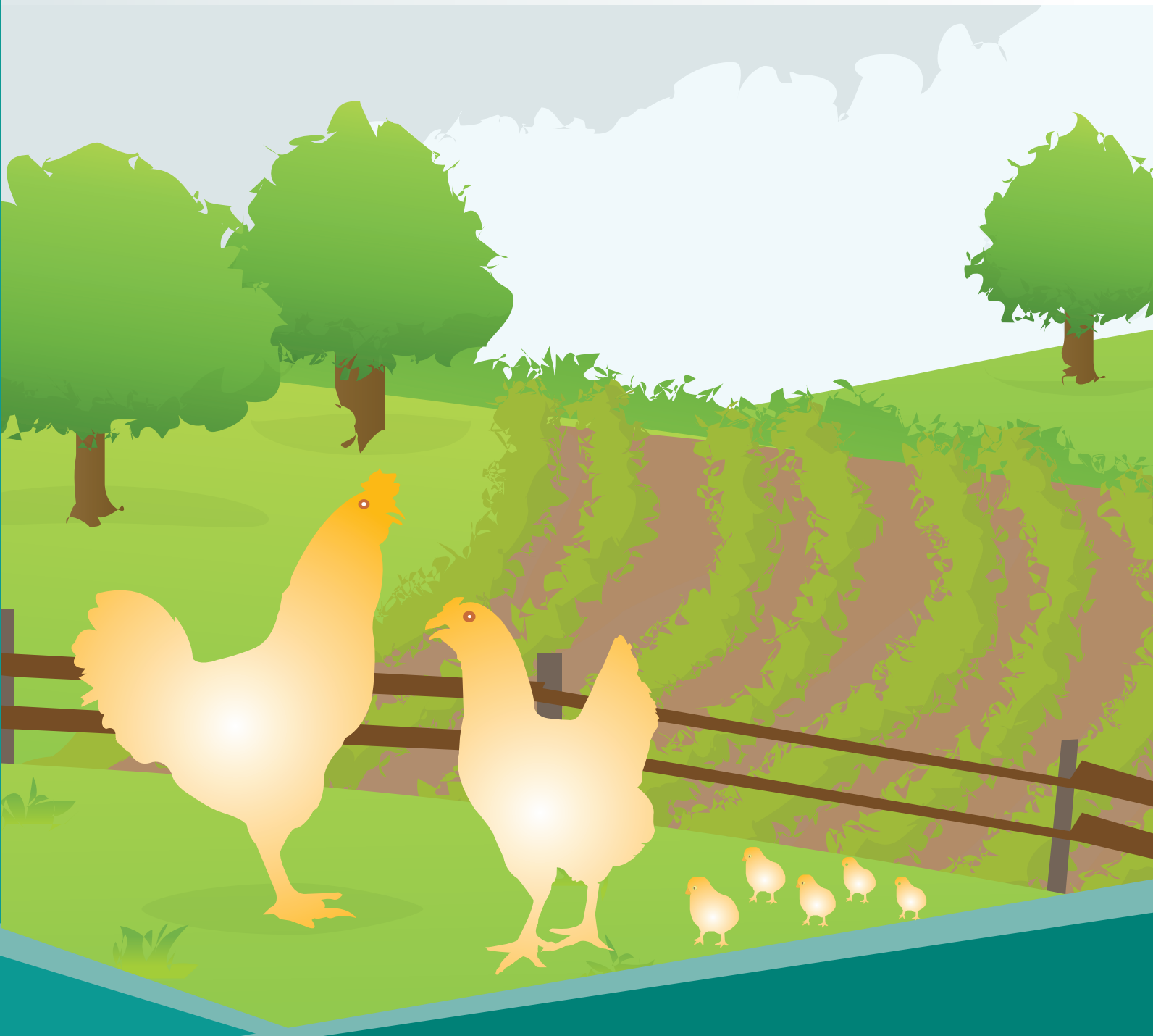
Annual Report

2016-2017



भाकृअनुप - कुक्कुट अनुसंधान निदेशालय

ICAR-DIRECTORATE OF POULTRY RESEARCH

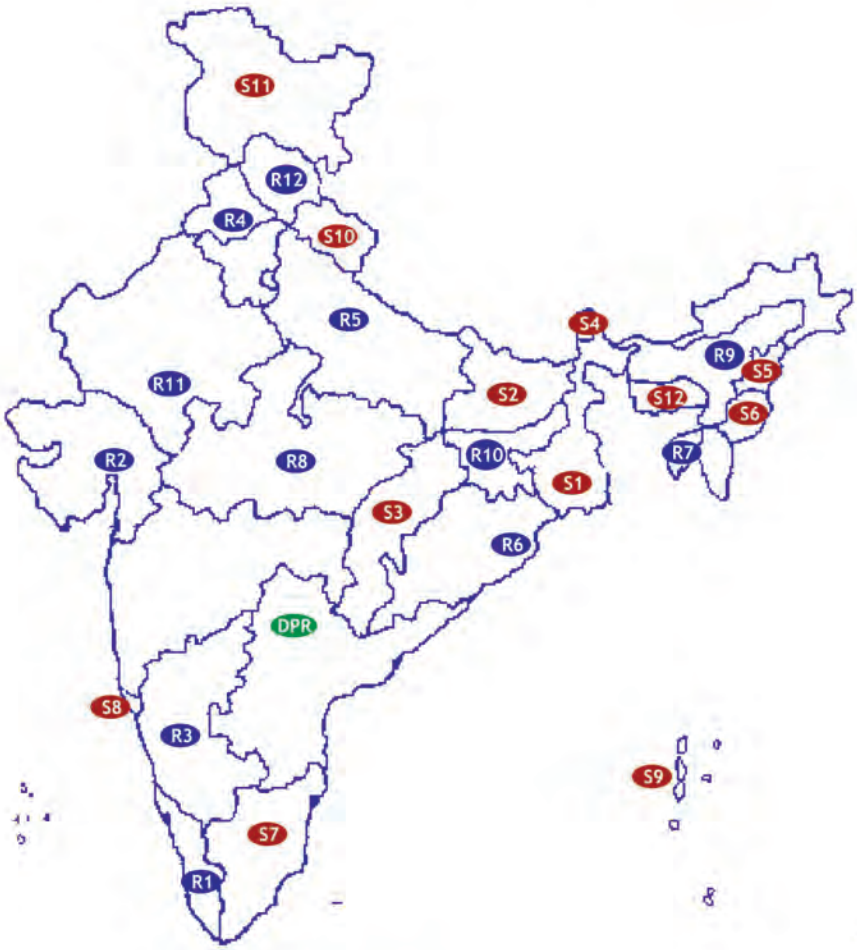
ISO 9001-2008

Rajendranagar, Hyderabad-500 030

Sardar Patel Outstanding ICAR Institution 2013

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
S1. BAU, Patna
S3. CKVV, Durg
S4. ICAR NOFRI, Sikkim
S5. ICAR RC, Nagaland
S6. ICAR RC, Manipur
S7. TANUVAS, Hosur
S8. ICAR-CCARI, Goa
S9. ICAR-CIARI, Portblair
S10. ICAR-IVRI, Mukteswar
S11. SKUAST, Srinagar
S12. ICAR-RC for NEHR, Barapani (NFC)

Annual Report 2016-17

भाकृ अनुप
ICAR

ICAR-Directorate of Poultry Research

Rajendranagar, Hyderabad, Telangana, India

www.pdonpoultry.org

ICAR-Directorate of Poultry Research

ICAR-DPR Annual Report

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Front Cover:

Grahic Representation of Rural Poultry Farming

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

Inside Back Cover
ICAR-DPR Publications

Back Cover
Tribal women from Telangana with improved chicken variety developed at ICAR-DPR

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Preface

The Directorate has successfully completed twenty nine years of dedicated service for the development of poultry production in the country. Continuous efforts of committed staff helped in fulfilling the mandated responsibilities of coordinating and monitoring ICAR-network projects, basic and applied research in various aspects of poultry farming. I feel privileged to present the Annual Report for the year 2016-17.

The two rural chicken varieties i.e. Vanaraja and Gramapriya developed by the Directorate have reached throughout the length and breadth of the nation. The birds are performing extremely well in low input system. This has made possible to alleviate protein hunger and malnutrition, and increase socio- economic condition of the farmers in rural and tribal areas. The Srinidhi variety is gaining popularity in some parts of the country. During the period, a promising two-way cross is being evaluated under farm and field conditions. The performance of 2-way cross offers a bright scope for propagating in the rural and tribal areas.

The AICRP on Poultry Breeding has been reoriented towards the rural poutlry and all the centres are working on development of location specific rural chicken varieties suitable for their local conditions. The elite layer and broiler purelines are being maintained for improvement of economic traits and utilized for development of rural crosess. During the year, a dual purpose variety Jharsim was developed at Ranchi centre and has been released for the benefit of rural and tribal farmers. A total of 7.11 lakhs of chicken germplams was supplied to the farmers across the country under AICRP component.

Twelve Poultry Seed Project centres spread across the country are in operation with aim of increasing the availability of improved germplasm throughout the country. A total of 4.39 lakhs of improved chicken germplasm was distributed in rural and tribal areas under seed project component.

The pure lines (Rural, Broiler, Layer) maintained at this Directorate have been constantly improved for various economic traits based on the feedback from farmers. Research is under progress in poultry genomics through functional genomics, epigenetics and gene silencing technology for augmenting poultry production. The research conducted in the area of nutrition and physiology and health is aiding in developing package of practices for different pure lines and crosses developed by this Directorate. Further, several extramural projects funded by DST and NICRA and collaborative projects with the industry under PPP mode were also undertaken by the Directorate. Besides, a contract research project is also under way. The research output was communicated through peer reviewed journals, magazines and electronic media.

