibro* and *Krishilayer*). There is huge demand for these chicken varieties and are widely distributed across the country. For wide and efficient distribution of these varieties of chicken throughout the country, a national project in the form of "Poultry Seed Project" funded by the ICAR has been initiated during the XI Plan. These chicken varieties are supplied to State Animal Husbandry Departments, State Agriculture Universities, ICAR Institutions, NGOs and farmers.

The Directorate has supplied total of 1,52,913 hatching eggs, 2,82,499 day old and grown up chicks of *Vanaraja, Gramapriya, Srinidhi, Krishibro* and *Krishilayer* during 2018-19.

Advisory consultancy

Sri Ramadhootha Poulltry Research Farm, Kothur village, Kandukur Mandal, Ranga Reddy Dist., Telangana on "Techno scientific advisory services to organized poultry research farm on nutrition and health care" for 3 years since December 2015, Rs. 4.7 lakhs.

Contract research

Evaluation of seaweed plant extract in broiler chicken diet for M/s Sea6 Energy Private Ltd., Bellary Road, Bengaluru for 8 months from August 2018, Rs. 8.58 lakhs.

Workshop on Intellectual Property Rights

The ITMU, ICAR-DPR organized a workshop on "Intellectual Property Rights (IPR)" on 18 February 2019. The Director, scientists and technical staff participated in the workshop. The purpose of the workshop was to enhance awareness about Intellectual Property Rights for effective IP management. The programme included two guest lectures by Dr. M. Elangovan, Principal Sceintist and I/c ITMU, ICAR-IIMR, Hyderabad and by Dr. Poornima Chandran, Prometheus Patent Services, Hyderabad.

IPR workshop

Patent granted

The first patent for the Directorate was granted by the Indian Patent Office, Chennai in March 2019.

Title of the patent: Diagnostic kit, primers and method for sex determination in chicks and adults of avian species.

Patent No.: 309612

Inventor: Dr. T.K. Bhattacharya

Patent filed

Title of the patent: Paper-dip assay kit for detection of myostatin/other proteins in blood serum of poultry/animals/human and use of myostatin detected by this method for predicting future growth in poultry.

Application No. : TEMP/E-1/30619/2018-CHE

Filing date: 25/07/2018

Applicant : Dr. T.K. Bhattacharya

NCBI GenBank Accession

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12. Committees

Fourth Quinquennial Review Team (2012-17)

The fourth Quinquennial Review Team (QRT) for the period 2012-2017 was constituted by Council under the Chairmanship of Prof. Purnendu Biswas, Vice Chancellor, West Bengal University of Animal & Fishery Sciences, Kolkata. The QRT began the review during January 2018 and held series of meetings and visited the institute, and some centres of AICRP, and PSP. The final meeting of QRT was held from 19th to 21st April 2018, where the report was finalized and recommendations were made. The interactive meeting of IMC with the Chairman, QRT was conducted on 19 September 2018 where the recommendations of the QRT were presented. The QRT report was submitted to Council during December 2018.

QRT visiting commercial layer farm

QRT meeting in progress

Research Advisory Committee

The meeting of the common Research Advisory Committee of ICAR-DPR and ICAR-CARI was held under the chairmanship of Dr. V. Prabhakar Rao on 28 April 2018 at ICAR-CARI, Izatnagar. The Directors of both the Institutes presented the overall research and developmental activities of the respective institute. The work progress of different sections was presented by the section incharges. The Chairman appreciated the research outcome from both the institutes.

Institute Research Committee Meeting

The annual IRC meeting for the year 2017-18 and half-yearly IRC meeting for the year 2018-19 were held on 12 April 2018 and 27 November 2018, respectively under the chairmanship of Dr. R.N. Chatterjee, Director. Principal Investigators presented the achievements of the research projects which were deliberated. The Chairman emphasized on exploring technologies in the field of poultry science research for doubling farmers' income.