The propagation of germplasm is being strengthened through brochures, visual media and participating in the exhibitions. I am happy to inform that the Directorate has distributed 3.79 lakhs of improved germplasm and realized an amount of 227.96 lakhs of revenue.

I am also happy that the foundation stone for the new campus was laid by Dr. Trilochan Mohapatra, Secretary, DARE and Director General, ICAR during the year. This campus will be exclusively dedicated for development of Animal House facility with the funds from the Head Quarter budget, wherein germplasm supply to various stakeholders will be undertaken as the priority activity.

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 in the development of the Directorate.

I am extremely thankful to Dr. H. Rahman, the former DDG (AS) and Dr. J.K. Jena, the present DDG (AS) for their keen interest and valuable guidance in delivering the mandated responsibilities of the Directorate. I am also thankful to Dr. R.S. Gandhi, ADG (AP&B); Dr. Vineet Bhasin, Principal Scientist (AG&B) and other scientific and administrative staff of the ICAR (HQ) for extending help from time to time.

The overall research progress achieved could not have been possible without the support and contribution of all the scientists at this Directorate and different centres of AICRP and Seed Project. I am highly thankful to them. I also thank all other staff for supporting the scientists in their research endeavor. I also thank the editorial committee in bringing out this report in an appreciable manner.

Date: 22 June 2017

(R.N. Chatterjee)
Director

Abbreviations

AAU	Anand Agricultural University/Assam Agricultural University
AICRP	All India Coordinated Research Project
ALV	Avian Leukosis Virus
ANGRAU	Acharya N. G. Ranga Agricultural University
ARIS	Argicultural Research Information System
ARS	Agriculrural Research Service
ASM	Age at Sexual Maturity
BWG	Body Weight Gain
BW	Body Weight
CARI	Central Avian Research Institute
CBH	Cutaneous Basophile Hypersensitivity
CP	Crude Protein
CPCSEA	Committee for the Purpose of Control and Supervision on Experiments on Animals
CPDO	Central Poultry Development Organization
CRD	Chronic Respiratory Disease
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
FES	Fertile Egg Set
g	Gram(s)
GP	Glutathione Peroxidase
GR	Glutathione Reductase
HDEP	Hen Day Egg Production
H:L	Heterophyl : Lymphocyte Ratio
HHEP	Hen Housed Egg Production
HVT	Herpes Virus of Turkey
IAEC	Institutional Animal Ethics Committee
IBD	Infectious Bursal Disease
IBSC	Institute Bio-Safety Committee
IBV	Infectious Bronchitis Virus
ICAR	Indian Council of Agricultural Research
IMC	Institute Management Committee

IIOR	Indian Institute of Oilseeds Research
IPSA	Indian Poultry Science Association
IRC	Institute Research Committee
IU	International Unit(s)
IVRI	Indian Veterinary Research Institute
KVASU	Kerala Veterinary and Animal Sciences University
KVK	Krishi Vignan Kendra
LPR	Lymphocyte Proliferation Ratio
MANAGE	National Institute of Agricultural Extension Management
MD	Marek's Disease
ME	Metabolizable Energy
mill	Million
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
NIRD	National Institute of Rural Development
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	Phytohemagglutinin-P
PJTSAU	Professor Jayashankar Telangana State Agriculture University
ppm	Parts Per Million
PVNRTVU	P.V. Narasimha Rao Telangana Veterinary University
QRT	Quinquennial Review Team
RAC	Research Advisory Committee
RBC	Red Blood Cell
SAU	State Agricultural University
SL	Shank Length
SOD	Superoxide Dismutase
SRBC	Sheep Red Blood Cells
SVU	State Veterinary University
SVVU	Sri Venkateswara Veterinary University
TES	Total Egg Set
TSA	Total Sulfur-containing Amino Acids
TSIPARD	Telangana State Institute of Panchayatraj and Rural Development
U	Unit(s)
VBRI	Veterinary Biologicals and Research Institute
VHL	Venkateswara Hatcheries Limited
wks	Weeks

Contents

Executive Summary

The ICAR-Directorate of Poultry Research is a premier Institute under the aegis of Indian Council of Agricultural Research and is mandated to carryout basic and applied research to enhance productivity of poultry, develop new germplasm for rural poultry husbandry and impart capacity building in poultry production. The Directorate also undertakes sponsored research projects from other agencies like DBT, DST etc. and contract research/consultancy services under PPP mode. The salient achievements for the year 2016-17 are summarized here under.

Research at the Directorate

Genetics and Breeding

The main focus of research in Genetics and Breeding includes development of rural chicken varieties, improvement of rural pure lines, maintenance and evaluation of layer, broiler, gene lines and conservation of native chicken germplasm.

Germplasm for rural poultry farming

Two male lines, PD-1 (Vanaraja male line) and PD-6 (GML, Gramapriya male line), and two female lines, PD-2 (Vanaraja female line) and PD-3 (Brown egg layer line) have been maintained for use in development of rural chicken varieties. In S-10 generation of PD-1 line, the ASM was 178.6d and the least square mean for body weight at 20 wks was 2193 g, while the egg production up to 40 and 72 wks of age was 49.6 and 148.2 eggs, respectively. In the S-11 generation, the least square means for body weight at 4 and 6 wks were 318.6 and 668.7 g respectively, whereas the corresponding shank length was 57.2 and 76.6 mm.

In SL-6 generation of PD-6 line, the least square means for body weight at 4 and 6 wks were 334.2 and 573.6 g, respectively. The shank length at 4 and 6 wks was 59.0 and 75.3 mm, respectively. The ASM was 167.8d and the egg production at 52 wks was 125.7 eggs. The S-7 generation was regenerated. In PD-2 line (S-13), body weight of females at 20 wks was 1821 g and the ASM was 161.6 d. The egg weight and egg production at 40 wks were 52.7 g and 86.8 eggs, while the annual egg production was 201.2 eggs. In the S-14 generation, body weight and shank length at 6 wks were 545.1 g and 66.8 mm, respectively. In G-5 generation of PD-3 line, the body weight at 20 wks was 1278.6 g and ASM was 170.3 d. The egg mass up to 40 wks improved by 334 g over the previous generation.

Native chicken populations

In G-3 generation of Aseel, the body weight at 40 and 72 wks was 1968 and 2798 g in hens and 2756 and 3794 g in cocks, the ASM was 219 d and egg production at 40 and 72 wks was 12.6 and 59.5 eggs, respectively while the corresponding egg weight was 42.3 and 50.1 g. In the G-4 generation, the body weight at 6 wks was 309.4 g and shank length was 60.9mm. In S-7 generation of PD-4, body weight and shank length at 8 wks improved by 75 g and 4.14 mm, respectively. Livability was better and egg production up to 40 wks improved by 6.67 eggs over the previous generation.

In Ghagus population (G-4 generation), egg production improved over the previous generation. The body weight and shank length in males at 20 wks were 1829 g and 129.4 mm, respectively. The body weight of male birds of brown and black Nicobari (G-3 generation) at 40 wks was 2359 and 2203 g, respectively, while the corresponding shank length was 105.9 and 101.4 mm. In the next generation (G-4), body weight and shank length of brown and black Nicobari birds were 277.9 and 53.77 mm; 361.1 g and 57.64 mm, respectively. Internal egg quality (albumen index, haugh unit and yolk index) was found better in Ghagus compared to White Leghorn and Nicobari breeds.

The 2-way (PD-1*PD-4) and 3- way (PD-1* IWI, PD-3) crosses were evaluated under farm and

field conditions. The 3-way cross was found superior in 52 wk egg production under farm (146.3 vs 122.5) and field (118.4 vs 83.7) conditions. Both the crosses showed good annual egg production potential (189.6 and 277.8) under farm conditions with egg weight of 60.5 and 58.1 g, respectively. In another evaluation, the new GML line (PD-6) was found on par with PD-2 line as male line for production of Gramapriya chicks.

Broiler populations

Three coloured synthetic broiler lines (PB-1, a male line; PB-2, a female line and control) have been maintained and evaluated. In PB-1(S-26 generation), 5 wk body weight was 916 g and the genetic response was 17.3 g. In S-25 generation of PB-2, the ASM was 180.2 d and the egg weight and egg production at 40 wks were 58.5 g and 68.0, respectively. The genetic response for 40 wk egg production over the last 10 generations was 1.28. In the subsequent generation (S-26), the body weight at 5 wks was 833.4 g, which was 67 g higher over the last generation. The genetic response for this trait over the last 7 generations was 18.7 g. In the G-15 generation of broiler control, juvenile body weights increased significantly over the previous generation. The naked neck and dwarf gene lines were maintained as resource populations.

Layer Populations

Six layer lines (IWH, IWI, IWK, IWD, IWF and control) were maintained and evaluated. The least square means of ASM in the pedigreed populations was 139.4, 139.2, 136.9 and 150.1d, respectively in IWH, IWI, IWK and control. The egg production up to 64 wks in IWH, IWI, IWK and control was 254.7, 258.0, 232 and 224.6, respectively and the corresponding egg weight was 56.1, 55.2, 57.5 and 57.7 g. The remaining two lines (IWD and IWF) were regenerated through random mating and the egg production up to 32 wks was 51.9 and 52.5, respectively in IWD and IWF.

Molecular Genetics

Chicken ACVR2B gene was silenced through RNAi under *in vitro* conditions and the shRNA constructs were transfected into chicken fibroblast cells. The percent knock down of ACVR2B miRNA varied between 47 and 87%. Expression profiling of BMP, BMP3, BMP4, FASN and ACACA genes during embryonic and juvenile phase was established in layer and broiler chickens. Certain haplo groups were found to have significant effect on body weight. The expression profile of growth hormone receptor gene in 5 tissues (breast muscle, bursa, heart, spleen and gizzard) in Aseel and Ghagus breeds of chicken during early post hatch period indicated breed and tissue differences in the expression levels. Further, the expression of ovalbumin gene in oviductal cell culture varied from 35.8 to 43.2 in different segments. Evaluation of immune competence traits in different breeds of chicken (Ghagus, Dahlem Red and Nicobari) showed significant differences among the breeds and between sexes. Significant breed effect in expression profile of PRR and some of the cytokine genes was observed among native and exotic breeds with Ghagus showing better expression profile of genes linked to innate immunity. Highest number of SNPs in coding regions of PRR genes was found in Nicobari followed by Ghagus and layer.

Nutrition, Physiology and Health

Balancing for critical amino acids (lysine, methionine and threonine) in the diet of Vanaraja chicks containing low protein levels improved anti-oxidant response. Supplementation of selenium (0.3ppm) in either organic or inorganic forms in combination with Vit.E (200 mg/kg) improved shell quality and activities of SOD, glutathione peroxidase and glutathione reductase in broiler breeders. When tocotrienol, a precursor of Vit.E was evaluated in broilers against Vit.E, it was found that tocotrienol was more effective in improving the anti-oxidant responses in broilers even at much lower concentrations (4-8 mg/kg) compared to those fed Vit.E (100 mg/kg). The effects of feeding sprouts of millets (ragi, korra, bajra and jowar) and pulses (green gram, black gram, small gram) at 5% of feed intake was evaluated in broiler chicken. Supplementation of sprouts significantly reduced lipid peroxidation

in liver and increased the activities of glutathione peroxidase and super oxide dismutase. Supplementation of nano-zinc at reduced levels in diet (80-7.5 mg/kg) improved feed efficiency, reduced lipid peroxidation and improved glutathione peroxidase activity and SOD in spleen and liver in broiler chicken. Antibody titres against ND increased, lipid peroxidation decreased and activity of glutathione peroxidase improved in broilers fed moringa leaf meal (500-1000 mg/kg) or pomegranate peel meal (250-500 mg/kg). Protease supplementation to diets containing 12% guar meal improved growth rate and feed conversion efficiency in vanaraja chicks.

For increasing the yeast cell bio mass production in order to increase the organic selenium yield, various herbal extracts were tested for their efficacy in YEPD broth. *Mentha aquatic* and *Gingiber officinale* extracts were the most effective among the agents tested. The organic selenium produced in yeast was evaluated *in vivo*. The organic selenium (0.2 to 0.3ppm) improved body weight, feed efficiency and serum glutathione reductase activity in Vanaraja chicks and broiler chickens. *In vitro* protocols for production of organic zinc in yeast (*Saccharomyces cerevisiae*) using different sources of inorganic zinc were evaluated. Highest biomass was obtained with zinc sulphate. The production performance and egg quality parameters in brown layers were not affected by replacement of normal maize with quality protein maize.

An extensive survey of 120 farmers from 4 states (Telangana, Tripura, Rajasthan and Himachal Pradesh) was conducted for identifying the nutritional status of scavenging poultry birds in rainy and winter seasons. A large proportion (75.8 - 77.8%) of the crop contents was from grains, bran and kitchen waste, the rest being green forages (16.7-18.2%) and insects and worms (4.01-7.35%). The diet of free range adult birds was found to be highly deficient in CP (44.9%), calcium (76.4%) and phosphorous (20%) during rainy season as compared to those reared at the institute farm.

Cryopreservation of chicken semen using two cryoprotectants (dimethyl formamide, DMF and dimethyl acetamide, DMA) was evaluated. DMF and DMA at 6% concentration resulted in higher sperm motility, but fertility rates with cryo semen were very low. Addition of supplements in frozen semen like vit.C (10 mg), vit.E (100 μm) and $CaCl_2$ (4 mM) to semen diluent BPSE resulted in moderate improvement in fertility in PD-1 roosters. Concentration of hormones leptin and ghrelin in plasma increased during summer in Dahlem Red birds, which decreased with dietary supplementation of fermented yeast culture (1.25 g/kg feed). Relative expression of hormone receptors was down-regulated with dietary yeast supplementation. The beneficial effects of yeast supplementation on egg production, fertility and hatchability were also recorded.

During the period, the major causes of mortality among the DPR flocks were heat stress, colibacillosis, CRD, coccidiosis, laryngotracheitis and gout. The ALV incidence among the tested pureline breeders was 5.3%. Upon challenge with *E.coli*, Nicobari chickens were found susceptible. Based on the transfer rate of maternal antibodies from parents to chicks, breakthrough maternal antibody titer for IBD intermediate vaccine was found to be 125 that was noticed on 12th to 13th day of age, when vaccination is to be done. Similarly, the maternal antibody titer against ND virus in chicks was 8.3 on day 1, which decreased to 3.5, 1.8 and 0 at 14^{th}, 21^{st} and 31^{st} d of age. The IBV variants such as IBVQX and IBV nephro-pathogenic were found prevalent in major poultry producing areas of India. Concanavalin A based sandwich ELISA with non-purified NDV whole virus antigen was developed and validated, which showed high rate of correlation with the results of commercially available indirect ELISA. Alcoholic extracts of cinnamon, turmeric and ether extracts of cinnamon, ginger, clove and turmeric were effective for their in vitro anti-microbial efficacy. Alternate antibiotic growth promoter containing herbal formulation improved FCR, decreased mortality and improved gut health in Krishibro chicks.

AICRP on Poultry Breeding

AICRP on Poultry Breeding was reoriented

towards Rural Poultry from the year 2014-15. At present it is being operated at twelve centres viz. KVASU, Mannuthy, AAU, Anand; KVAFSU, Bengaluru, GADVASU, Ludhiana, OUAT, Bhubaneswar, CARI, Izatnagar, ICAR Research Complex 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 and elite layer and broiler germplasm and development of package of practices for village poultry and entrepreneurships in rural, tribal and backward areas. In addition, KVASU, Mannuthy and AAU, Anand centres are maintaining two elite layer germplasm (IWN and IWP). KVAFSU, Bengaluru, GADVASU, Ludhiana OUAT, Bhubaneswar and CARI, Izatnagar are maintaining four elite broiler strains (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 Directorate of Poultry Research, Hyderabad. Samples of hatching eggs from these populations were sent to different centers of the AICRP on Poultry Breeding at the time of regeneration. As per the decision taken by the Council, the strains maintained at different AICRP centers and DPR were duplicated at various AICRP centres to be utilized in case of exigencies and as a resource population by the centre for three and four way crossing. The strains being duplicated at different AICRP centre are IWF at Mannuthy, IWD and IWK at Anand and M1 and M2 at Jabalpur centre. During the current year, a total of 7,10,889 germplasm was supplied with an amount of Rs. 2.62 crores revenue from AICRP centres.

The KVASU, Mannuthy centre has evaluated the S-1 generation of native chicken germplasm up to 40 weeks of age. Egg production of native chicken germplasm up to 40 weeks of age was 72.08 eggs with average egg weight of 41.77g. Average genetic response for 64 weeks hen housed egg production was 4.77 and 1.65 eggs, respectively in IWN and IWP strains during last ten generations (S-20 to S-29). The centre has generated the revenue of Rs. 64.256 lakhs, which was 194.72% of the total expenditure on feed (Rs. 33.00 lakhs). The centre has supplied a total of 1,36,743 number of germplasm during the year. At AAU, Anand, chicks of S-0 generation of native birds, RIR breed, F1 cross (IWN X Native) and three way cross (F1 X RIR) were evaluated for production traits up to 40 weeks of age. Genetic response for egg production up to 64 weeks of age in IWN and IWP strains were 0.43 and 0.776, respectively over the last 10 generations. The centre has generated the revenue of Rs. 26.72 lakhs, which was 76.78% of the expenditure on feed cost. The centre supplied a total of 39,474 germplasm during the present year.

The average body weight of local native chicken at day one and 8 weeks was 30.43 and 477.84 g, respectively at Bengaluru. The body weight at 5 week in PB-1, PB-2 and Control lines was 1046.35±2.89, 1017.89±3.73 and 719.85±15.21g, respectively. The average phenotypic and genetic response of body weight at 5 week over 9 generations in PB-1 was 6.43 and 5.34 g, respectively. A total of 1,52,641 germplasm were supplied to farmers and other stakeholders during the current year with revenue of Rs. 41.71 lakhs. A total of 2,266 good chicks of local native chicken were hatched at Ludhiana. The average body weight at 5 weeks was 1157.57±4.3, 1061.62±3.54 and 946.87±19.35 g in PB- 1, PB-2 and Control lines, respectively. The phenotypic and genetic response over the last 9 generations for 5 weeks body weight was 10.07 and 24.50 g in PB-1 3.68 and 24 g over the last 10 generations in PB-2. Centre supplied 57,950 germplasm to the farmers and generated revenue of Rs.15.66 lakhs which is 94.32% of expenditure on feed. At CARI center, a total of 542 good chicks of local chicken were produced. The body weight at 5 weeks of age in CSML, CSFL and control lines was 1222.63±4.65, 1209.32±1.95 and 756.67±7.45 g, respectively. The intensity of selection increased in CSML as well as CSFL as compared to previous generation. The phenotypic response per generation was 15.96 and 15.85g in CSML and CSFL, respectively. While genetic response was 14.34 and 14.19 g, respectively. Bhubaneswar centre has completed purification of native local chicken germplasm

and a total of 1441 good chicks of S-1 generation were hatched. The egg production up to 40 weeks in S-0 generation in native chicken was 14.27. The phenotypic response of CSML and CSFL over four generations was 111.8 and 68.35 g, respectively. The genetic response in respective lines was 94.64 and 51.18 g. This center supplied a total of 51,783 germplasm to the farmers with revenue of Rs. 14.00 lakhs which is 72.87% of expenditure on feed.