Half yearly IRC in progress

Annual Review Meeting of AICRP on Poultry Breeding and Poultry Seed Project

The Annual Review Meeting of All India Coordinated Research Project (AICRP) on Poultry Breeding and Poultry Seed Project (PSP) was organised on 23 and 24 August 2018 at ICAR Research Complex for NEH Region, Umiam, Meghalaya. Dr. J. K. Jena, Deputy Director General (Animal Science) graced the occasion as Chief Guest. He urged upon the scientists to work hard to fulfill the dream "Doubling Farmers Income" of Hon'ble Prime Minister of India. Dr. R. S. Gandhi, ADG (AP&B), ICAR, New Delhi emphasized on the need of production and dissemination of superior backyard poultry germplasm for nutritional and livelihood security of rural masses. Dr. R.N.

Chatterjee, Director, appreciated the performance of the PSP centres located in different parts of the country. Dr. A. Sharma, Director, ICAR-NBAGR, Karnal and Dr. S. Rajkhowa, Director, ICAR-NRC on Pig, Guwahati also expressed their views on this occasion. Dr. N. Prakash, Director, ICAR Research Complex for NEH Region, Umiam delivered the welcome address. Centre In-charges of 12 AICRP and 12 Poultry Seed Project Centres covering different states of the country participated in the review meeting.

Annual review meeting of AICRP on Poultry Breeding and Poultry Seed Project in progress

IAEC meeting

XXII Institutional Animal Ethics Committee Meeting was conducted on 29 September 2018 at ICAR-DPR, Hyderabad, wherein proposals on animal experiments were reviewed and approved.

Institute Joint Staff Council (IJSC) Meetings

The 4th and 5th meetings of 10th IJSC were held on 11 September 2018 and 31 December 2018.

Institute Management Committee Meeting

The Institute Management Committee meeting was held on 19 September 2018.

13. Participation in Seminars, Conferences, Meetings and Workshops

Sl. No.	Particulars of Training	Official(s)	Schedule	Organisers and Venue
1.	International Day for Biological Diversity (IDB)	Dr. R. K. Mahapatra, Pr. Scientist Dr. Santosh Haunshi, Pr. Scientist Dr. A. Kannan, Pr. Scientist Dr. Leslie Leo Prince, Pr. Scientist	22 May 2018	NBA and TS Biodiversity Board, PJTSAU, Hyderabad
2.	International Meeting on Veterinary and Animal Science	Dr. N. Anand Laxmi, Pr. Scientist	6 -7 August 2018	Dubai, UAE
3.	Hindi workshop (Town Official Language Implementation Committee-2, Hyderabad)	Dr. S.P. Yadav, Pr. Scientist	8 August 2018	NFDB, Hyderabad
4.	Annual Review Meeting of AICRP on Poultry Breeding & Poultry Seed Project	Dr. R.N. Chatterjee, Director Dr. U. Rajkumar, Pr. Scientist Dr. Leslie Leo Prince, Pr. Scientist	23-24 August 2018	ICAR Research Complex for NEH Region, Umiam
5.	Workshop on "Genomic selection"	Dr. T.K. Bhattacharya, National Fellow	17 September 2018	ICAR-IVRI, Izatnagar
6.	Fourth Biennial Conference & National Symposium of AAHP on "The way forward to ensure food security and food safety"	Dr. D. Suchitra Sena, Pr. Scientist Dr. T.R. Kannaki, Sr. Scientist	26-27 October 2018	Mohali, Chandigarh
7.	पाठयक्रम हिंदी भाषा अल्पकालिक गहन (पारंगत 20 पूर्ण कार्य दिवस)	Dr. S.P. Yadav, Pr. Scientist	1 November - 3 December 2018	Department of Official language (GOI) at ICAR-DPR
8.	Meat Tech 2018 Conference on " Technology Trends & Opportunities in Meat & Allied Industries for a New Pink Revolution"	Dr. R.K. Mahapatra, Pr. Scientist Dr. S.P. Yadav, Pr. Scientist Dr. Leslie Leo Prince, Sr. Scientist	2 November 2018	Confederation of Indian Industry, ITC Kakatiya, Hyderabad
9.	XXXV Annual conference of IPSA and National Symposium, IPSACON-2018 on "Rural Poultry Production: Challenges for sustainable entrepreneurship development".	Dr. R N. Chatterjee, Director Dr. U. Rajkumar, Pr. Scientist Dr. D. Suchitra Sena, Pr. Scientist Dr. Santosh Haunshi, Pr. Scientist Dr. B. Prakash, Sr. Scientist Dr. T.R. Kannaki, Sr. Scientist Dr. S. K. Bhanja, CTO	15-17 November 2018	ICAR-CIARI, Port Blair, Andaman and Nicobar Islands
10.	BIS workshop on "Outside laboratories (OSLs) under its laboratory recognition scheme (LRS2018)"	Dr. T.K. Bhattacharya, National Fellow	16 November 2018	BIS, Chennai

Sl. No.	Particulars of Training	Official(s)	Schedule	Organisers and Venue
11.	International Symposium and VIII-IMSACON-2018	Dr. T.K. Bhattacharya, National Fellow	22-24 November 2018	WBUAFS, Kolkata
12.	Knowledge Day Seminar by Poultry India	Dr. S. V. Rama Rao, Pr. Scientist Dr. M.V.L.N. Raju, Pr. Scientist Dr. B.L.N. Reddy, Pr. Scientist Dr. U. Rajkumar, Pr. Scientist Dr. T.K. Bhattacharya, Pr. Scientist Dr. R.K. Mahapatra, Pr. Scientist Dr. Santosh Haunshi, Pr. Scientist Dr. S.P. Yadav, Pr. Scientist Dr. A. Kannan, Pr. Scientist Dr. L.L.L. Prince, Pr. Scientist Dr. M. Shanmugam, Sr. Scientist Dr. T.R. Kannaki, Sr. Scientist	27 November 2018	Novotel, Hitech City, Hyderabad
13.	XXVII Annual conference of Society of Animal Physiologists of India	Dr. N. Anand Laxmi, Pr. Scientist	27-28 November 2018	NDRI, Karnal, Haryana
14.	Interactive Meet on Characterization and Registration of Animal Genetic Resources in India organized by NBAGR	Dr. Santosh Haunshi, Pr. Scientist Dr. L.L.L. Prince, Sr. Scientist	3 December 2018	NASC Complex, New Delhi
15.	3rd National Workshop of Officer In-charge, Data Management, ICAR Research Data Repository for Knowledge Management	Dr. Santosh Haunshi, Pr. Scientist	4 December 2018	NASC Complex, New Delhi
16.	First National Genetics Congress (NGS)	Dr. T.K. Bhattacharya National Fellow Dr. S.P. Yadav, Pr. Scientist	14-16 December 2018	IARI, New Delhi
17.	Interactive session on 'One Health: Unprecedented Opportunities and Challenges'	Dr. D. Suchitra Sena, Pr. Scientist Dr. M. Shanmugam, Sr. Scientist	17 December 2018	ICAR-NRCM, Hyderabad
18.	National Seminar on "IoT Inspired Food Safety and Residue Detection (Sensfood)" Organized by C-DAC, Kolkata.	Dr. A. Kannan, Pr. Scientist	18 December 2018	Indismart Hotel, Salt lake, Kolkata
19.	National Conference on "Native Chicken production: Opportunities for conservation, productivity enhancement and commercial exploitation in view of global warming"	Dr. R.N. Chatterjee, Director Dr. U. Rajkumar, Pr. Scientist Dr. Leslie Leo Prince, Pr. Scientist	19-20 December 2018	Madras Veterinary College, TANUVAS, Chennai

Sl. No.	Particulars of Training	Official(s)	Schedule	Organisers and Venue
20.	Seminar on "Sustainability of small farmer in changing Agricultural Scenario" organized by RICAREA, Hyderabad	Dr. S. V. Rama Rao, Pr. Scientist Dr. M.V.L.N. Raju, Pr. Scientist Dr. B.L.N. Reddy, Pr. Scientist Dr. T.K. Bhattacharya National Fellow Dr. N. Anand Laxmi, Pr. Scientist Dr. S.S. Paul, Pr. Scientist Dr. U. Rajkumar, Pr. Scientist Dr. R.K. Mahapatra, Pr. Scientist Dr. S.P. Yadav, Pr. Scientist Dr. A. Kannan, Pr. Scientist Dr. L.L.L. Prince, Pr. Scientist Dr. M. Shanmugam, Sr. Scientist Dr. T.R. Kannaki, Sr. Scientist	22 December 2018	PJTSAU, Hyderabad
21.	Technical Seminar by Poultry Vet Federation	Dr. T.R. Kannaki, Sr. Scientist	28 December 2018	Namakkal, Tamil Nadu
22.	UK & International Veterinary Vaccinology Network Conference	Dr. T.R. Kannaki, Sr. Scientist	9-10 January 2019	London, UK
23.	XVI National Symposium of Society for Conservation of Domestic Animal Biodiversity	Dr. L.L.L. Prince, Pr. Scientist Dr. M. Shanmugam, Sr. Scientist	7-8 February 2019	ICAR-NBAGR, Karnal
24.	XIV Agricultural Science Congress	Dr. T.K. Bhattacharya National Fellow	20-23 February 2019	NASC Complex, New Delhi
25.	Training-Cum-Workshop for Unit level data repository for AICRPs (AICRP on Poultry Breeding) under ICAR Research Data Repository for Knowledge Management (KRISHI portal)	Dr. Santosh Haunshi, Pr. Scientist	25 February 2019	IASRI, PUSA, New Delhi