Tripura centre evaluated Tripura black, Dahlem Red and broiler dam line up to 20 weeks of age. The 20 week body weight was 1105.68, 1720.28, and 3240 g. During first evaluation (E-1), the 72 week egg production was 121.56 and 98.72 eggs under farm and field conditions in BND cross, respectively. During the year, the germplasm supply was 14,023 chicks with revenue of Rs. 7.98 lakhs. At Jabalpur, Narmadanidhi birds were evaluated in farm and field up to 52 weeks of age. During G-7 generation, the 6 week body weight was 381 and 864g in Kadaknath and Jablpur populations. The hen housed egg production up to 40 weeks of age was 86.80 eggs in JBL population and 50.30 eggs in Kadaknath population. Narmadanidhi produced 69 and 127 eggs up to 40 and 52 weeks at farm. This cross produced 43, 87 and 171 eggs, upto 40, 52 and 72 weeks in field conditions, respectively. The germplasm supplied during the year was 69,407. The center realized a revenue of Rs. 22.66 lakhs. Guwahati centre evaluated native, Dahlem Red, PB-2 and BN populations up to 52 weeks of age. The 5 week body weight was 118.12 g in indigenous, 1065.39g in PB-2 and 365.17g in Dahlem Red. The hen housed egg production upto 40 and 52 weeks of age was 47.10 and 87.60 eggs in the farm and corresponding values in the field were 42.10 and 71.60 eggs, respectively in Kamrupa. The centre supplied 25,021 germplasm to farmers and realized receipt of Rs. 4.27 lakhs. Ranchi centre released Jharsim, a dual type chicken variety. The hen housed egg production up to 64 weeks was 67.78 eggs in native population during G-5 and it improved by 6.97 eggs compared to previous generation. The hen day egg production up to 64 weeks of age was more in DNB cross (101.42 eggs) than BND cross (93.17 eggs) during E-5 evaluation under farm conditions. Centre supplied 15,103 germplasm to the farmers. The center realized a receipt of Rs. 8.90 lakhs during the financial year. Palampur centre has evaluated the DND cross under farm and field conditions satisfactorily and it is ready for release. The hen housed egg production upto 52 weeks of age was 103.90, 60.62 and 106.17 eggs in Dahlem Red, native and DRxN populations, respectively. The hen housed egg production in DNxD cross was 65.74 eggs in farm and 39.54 eggs in field conditions up to 40 weeks. This cross produced 148.54 eggs upto 72 weeks of age and showed improvement of 12.96 eggs at farm compared to previous generation. The centre supplied 36,599 chicks to farmers and realized receipt of Rs. 12.64 lakhs during the financial year. Udaipur centre evaluated G-6 generation of Mewari breed up to 52 weeks of age and G-7 generation was reproduced. In Pratapdhan, the hen day egg production was 170.89 eggs up to 72 weeks of age. A total of 78,225 germplasm was supplied during the current year. The center realized a receipt of Rs. 20.69 lakhs during the year.

Poultry Seed Project

Poultry Seed Project was evolved with the sole aim to increase the availability of rural chicken germplasm in remote areas of the country. The Indian Council of Agricultural Research has initiated the project during the XI five year plan. The PSP centres are located at West Bengal University of Animal and Fishery Sciences, Kolkata; Bihar Agricultural University, Patna; Chhattisgarh Kamadhenu Viswa Vidyalaya, Durg, ICAR Research complex, Nagaland regional centre, Jharnapani; ICAR-National Organic Farming Research Institute, Gangtok; ICAR Research complex, 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; ICAR-IVRI Regional Station, Mukteswar; Sher-e-Kashmir University of Agricultural Sciences and Technology, Srinagar were added from 2014-15. A non funded Centre was also initiated at ICAR Research Complex

for NEH Region, Umiam. The Directorate as a coordinating unit, supplied parent chicks, co-ordinated and monitored the activities of different centres to enable them to achieve the set targets for each centre. The seed project was launched on 15th May, 2009. The target set for supplying chicks for mainland and north-east centres during the year under report (2016-17) was 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 4,38,822 improved chicken varieties have been distributed in their respective regions/states during the year with a total revenue of Rs.140.79 lakhs.

A total of 1135 female parents and 229 male parents of Vanaraja are in position at Kolkata Centre. The average hen day egg production (HDEP) ranged from 25.03 (55-84 weeks) to 46.38 % (24-63 weeks) in Vanaraja parents. A total of 63,554 chicks of Vanaraja were distributed to farmers of West Bengal and adjoining north eastern states with an amount of Rs. 7.50 lakhs revenue. Three batches of Vanaraja parents were reared under deep litter system at Patna Centre. The HDEP in Vanaraja at 40 weeks of age was 52.57 % with an egg weight of 52.24 g. A total of 55,329 improved chicken germplasm was distributed with an amount of Rs. 10.60 lakhs revenue from the Centre. Two batches of Vanaraja parents are in laying stage and one batch is in growing stage at Durg center. The average HDEP was 46.8 % (24-56 weeks) in Vanaraja. A total of 31,224 improved chicken germplasm of Vanaraja were distributed to 224 farmers covering 85 villages across Chhattisgarh. An amount of Rs. 8.86 lakhs revenue was generated from the Centre. Five batches (3 Vanaraja and 2 Srinidhi) of parents were reared at Jharnapani. The production of 50 % was attained at 36 weeks of age and maintained till 46 weeks of age in both female parents. The peak production of 69% was recorded at 50 weeks in Vanaraja and 72 % at 43 weeks of age in Srinidhi. A total of 81,729 improved chicken germplasm was distributed to farmers with 36.61 lakh revenue at Jharnapani. Two batches of Vanaraja parents were reared at ICAR-NOFRI, Gangtok, Sikkim during the year. The average HDEP in Vanaraja was 52.76 (27-64 weeks) with an average egg weight of 58.04 g. Peak production (50-67 %) was attained at 30 weeks of age and sustained till 58 weeks of age. A total of 71,109 improved chicken germplasm (Vanaraja) was distributed to 2702 farmers covering 626 villages across Sikkim. An amount of Rs. 32.87 lakhs revenue was generated from the Centre. Two batches of Vanaraja and two batches of Srinidhi parents were reared at Manipur Centre. A total of 17,428 improved rural chicken germplasm was distributed to the farmers. The Centre has generated Rs. 20.06 lakhs of revenue during the year. Two batches of Vanaraja and Gramapriya parents were reared at Hosur Centre. The HDEP ranged from 53-59 (36-76 weeks) in Vanaraja and 63-78% (36-76 weeks) in Gramapriya, respectively. A total of 1,15,956 improved rural chicken germplasm were distributed to 656 farmers in Tamil Nadu. The Centre has generated total revenue of Rs. 23.64 lakhs. The construction of poultry houses and hatchery are in progress at Goa. One batch each of Gramapriya and Srinidhi parents were reared at Goa in the existing facility. The construction of poultry houses and hatchery is in progress at Port Blair. One batch each of Vanaraja and Gramapriya parents were reared under deep litter system. A total of 1,300 Vanaraja chicks were distributed in Andaman & Nicobar Islands with revenue of Rs. 32,745 during the year. At Srinagar, one batch of Vanaraja parents were maintained under deep litter system during the year. The egg production of 49% was attained during 37-40 weeks of age. A total of 2,234 Vanaraja chicks were distributed to 90 farmers in four districts of Jammu and Kashmir.

Technology Transferred

The Directorate participated in several exhibitions and Kisan Melas during the year and propagated the varieties and technologies developed by the Institute. Training was imparted to the farmers, veterinary officers and other beneficiaries from across the country on rural and commercial poultry production. Consultancy and contract research services were also extended to the poultry industry in nutrition and health cover. The rural chicken

varieties developed by the Directorate, Vanaraja, Gramapriya and Srinidhi reached majority of the states in the country. A total of 95,870 hatching eggs and another 2,21,710 day-old chicks and grown-up birds of Vanaraja, Gramapriya, Srinidhi, Krishibro etc. were supplied to the farmers and different organizations including Govt. agencies across the country during the period. Further, the Directorate supplied 39,568 day-old parent chicks of the varieties to Govt. organisations including Seed Project centres. In addition, another 7,10,889 and 4,38,822 nos. of germplasm were supplied from the AICRP and Seed Project centres, respectively. The Directorate has been playing the pioneering role in promoting rural poultry production in the country through functional linkages with line departments and other agencies.

Awards and Recognitions

The scientists of the institute have bagged several awards from different Organizations/ Associations/Societies in recognition of their contribution in the field of poultry research and development. The Directorate also won award for its committed efforts in Hindi implementation in day to day activities.

Other Activities

Activities like organising Farmers-Scientists Interface, technical seminars, stakeholders meeting, training/short courses for field veterinary officers and farmers were conducted on routine basis for the overall benefit of poultry sector in the country. The priority programmes like Mera Gaon Mera Gaurav and Swatch Bharath were implemented. The Research Advisory Committee, Institute Research Committee and Institute Management Committee constantly monitored and suggested improvement in research, administration and financial management of the Institute. Foundation stone was laid by Dr.T. Mohapatra, Secretary, DARE & DG, ICAR for the Animal House facility in the new campus acquired from SVVU.