14. Distinguished Visitors

- Dr. Trilochan Mohapatra, Secretary, DARE & Director General, ICAR
- Shri B. Pradhan, Additional Secretary & Financial Advisor, DARE/ICAR
- Dr. A. K. Shrivastav, Chairman, ASRB
- Dr. J. K. Jena, DDG (Fisheries and Animal Sciences), ICAR
- Prof. Purnendu Biswas, VC, WBUAFS
- Dr. R. S. Gandhi, ADG (AP & B), ICAR, New Delhi
- Dr. Ashok Kumar, ADG (AH), ICAR, New Delhi
- Dr. S.C. Mohapatra, Founder Director, PDP
- Dr. R. P. Sharma, Former Director, PDP
- Dr. V. Prabhakar Rao, Former VC, SVVU, Tirupati
- Dr. A. Padma Raju, Former VC, ANGRAU, Hyderabad
- Dr. S. K. Agarwal, Former Director, CIRG
- Dr. S.K. Dwivedi, Former Director, NRCE
- Dr. A. Kundu, Director, ICAR-CIARI, Port Blair

Dr. R.N. Chatterjee explaining about research activities to Shri B. Pradhan and Dr. J.K. Jena

Dr. Trilochan Mohapatra planting a sapling at the Institute

15. Personnel

Research Management Position

1. Dr. R.N. Chatterjee, Director (Acting)

Scientific

1. Dr. S.V. Rama Rao, Pr. Scientist
2. Dr. M.V.L.N. Raju, Pr. Scientist
3. Dr. B.L.N. Reddy, Pr. Scientist
4. Dr. (Mrs.) N. Anand Laxmi, Pr. Scientist
5. Dr. Shyam Sundar Paul, Pr. Scientist
6. Dr. U. Rajkumar, Pr. Scientist
7. Dr. R.K. Mahapatra, Pr. Scientist
8. Dr. (Mrs.) D. Suchitra Sena, Pr. Scientist
9. Dr. Santosh Haunshi, Pr. Scientist
10. Dr. S.P. Yadav, Pr. Scientist
11. Dr. A. Kannan, Pr. Scientist
12. Dr. L. Leslie Leo Prince, Pr. Scientist
13. Dr. B. Prakash, Sr. Scientist
14. Dr. M. Shanmugam, Sr. Scientist
15 Dr. (Mrs.) T.R. Kannaki, Sr. Scientist
16. Dr. Chandan Paswan, Sr. Scientist

Administration

1. Sri A.V.G.K. Murthy, A.O.
2. Sri C. Bagaiah, A.F. & A.O.
3. Smt. O. Suneeta, P.S.
4. Smt. R.T. Nirmala Veronica, A.A.O.
5. Sri R. Sudarshan, J.A.O.
6. Smt. T.R. Vijaya Lakshmi, Assistant
7. Smt. M. Kamala, Assistant
8. Sri Rajesh Parashar, U.D.C.
9. Sri L.V.B. Prasad, U.D.C.
10. Miss N. Siva Dharani, L.D.C.
11. Sri R. Ganesh, L.D.C.

National Fellow

1. Dr. T.K. Bhattacharya, National Fellow

Technical

1. Dr. S.K. Bhanja, C.T.O. (Farm Manager)
2. Sri V.V. Rao, A.C.T.O.
3. Smt. Minakshi Dange, A.C.T.O.
4. Sri D. Pratap, A.C.T.O.
5. Sri J. Srinivas Rao, A.C.T.O.
6. Sri A. Ravi Kumar, Tech. Officer
7. Sri G. Rajeshwar Goud, Tech. Officer
8. Sri A. Subrahmanyam, Tech. Officer
9. Sri Md. Maqbul, Tech. Officer (Driver)
10. Smt. N.R. Dhanutha, Sr. Tech. Asst.
11. Sri M. Pantulu, Sr. Tech. Asst. (Driver)
12. Sri Md. Yousufuddin, Sr. Tech. Asst. (Driver)
13. Sri P. Santosh Phani Kumar, Tech. Asst.

Skilled Support Staff

1. Sri Syed Mujtaba Ali
2. Sri D. Ashok Kumar
3. Sri N. Manyam
4. Sri K. Charles
5. Sri G. Narsimha
6. Sri Manzoor Ahmed
7. Sri D. Srinivas
8. Sri M. Narsing Rao
9. Sri V. Ravinder Reddy
10. Sri P. Shankaraiah
11. Sri K. Venkataiah
12. Sri D. Shiva Kumar
13. Smt. K. Vimala

Promotions

- Dr. L.L.L. Prince, Sr. Scientist has been promoted to the next higher grade of Pr. Scientist w.e.f. 21 January 2016.
- Smt. O. Suneeta, PS to Director has been granted 3rd and Final Financial upgradation under MACPS w.e.f. 1 September 2018.
- Sri Rajesh Parashar, UDC has been granted 3rd and Final Financial upgradation under MACPS w.e.f. 12 May 2018.
- Sri L.V.B. Prasad, UDC has been granted 3rd and Final Financial upgradation under MACPS w.e.f. 17 October 2018.
- Sri Syed Mujtaba Ali, SSS has been granted 3rd and Final Financial upgradation under MACPS w.e.f. 17 September 2018.
- Sri D. Ashok Kumar, SSS has been granted 3rd and Final Financial upgradation under MACPS w.e.f. 17 October 2018.
- Sri N. Manyam, SSS has been granted 3rd and Final Financial upgradation under MACPS w.e.f. 19 October 2018.
- Sri K. Charles, SSS has been granted 3rd and Final Financial upgradation under MACPS w.e.f. 21 October 2018.
- Late Sri G. Vijay Kumar, SSS has been granted 3rd and Final Financial upgradation under MACPS w.e.f. 08 September 2018 posthumously.
- Sri Md. Yousufuddin, Tech. Assistant (T-3) (Driver) has been promoted to the next higher grade of Sr. Tech. Assistant (T-4) (Driver) w.e.f. 31 January 2019.

New Joinings

- Sri P. Santosh Phani Kumar has joined as Technical Assistant (T-3) w.e.f. 23 July 2018.
- Miss N. Siva Dharani has joined as Lower Division Clerk w.e.f. 19 November 2018.
- Sri R. Ganesh has joined as Lower Division Clerk w.e.f. 24 November 2018.
- Sri P. Demudunaidu has joined as Technician (T-1) w.e.f. 11 January 2019.

Retirement

- Dr. R.V. Rao, C.T.O. has retired on superannuation on 31 July 2018.

Resignation

- Sri P. Demudunaidu has resigned the post of Technician (T-1) w.e.f. 15 March 2019.

Obituary

- Sri G. Vijay Kumar, SSS has passed away on 2 December 2018.

16. Other Relevant Information

Experimental Hatchery

ICAR-DPR is having an experimental hatchery with state of art equipment and infrastructure to conduct the high end research programs. Hatchery has been the central facility of the Directorate in which fumigation and storage of hatching eggs, incubation and hatching of pedigreed and commercial chicks are performed throughout the year. As a part of automation, data loggers have been installed in the hatchery to monitor and control humidity and temperature in the setters, hatchers and in cold room. During the current year, a total of 1,52,913 hatching eggs, 2,80,061 day old chicks, 45,075 parents and 2,738 grown up birds were sold/supplied to the farmers across the country. In addition, 7102 embryonated eggs were made available for diagnosis and vaccine production to different organizations.