The budget utilized during the period was Rs. 424.99 lakhs (Plan) and Rs. 1110.91 lakhs (Non-Plan) at the Directorate and Rs. 594.00 lakhs and Rs. 522.50 lakhs were utilized by the AICRP and Seed Project, respectively under plan expenditure. The Directorate generated revenue of Rs. 227.96 lakhs during the year.

1. Introduction

History

The ICAR-Directorate of Poultry Research is one among the premier institutions in the field of poultry science research and extension in the country. This institute was established on 1st March 1988 at Hyderabad, Andhra Pradesh under the aegeis 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 to this, 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 with 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 maintainance 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 18th September 2013.

The primary 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 on nutrition, health, physiology and molecular genetics hasbeen 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 on Poultry Breeding was started during IV plan which was the landmark in the history of poultry breeding research in India. The AICRP has made significant contribution in the development of poultry sector in India over a period of time. Seven promising varieties of chickens were released for commercial exploitation for the benefit of the intensive poultry farming. Rural component of the project was added during XI plan with two centres and further strengthened in XII plan period by adding 4 more centres to carryout research in rural poultry farming. The AICRP on Poultry Breeding was completely re-oriented towards the rural poultry from 2014-15 to cater to the needs of the rural/tribal farmers across the country. The primary objective of the AICRP centres is to develop location specific rural chicken varieties utilizing the local native germplasm. The constant efforts of the scientists lead to the development of four location specific varieties from different centres suitable for the region. The varieties developed and released are *Pratapdhan* (MPUAT, Udaipur), Kamrupa (AAU, Guwahati), Jharsim (BAU, Ranchi) and Narmadanidhi (MPUAT, Jablpur). During XI plan, the activities of the Directorate were further expanded by introduction of a new

net work 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. The Poultry Seed Project was further strengthened by addition of five new centres from 2014-15. The Directorate is coordinating the activities of the AICRP on Poultry Breeding and Poultry Seed Project, carrying out research in core areas of poultry science and supplying rural chicken germplasm to meet the demand in rural and tribal areas.

At the Directorate, two promising chicken crosses for rural poultry farming were evolved i.e., *Vanaraja*, a dual-purpose bird and *Gramapriya*, predominantly a layer, meant for free-range and backyard farming. These two chicken varieties have become extremely popular and are being reared in every part of the country. 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. Besides these varieties, a dual purpose variety *Srinidhi* is being popularized in the country. Further research in this direction is underway for developing new crosses that could be tailor-made for better adaptability under diversified regions in rural and tribal backyard conditions.

India is basically an agrarian country where more than 70% 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 by adopting a holistic approach to develop high performing, better adaptable and better immune 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 at this Directorate resulted in development of important technologies that have been adopted by the commercial and rural farmers to reduce cost of production. Besides nutritional knowhow, 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 all the stake holders of poultry farming including network programmes and contract research programmes being operated by the Directorate. The studies on advanced molecular genetic tools like SNP typing, microsatellite analysis, DNA marker based selection etc. have also been undertaken in evaluating and augmenting the productivity of various chicken germplasm maintained at the Directorate and at AICRP centres. 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. In addition, the Directorate is organizing capacity building programmes in poultry production and management to all the stakeholders including animal husbandry officers, trainers, technicians, farmers etc.

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 commit-

tees formulated and approved by the council are guiding the Directorate for efficient and quick functioning of the Institute with greater transparency. The organizational set up of the Institute is shown in organogram.

Financial outlay

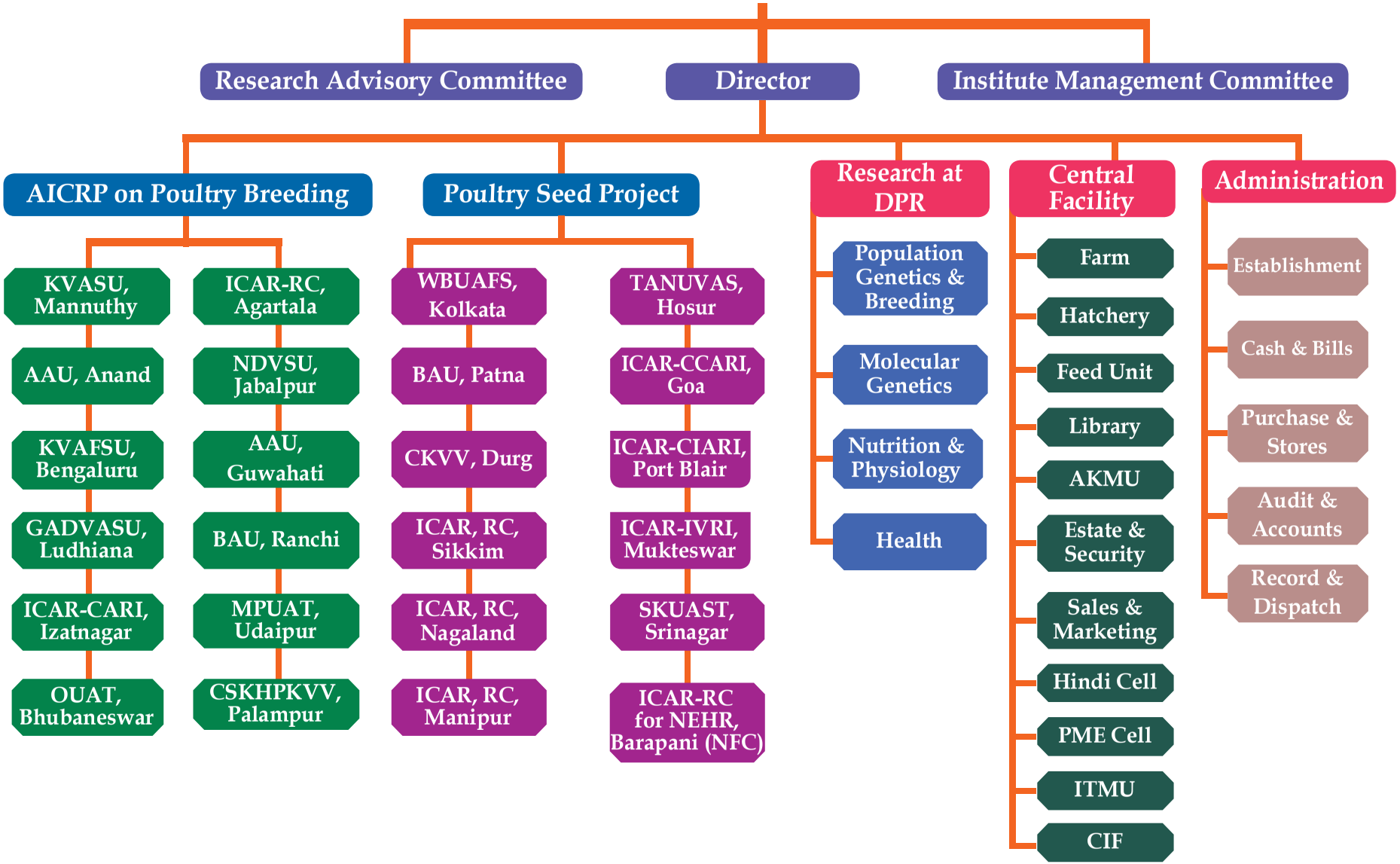
(Rs lakhs)

Component	Plan		Non-Plan		Receipts
	Budget	Expenditure	Budget	Expenditure	
DPR	425.00	424.99	1111.00	1110.91	227.96
AICRP	594.00	594.00	--	--	--
Seed Project	523.00	522.50	--	--	--

Staff position

Cadre	Sanctioned	Cadre in position as on March 31, 2017
RMP	01	01
Scientists	15	18
Technical	16	13
Administrative	14	9
Skilled support	15	14
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
BAU, Patna
CKVV, Durg
ICAR, RC, Sikkim
ICAR, RC, Nagaland
ICAR, RC, Manipur
TANUVAS, Hosur
ICAR-CCARI, Goa
ICAR-CIARI, Port Blair
ICAR-IVRI, Mukteswar
SKUAST, Srinagar
ICAR-RC for NEHR, Barapani (NFC)
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

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

Evaluation of PD-1 line

Production performance

The PD-1 population was evaluated for production traits up to 72 weeks of age in S-10 generation. The ASM was 178.58±0.16 days. The least squares means for body weight at 20 and 40 weeks were 2193.07± 0.57 and 2808.20±0.77 g, respectively. There was a marginal decrease in body weights from the last generation. The body weight at 52, 64 and 72 weeks was 2876.28 ±1.08, 3069.64±1.70 and 3203.33±1.96 g, respectively (Table 1). The egg weights at 40 and 72 weeks were 56.28 ±0.03 and 63.15±0.002 g, respectively. The egg weight improved compared to previous generation. The part period egg production at 40, 52, 64 and 72 weeks of age was 49.58±0.06, 85.45±0.14, 128.72±0.18 and 148.18±0.18 eggs, respectively. The heritability estimates for production traits were low to high from sire & dam components variance. The egg production up to 40 weeks of age reduced from the last generation.