Trainees Hostel Inaugurated

The newly built Trainees Hostel was inaugurated by Dr. Trilochan Mohapatra, Secretary, DARE and DG, ICAR on 22 September 2018. The Hostel has 10 rooms and is meeting the accommodation needs of the trainees of various training programmes being conducted at the institute.

Experimental Farm

The experimental poultry farm with state of art facilities is located inside the campus and has two units, Pureline and Commercial Units. Pureline farm is for carrying out research whereas the Commercial one is for supplying germ plasm to different stakeholders and farmers. One cage house was constructed along with creation of 3600 sq. feet area as vertical extension over existing houses for brooding purpose. During the period under report, the average livestock reared at the farm was 27,672 per month. A total of 16,91,827 eggs were produced out of which 7,49,003 were hatching eggs and the remaining were table eggs.

Feed Processing Unit

The required raw materials were procured for compounding balanced rations for chick, grower and adult breeding stocks of both layer and broiler

Dr. Trilochan Mohapatra, Secretary, DARE and DG, ICAR inaugurating the Trainees Hostel

types at feed processing unit of the Directorate. During the year, a total quantity of 906.7 MT of feed was compounded and supplied to experimental farm. In addition, a small quantity of feed was made available to the farmers who bought chicks from this Directorate.

Sales and Marketing Unit

Supply of hatching eggs and day-old chicks of parent stock and terminal crosses of germplasm was the main activity of this unit. The birds culled in the breeding programme, dressed birds and surplus eggs for table purpose were sold for table purpose. The grownup birds of about 6 weeks age of rural germplasm were supplied to the farmers for rearing purpose.

Agricultural Knowledge Management Unit (AKMU)

The Agricultural Knowledge Management Unit (AKMU) is equipped with desktops, server and other peripheral systems, integrated with user terminals within the Directorate through Local Area Network (LAN). SPSS software (version 12) and SAS software have been used in statistical analyses of research data generated at the Directorate. Symantec Endpoint protection (version 14) for cyber security from viruses, spyware, malware and firewall etc. was ensured for the server as well as nodes on the Local Area network. Local Area Network of the Directorate is enabling users to communicate, store and transfer data within and outside the Organization. The website of Institute (www.pdonpoultry.org) is being maintained and updated for projection of Institute's activities on the public domain. As per the Council's directive, public notices like tenders, quotations, recruitment advertisements etc. have been posted on website for wider publicity. Internet facility has been provided through fibre optic cable network from National Knowledge Network (NKN) to all the users on LAN with 100 Mbps bandwidth. Electronic mail facility is also used extensively for communicating and exchanging the information among the users in the Directorate as well as Council and other Institutes/ agencies. Biometric attendance of employees is made mandatory by the Government of India. In this connection, Directorate is maintaining three wall-mounted bio-metric devices and one desktop device under the supervision of AKMU unit. Attendance related reports are regularly generated and submitted to Director's Cell as well as Administration for taking further action on these reports. Circuit Camera surveillance system is also maintained using ten cameras and its associated equipment.

Library and Information Centre

The Directorate has a well-organized library with an impressive collection of literature on Poultry Science and related subjects which is helpful to the readers like scientific and technical staff of the institute. The Library facilities are also offered to the officials and students of the Veterinary Colleges, Universities, researchers and other ICAR Institute officials for their reference work. The library is subscribing six foreign journals and eight Indian journals and has more than 800 books on different aspects of poultry science, livestock as well as other general subjects to keep the scientists and technical staff abreast of the latest scientific and technical developments. In 2018-19, 45 new books on various aspects of poultry production as well as other general subjects were added to the collection. Additionally the library subscribes general magazines, six newspapers in Hindi, Telugu and English (two from each language) and Employment News for the benefit of staff and visitors. Under e-CERA, Institute is getting access to online journals. Necessary services are being exchanged with the member libraries under the consortium. Library has also rendered reprographic services to the staff, trainees and students.

Hindi Implementation Activities

The Directorate conducted four quarterly meetings of Official Language Implementation Committee (OLIC) on 30 June 2018, 28 August 2018, 21 December 2018 and 27 March 2019 in which different issues related to effective implementation of Hindi Language in office were discussed. The Directorate effectively implemented the OL rules/ orders received from the OL Dept. and as well from Council. The Directorate also conducted four Hindi workshops, i.e. on 30 June 2018, 24 September 2018, 22 December 2018 and 23 March 2019 for upgrading the Hindi language and Hindi typing skills of staff in their day to day official work.

Director receiving the prize of Town Official Language Implementation Committee-2

The Directorate celebrated Hindi fortnight celebrations during 14-28 September 2018 and Hindi Day on 14 September 2018. During these celebrations different literary competitions were conducted for the staff and the winners and runners of these competitions were awarded with cash prizes and certificate. During the period under report, eleven Scientists passed with distinction in Hindi Parangat course in November 2018 and thirteen skilled support staff passed Hindi Prabodh course in May 2018 conducted by Central Hindi Teaching Scheme, OL Dept, Govt. of India. The Institute received third prize of Town Official Language Implementation Committee-2, Hyderabad for the year 2018.

Swachh Bharat Activities

Under the Swachh Bharat Abhiyan, the Directorate conducted cleaning activities once in a week within and outside the institute premises. "Swachhta Hi Sewa" campaign was conducted from 15 September – 2 October 2018 by organizing different activities in the institute campus, schools, adopted village and other nearby villages and tourist spots. Further, Swachhta Pakhwada was also conducted from 16–31 December 2018.

Staff taking out awareness rally on Cleanliness

Staff taking oath

Independence Day and Republic Day

ICAR-DPR celebrated the Independence Day on 15 August 2018 and Republic Day on 26 January 2019. On these occasions, the Director hoisted national flag and addressed the staff of the institute.

Institute Foundation Day

ICAR-DPR celebrated National Science Day on 28 February 2019. To commemorate this occasion a host of activities were organized. Dr. R.N. Chatterjee, Director inaugurated a poultry exhibition, in presence of invited guest speakers and school children from various schools. School students were explained about scientific poultry rearing. In the poultry exhibition school students exhibited models on different scientific themes related to climatic change, cleanliness etc. Posters on scientist's research activities were also displayed. Guest speakers delivered lecture on the topics of Artificial Intelligence and its application in poultry rearing. At the end of the function, prizes and appreciation certificates were distributed to school students by the Director for exhibiting scientific models.

National Science Day celebrations

School children depicting models on Science Day

ICAR-DPR celebrated its 32nd Foundation Day at institute campus on 1 March 2019. Dr. Ashok Kumar, ADG (Animal Health), ICAR, New Delhi was the Chief Guest for this occasion. He visited the poultry exhibition and labs of the institute. Different research activities undertaken by the institute were explained to the Chief Guest. Dr. R.N. Chatterjee, Director welcomed the Chief Guest, Directors of different ICAR institutes located at Hyderabad, tribal farmers, and school children. Chief Guest, Dr. Ashok Kumar, applauded the achievements of the scientists of the institute. He emphasized on focused approach towards poultry research. Children from different schools invited on this occasion exhibited scientific models on different themes. On this occasion, games were conducted for the employees of this institute.

Dr. Ashok Kumar, ADG (AH), Chief Guest for the Foundation Day

National Productivity Week

ICAR-DPR celebrated National Productivity Week during 12-18 February 2019 with the aim to generate productivity consciousness among staff of the institute. Dr. R.N. Chatterjee, Director, inaugurated the programme and highlighted the importance of the theme "Circular Economy for Productivity and Sustainability".

National productivity week celebration

Dr. K. Alwal Reddy, MD (Layer Parent Production), Venkateshwara Hatcheries and Mr. Shravan Gattu, Senior Engineer, Viven Farms Pvt. Ltd., Hyderabad spoke on topics "Practical aspects of poultry production" and "Usage of poultry waste" respectively. Different competitions such as essay writing, quiz and slogan writing were conducted for the staff of the institute during the week.

International Women's Day

ICAR-DPR celebrated International Women's Day on 8 March 2019. The Director of the institute chaired the meeting and also spoke on the varied responsibilities of the working women. Women employees of the institute discussed issues related to welfare, grievances etc. Some of the employees gave a talk on the women's contribution in different fields for the wellbeing of the society.

Director with women staff

Games and sports

The staff of the Directorate participated in the ICAR sports meet organized by ICAR-CTRI, Rajahmundry during 5-9 September 2018.

Notes

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भाकृअनुप - कुक्कुट अनुसंधान निदेशालय

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