A pair of PD-1 line

Table 1. Production performance of PD1 line (S-10)

Traits	Means	Heritability		
		h^2_S	h^2_D	$h^2_{(S+D)}$
ASM (days)	178.58 ±0.16	0.54±0.37	0.62 ±0.41	0.57±0.28
Body wt. (g)				
20 wks	2193.07±0.57	0.52±0.18	--	--
40 wks	2808.20±0.77	0.02±0.29	0.59±0.47	0.29±0.20
52 wks	2876.28±1.08			
64 wks	3069.64±1.70			
72 wks	3203.33±1.96			
Egg weight (g)				
28 wks	50.61±0.02	0.43±0.26	0.56±0.39	0.49±0.25
32 wks	52.91±0.02			
36 wks	54.52±0.03			
40 wks	56.28±0.03	0.63 ±0.36	0.28 ±0.38	0.45±0.28
52 wks	60.45±0.01			
64 wks	62.24±0.02			
72 wks	63.15±0.02			
Egg production				
40 wks	49.58±0.06	0.07 ±0.49	0.20 ±0.31	0.13±0.25
52 wks	85.45±0.14			
64 wks	128.72±0.18			
72 wks	148.18±0.19			

PD-1 chicken was regenerated in pedigreed mating with 50 sires and 250 dams in five hatches during S-11 generation. A total of 3189 chicks were produced. The fertility and hatchability on FES and TES were 89.34 and 86.28 and 77.08 percent respectively. Hatchability reduced compared to last generation.

Juvenile traits

The PD-1 population was evaluated for juvenile traits in S-11 generation and results are presented in Tables 2-3. The least squares means for body weight at 4 and 6 weeks of age were 318.59±0.30 and 668.67±0.40 g, respectively, which decreased from the previous generation. The shank length at 4 and 6 week was 57.19 ±0.02 and 76.63±0.02 mm, respectively which decreased from last generation. The heritability of 6 week body weight and shank length was 0.27 and 0.28, respectively. The heritability estimates for body weight and shank length were moderate. The body weight and shank length were positively correlated with high degree of positive association.

Evaluation of PD-6 (GML)

The least squares means for body weight at 4 and 6 weeks of age were 334.17±0.4 and 573.62±0.4

Table 2. Juvenile traits and their heritability estimates in PD-1

Parameter	Mean	Sire (h2S)	Dam (h2D)	Sire+Dam (h2S+D)
Body weight, g				
0 wks	37.79±0.02	-	--	--
2 wks	120.30±0.11	0.13 ±0.06	0.39 ±0.06	0.26 ±0.05
4 wks	318.59±0.32	0.22 ±0.08	0.42 ±0.08	0.33 ±0.06
6 wks	668.67±0.44	0.25 ±0.08	0.28 ±0.07	0.27 ±0.05
Shank length, mm				
4 wks	57.19±0.02	0.27 ±0.08	0.29±0.07	0.28±0.07
6 wks	76.63±0.02	0.21±0.07	0.35±0.08	0.28±0.07

Table 3. Correlation coefficient for juvenile traits in PD-1 (genetic :above the diagonal and phenotypic: below the diagonal)

	0BW	2BW	4SL	4BW	6SL	6BW
0 BW	*	0.46	0.20	0.61	0.17	0.28
2 BW	0.19	*	0.90	0.94	0.79	0.85
4 SL	0.11	0.69	*	0.97	0.96	0.89
4 BW	0.15	0.69	0.85	*	0.84	0.94
6 SL	0.12	0.56	0.79	0.75	*	0.87
6 BW	0.15	0.57	0.71	0.77	0.86	*

Table 4. Juvenile traits and their heritability estimates in PD-6

Parameter	Mean	Sire (h2S)	Dam (h2D)	Sire+Dam (h2S+D)
Body weight, g				
4 wks	334.17±0.04	0.18 ±0.10	0.15 ±0.12	0.16 ±0.09
6 wks	573.62±0.04	0.15 ±0.05	0.21 ±0.05	0.17 ±0.04
Shank length, mm				
4 wks	58.96±0.002	0.12 ±0.09	0.19±0.05	0.15±0.10
6 wks	75.32±0.004	0.15±0.05	0.21±0.06	0.18±0.04

g in PD-6 population during SL-6 generation. The shank length at 4 and 6 weeks was 58.96 ±0.02 and 75.32±0.04 mm, respectively which decreased from last generation (Table 4). The heritability estimates for body weight and shank length were moderate (Table 4). The body weight and shank length were positively correlated with high degree of association (Table 5).

Table 5. Correlation coefficient for juvenile traits in PD-6

	4BW	6BW	4SL	6SL
4 BW	*	0.96	0.81	0.68
6 BW	0.60	*	0.71	0.91
4 SL	0.55	0.62	*	0.90
6 SL	0.31	0.78	0.77	*

The selected population of PD-6 was evaluated for production traits up to 52 weeks of age. The ASM was 167.82±0.04 days. The least squares mean for body weight at 20, 40 and 52 weeks was 1962.96± 0.51, 2553.64± 0.70 and 2781.32± 1.09 g, respectively. There was a marginal decrease in body weights. The egg weights at 28 and 40 weeks were 48.60±0.01 and 54.22 ±0.02 g respectively. The part period egg production at 40 and 52 weeks of age was 72.24 ± 0.06 and 125.65 ±0.13 eggs, respectively, which decreased from the last generation. The heritability estimates for production traits were low to high from sire and dam components variance (Table 6).

PD-6 line was regenerated in pedigreed mating with 50 sires and 250 dams in three hatches during S-7 generation. A total of 2494 chicks were produced. The fertility and hatchability percent on FES and TES were 81.41 and 92.26 and 75.12, respectively.

A Pair of PD-6 line

Table 6. Production performance of PD-6

Traits	Means	Heritability		
		h^2_S	h^2_D	$h^2_{(S+D)}$
ASM (days)	167.82±0.04	0.42±0.26	0.25 ±0.23	0.33±0.23
Body wt. (g)				
20 wks	1962.96± 0.51	0.45±0.26	0.07 ±0.35	0.26±0.21
40 wks	2553.64± 0.70	--	--	--
52 wks	2781.32± 1.09	0.12±0.21	0.23 ±0.35	0.17±0.21
Shank length, mm				
20 wks	110.70±0.01	--	--	--
Egg wt. (g)				
28 wks	48.60±0.01	0.51 ±0.22	0.26 ±0.25	0.31±0.22
32 wks	50.71± 0.01			
36 wks	52.97±0.01			
40 wks	54.22±0.02	0.42 ±0.24	0.19 ±0.29	0.30±0.24
52 wks	56.97±0.01			
Egg prodn.				
40 wks	72.44± 0.09	0.17 ±0.23	0.08 ±0.21	0.10±0.21
52 wks	125.65±0.13	0.11 ±0.29	0.05 ±0.12	0.07±0.24

Improvement of PD-2 line

PD-2 line was reproduced utilizing 50 sires and 250 dams selected based on Osborne Index for higher 52 weeks egg mass in S-13 generation. The body weight of females at 20, 40, 64 and 72 weeks of age was 1821.20±029, 2455.28±0.39, 2715.29±0.48 and 2985.23±04.10g, respectively. The age at sexual maturity was 161.59±0.03 days. The egg weight at 24, 28, 32, 40 and 52 weeks of age was 41.35±0.006, 46.58±0.005, 49.08±0.006, 52.68±0.006 and 52.043±0.007g, respectively. The egg production up to 40 and 52 weeks of age was 86.79±.002 and 123.71±0.06 eggs. The egg mass upto 52 weeks of age was 6437.15±3.55g. The annual egg production was 201.16±029 eggs. The egg production upto 52 weeks of age improved by 2.21 eggs compared to previous generation.

PD-2 line was regenerated (S-14) by pedigreed mating. The fertility was 80.05% and hatchability on total and fertile eggs set was 69.72% and 89.73%, respectively. The body weight at day old, 2, 4 and 6 weeks of age was 34.07±0.0001, 116.42±0.003, 272.28±0.002 and 545.06 ±0.009g, respectively. The shank length at 6 weeks of age was 66.79±0.001 mm. The juvenile body weight showed decreasing trend over generations in PD-2 line, probably due to selection for part period egg production.

A pair of adult PD-2 birds

Improvement of PD-3 line

PD-3 line is used as a female line for production of coloured germ plasm for free range farming. The criteria of selection was part period egg mass upto 40 weeks of age. The production traits were evaluated upto 40 weeks of age in G-5 generation. The body weight at 20 and 40 weeks of age was 1278.58±0.33 and 1653.35±0.48 g. The age at sexual maturity was 170.25±0.06 days. The egg weight at 24, 28, 32, 40 and 52 weeks of age was 43.68 ±0.006, 49.29±0.008, 51.17±0.007, 53.10±0.006 and 53.49±0.00g, respectively. The egg production up to 40 weeks of age was 80.39±0.04 eggs. The egg mass up to 40 weeks of age was 4294.98±2.62g. which improved by 334 g compared to previous generation..

A pair of PD-3 birds

Maintenance and evaluation of native chicken germplasm

Conservation and evaluation of Aseel

Aseel chicken was evaluated for growth and production traits up to 72 weeks of age in G-3 generation. The body weight at 40, 52, 64 and 72 weeks of was 1968, 2082, 2268 and 2798 g in hens and 2756, 2896, 3312 and 3794 g in cocks, respectively. The ASM was 219 days. The egg production up to 40, 52, 64 and 72 weeks of age was 12.6, 38.82, 49.10 and 59.53 eggs (60 birds). The egg weight at 40 and 72 weeks was 42.34 and 50.12 g, respectively.

Aseel birds were regenerated in random mating in G-4 generation. A total of 541 chicks were produced. The fertility and hatchability was 74.38% and 64.61 (FES) and 48.15 % (TES), respectively. The body weight of Aseel at 4, 6, 12

Aseel cocks and hen

and 18 weeks of age was 143.15, 309.43, 877.90 and 1326.52 g and the corresponding shank length was 44.86, 60.88, 95.38 and 112.32 mm, respectively.

Evaluation of PD-4

PD-4 variety evolved from Aseel Peela is being improved for body weight at 8 weeks of age through individual selection. In S-7 generation, a total of 825 good chicks were hatched in two hatches with the fertility of 82.12% and hatchability of 77.22 and 63.41% on FES and TES, respectively. In this generation, there was an improvement of 75 g in body weight (primary trait) and 4.14 mm in shank length at 8 weeks of age on pooled sex (Table 7). Positive and high genetic (0.93±0.06) and phenotypic (0.87) correlations between body weight and shank length at 8 weeks of age were observed. Sex wise body weight and shank length recorded at 20 and 40 weeks of age are presented in Table 8. The adult body weights increased considerably during S-7 generation compared to last generation (Table 8). Liveability during 0-8 (95.76%), 9-20 (97.72%) and 0-20 (93.58%) weeks of age was better compared to previous generation. Similarly, liveability of males (99.06%) and females (95.02%) during 21-40 wks was higher as compared to previous generation in respective sex.

Table 7. Means and estimates of heritability of growth traits of PD-4 birds on pooled sex

Traits	N	Mean±S.E.	h2(Dam)
Body weight (g)			
0 day	778	33.8±0.11	-
4 wks	778	183.5±1.1	0.51±0.18
8 wks	778	554.5±2.97	0.38±0.17
Shank length (mm)			
8 wks	778	79.11±0.18	0.31±0.16

Table 8. Means of growth traits of female and male PD-4 birds

Traits	N	Female	N	Male
Body weight (g)				
20 wks	240	1492±7.73	106	2135±19.5
40 wks	229	2062±13.6	83	3069±28.3
Shank length (mm)				
20 wks	240	105.8±0.23	106	129.8±0.41
40 wks	229	106.9±0.23	44	132.6±0.72

Adult PD-4 birds

Egg production traits: Survivors' egg production up to 40 weeks of age improved by 6.67 eggs in S-7 generation as compared to previous generation although average age at sexual maturity increased in this generation. Body weight at 40 weeks of age has increased by 140 and 106 g in male and female birds, respectively (Table 9).

Table 9. Production traits of PD-4 birds in S-7 generation

Traits	N	Figures
Age at fist egg in the flock (d)	2	144.5
Age at sexual maturity (d)	227	180.3±0.58
Survivors' EP 40 wks (Nos.)	227	69.21±1.11
HHEP 40 wks (Nos.)	241	66.54
HDEP 40 wks (Nos.)	-	68.16
Egg weight (g)		
28 wks	205	44.48±0.22
32 wks	210	47.25±0.24
36 wks	209	48.23±0.24
40 wks	192	48.85±0.27

Characterization of Ghagus

Ghagus, a native chicken breed in G-4 generation was evaluated for production traits up to 40 weeks of age. Female and male birds of Ghagus selected for uniform plumage and comb patterns were housed for recording growth and production performance. Average body weights and shank lengths of male birds recorded at 40 weeks of age were 2582±31.27 g and 129.9±0.78 mm, respectively.

Production traits: Results of production traits of Ghagus breed recorded in G-4 generation are presented in Table 10. Egg production has improved in G-4 generation compared to previous generation despite increase in age at sexual maturity. There was also increase in body weight and shank length as compared to previous generation.

A pair of Ghagus birds

Table 10. Production traits in G-4 generation in Ghagus breed

Traits	N	Mean ± S.E.
Age at first egg (d)	2	154.5
ASM (d)	215	183.5±0.83
EP 40 wks (Nos.)	221	39.16±1.21
Body wt. at 40 wks (g)	219	1786±19.09
S L at 40 wks (mm)	219	103.16±0.33
Egg weight (g)		
28 wks	161	42.24±0.29
32 wks	120	44.15±0.40
36 wks	96	44.17±0.47
40 wks	138	45.99±0.34

G-5 generation of Ghagus was produced in two hatches by pedigree mating of 50 sires with 150 dams. Fertility was 90.13%, while hatchability on fertile and total eggs set was 86.51 and 77.98% respectively. Growth traits recorded on pooled sex up to 8 weeks of age are presented in Table 11. Heritability estimates for the juvenile growth traits were on higher side indicating that there is a scope for improvement of this breed for growth traits. Genetic (0.99±0.006) and phenotypic (0.92) correlations between body weight and shank length recorded at 8 weeks of age were positive. Body weight recorded at 20 weeks of age in male and female birds was 1829±32.99 and 1308±12.13 g, respectively while shank length of corresponding sex was 125.4±0.93 and 101.6±0.40 mm, respectively.

Table 11. Least square means of growth traits of Ghagus breed in G-4 generation on pooled sex

Traits	N	Mean ± S.E.	h2(Sire)
Body wt (g)			
0 day	752	32.12±0.004	-
4 wks	752	128.6±0.05	0.55±0.20
8 wks	752	383.8±0.17	0.76±0.24
Shank length (mm)			
8 wks	752	64.19±0.012	0.71±0.23

Maintenance of Nicobari breed

Random bred brown and black Nicobari birds are being maintained at the institute farm as resource population for experimental purposes. G-3 generation was evaluated for production traits up to 40 weeks of age (Table 12). Average body weights of male birds of brown and black Nicobari at 40 weeks of age were 2359±65.7 and 2203±52.0 g respectively while shank length of respective varieties were 105.9±2.2 and 101.4±2.58 mm.

A pair of Nicobari chicken

G-4 generation of Nicobari breed (Brown and Black varieties) was regenerated by random mating using pooled semen. Overall fertility was 84.23%, while hatchability on fertile and total eggs set was 87.46 and 73.66%, respectively. Better fertility and hatchability on fertile egg set was observed in G-4 generation. A total of 293 and 191 good chicks of brown and black varieties respectively were produced in a single hatch. Growth performance of brown and black Nicobari breeds was evaluated on pooled sex up to 8 weeks of age (Table 13). Body weight and shank length of male and female brown Nicobari birds were 1476±67.8g and 100.2±3.50mm; 1068±69.45 and 85.67±3.58 mm, respectively. Body weight and shank length of black Nicobari birds were 1593±61.7g and 98.59±3.32 mm; 874.5±81.63g and 70.95±3.84 mm, respectively.

Table 12. Production performance of Brown and Black Nicobari birds in G-3 generation (Mean ± S.E.)

Traits	N	Brown	N	Black
ASM (d)	59	172.4±1.61	55	173.1±2.1
HHEP 40 wks (Nos.)	59	61.91±2.42	58	58.23±3.80
Body wt. (g)				
40 wks	56	1385±27.4	55	1314±27.8
Shank length (mm)				
40 wks	56	84.24±1.44	44	78.89±1.37
Egg weight (g)				
28 wks	53	43.13±0.54	47	39.85±0.45
32 wks	52	44.61±0.56	48	41.00±0.49
40 wks	52	45.24±0.49	44	42.60±0.45

HHEP: Hen Housed Egg Production, S L: Shank length

Egg quality

Egg quality study of three breeds was carried out at 40 weeks of age. A total of 103, 120 and 121 eggs from Ghagus, Nicobari and White Leghorn breeds respectively were used for the study. Egg weight was significantly higher in WLH followed by Ghagus and Nicobari breeds. Albumen index and Haugh unit were significantly higher in Ghagus and WLH as compared to Nicobari. Yolk index was significantly higher in Ghagus as compared to WLH and Nicobari breeds. Shape index was significantly better in WLH and Ghagus breeds as compared to Nicobari. Yolk colour was better in Nicobari and WLH as compared to Ghagus (Table 14).

Table 13. Growth performance of brown and black Nicobari birds (Mean ±S.E.) in G-4 generation

Traits	N	Brown	N	Black
Body weight (g)				
0 day	293	31.05±0.19	191	28.75±0.21
4 wks	277	148.3±2.29	182	168.9±2.95
8 wks	221	277.9±6.96	173	361.1±9.00
Shank length (mm)				
8 wks	221	53.77±0.60	173	57.64±0.72

Table 14. Egg quality traits at 40 weeks of age in three chicken breeds

Parameters	Ghagus	WLH	Nicobari	P value
Egg weight (g)	46.81±0.57b	54.80±0.69a	44.37±0.64c	0.001
Shape index	76.25±0.40 ab	76.71±0.48 a	75.38±0.44 b	0.035
Yolk index	0.45±0.005 a	0.32±0.013 b	0.30±0.012 b	0.001
Albumen index	0.093±0.004 a	0.087±0.002 a	0.07±0.003 b	0.001
Haugh unit	79.73±1.64 a	80.58±0.98 a	70.72±1.65 b	0.001
Yolk colour	4.92±0.13 b	5.32±0.09 a	5.39±0.15 a	0.029
Albumen (%)	64.78±1.09	67.96±0.94	65.23±1.11	0.072
Yolk (%)	26.53±1.05	23.30±0.96	26.35±1.06	0.071
Shell (%)	9.14±0.14 a	8.70±0.099 b	9.09±0.10 a	0.016

Evaluation of crosses

The 2–way and 3-way crosses were evaluated under farm and field conditions. The 20 week body weight in 2-way and 3-way crosses was 1972.02 ± 21.26 and 1626.79±27.84 g, respectively in farm and 1507.92 and 1122.87 g in village conditions. The 40 week body weight in hens of 2- and 3- way cross was 2489.74 ±38.22 and 1901.93± 40.50 g, respectively under farm conditions. The corresponding values under filed conditions were 2018.81 and 1589.20 g, respectively. The egg production at 52 weeks of age was 122.54± 4.64 in 2 way and 146.33 ± 4.41 eggs in 3 way cross under farm conditions. The corresponding EP 52 under field condition was 83.74 and 118.40 eggs in 2 and 3 way crosses, respectively. The annual egg production (72 weeks) was 189.61±6.72 and 277.81±6.75 eggs in 2 and 3 way cross respectively in farm. The egg weight at 72 weeks was 60.45 g in 2 way and 58.05 g in 3 way cross in farm (Table 15).

Table 15. Production performance in crosses under farm condition

Traits	2 way, n=61		3 way, n=58		Prob.
	Mean	SE	Mean	SE	
Body weight, g					
20 wks	1972.02	21.26	1626.79	27.84	0.001
40 wks	2489.74	38.22	1901.93	40.50	0.001
52 wks	2499.46	43.37	1933.81	46.55	0.001
64 wks	2472.80	42.36	1898.33	44.51	0.001
72 wks	2625.89	47.02	2041.33	42.88	0.001
ASM, days	152.35	1.03	144.55	1.38	0.001
Egg weight, g					
28 wks	47.17	0.58	45.34	0.52	0.023
32 wks	51.55	0.38	50.14	0.43	0.014
36 wks	52.86	0.45	52.91	0.62	0.945
40 wks	56.20	0.52	54.40	0.70	0.040
52 wks	56.29	0.49	56.35	0.55	0.942
64 wks	59.78	0.57	57.58	0.70	0.016
72 wks	60.45	0.54	58.05	0.67	0.007
Egg Production					
40 wks	69.22	3.89	84.79	3.59	0.004
52 wks	122.54	4.64	146.33	4.41	0.001
64 wks	165.61	5.93	198.95	5.67	0.001 0.0.001
72 wks	189.61	6.72	227.81	6.75	0.001

2-way cross cock

2-way cross hen

Flock of 2-way cross in field

Flock of 3-way cross

The terminal crosses involving PD-2 and GML as male lines and PD-3 as female line were evaluated for production performance. The performance was statistically similar for all the traits including body weight, age at sexual maturity, egg weights and egg production throughout the production cycle. Therefore, the new GML line can be utilized as male line for Gramapriya chicks without affecting the performance. The production performance was presented in Table 16.

Adult birds of 3-way cross

Flock of 2-way cross

Flock of 2-way cross in farmer's house hold

Table 16. Production performance in terminal crosess involving PD-2 and GML chicken

Traits	GMLx PD-3		PD-2xPD-3		Prob.
	Mean	SE	Mean	SE	
Body weight, g					
20 wks	1805.89	23.73	1778.84	23.15	0.433
40 wks	2371.92	42.42	2295.75	30.36	0.183
52 wks	2540.21	44.78	2402.14	35.94	0.027
64 wks	2699.70	49.99	2764.75	39.29	0.599
72 wks	2849.22	55.37	2762.93	40.26	0.248
ASM, days	159.02	0.84	159.50	1.35	0.749
Egg weight, g					
28 wks	49.25	0.34	49.08	0.68	0.808
32 wks	51.27	0.40	50.58	0.49	0.272
36 wks	53.57	0.45	53.26	0.45	0.635
40 wks	56.47	0.51	56.58	0.62	0.891
52 wks	58.99	0.59	57.39	0.55	0.061
64 wks	62.00	0.64	60.98	0.69	0.291
72 wks	61.67	0.62	60.68	0.55	0.261
Egg Production, no.					
40 wks	90.60	2.47	95.18	2.65	0.218
52 wks	153.46	3.38	158.66	4.12	0.330
64 wks	211.32	4.34	218.32	4.57	0.280
72 wks	247.33	4.81	255.73	5.19	0.247

Maintenance and evaluation of coloured broilers

Coloured Broiler Male Line (PB-1)

PB-1 was regenerated with 50 sires and 250 dams during S-26 generation. Percent fertility was 79.33. Percent hatchability on total eggs set (TES) and fertile eggs set (FES) was 66.56 and 83.86, respectively. As compared to last generation fertility and hatchability were marginally decreased. The summary of selection records is presented in Table 17. Intensity of selection was 1.26.

Table 17. Summary of selection records of PB-1 (S-26)

Particulars	Magnitude
No of sires	50
No of Dams	250
No of sires contributed	50
No of dams contributed	250
Effective number	153.60
Rate of inbreeding	0.0065
Average selection differential (5WK BW) g	148
Intensity of selection	1.26
Expected response(g) 5WK BW	59.20

A pair of PB-1 birds

Table 18. Juvenile traits performance of PB-1(S-26 Generation)

Traits	Mean±S.E(S-25)	Mean±S.E(S-26)
Body weight, g		
4 wks	620±0.53	618±0.62
5 wks	976±0.71	916±0.81
6 wks	1201±0.63	1150±0.72
Shank length (mm)		
5 wks	73.41±0.08	74.69±0.06
Breast angle(^{0})		
5 wks	82.28±0.07	83.22±0.08

Genetic response in 5wk body weight was 17.30g. Phenotypic response was 5.8 g (Fig 1). Recording of production traits is in progress in cages.

Coloured Broiler Female line (PB-2)

PB-2 line was evaluated for production traits (S-25) and juvenile traits for (S-26) generation during the reporting period. The Production parameters of PB-2 in S-25 generation are presented in the Table 19.

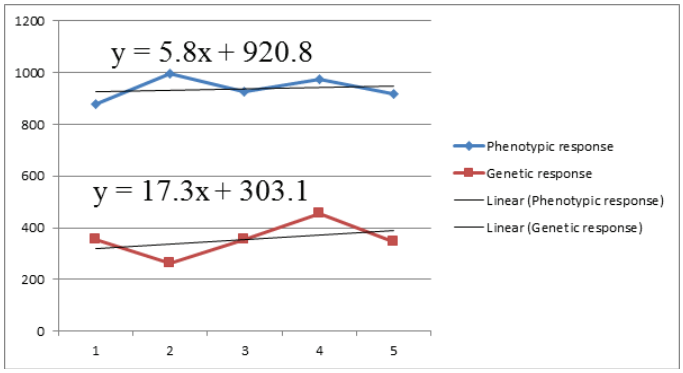


Fig.1. Genetic and phenotypic response of 5WK body weight in PB-1

A pair of PB-2 birds

Table 19. Production performance in PB-2 line

Trait	S-25
ASM (days)	180.20±0.98
Egg production (no)	
32 wks	33.23±0.60
40 wks	67.96±0.93
Egg weight (g)	
28 wks	51.21±0.31
32 wks	55.03±0.24
36 wks	57.64±0.23
40 wks	58.51±0.26
Body weight (g)	
20 wks	2199.65±11.93
40 wks	3208.27±17.79

The average ASM has increased by ten days compared to the last generation (170.87±1.83 days). The egg weight and egg production at 40 weeks remained stable compared to the last generation. The phenotypic and genetic response to selection for the 40 week part period egg production over the last ten generations was 0.68 and 1.28 eggs per generation, respectively (Fig. 2).

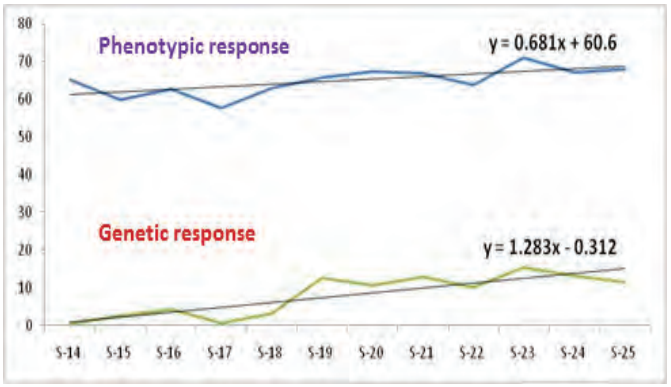


Fig: 2. Phenotypic and genetic response of 40 week egg production in PB-2 over last 10 generations

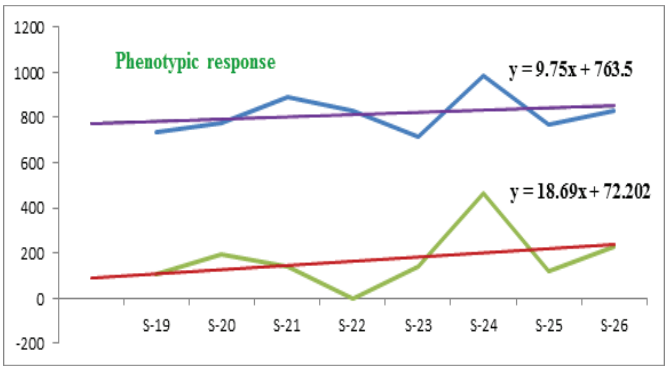


Fig: 3. Phenotypic and genetic response of 5 week body weight in PB-2 over last 7 generations

The effective population size was 200 and the level of inbreeding was 0.003. A total of 6398 eggs were set of which 3659 healthy chicks were obtained in four hatches. The percent fertility, hatchability on TES and FES were 72, 57 and 80, respectively. The fertility remained stable while the hatchability parameters reduced slightly by 4% compared to the last generation. A sample of 284 eggs of Control Broiler was set along with the third hatch of the PB-2. The percent fertility, hatchability on TES and FES in CB were 78, 65 and 84, respectively. The fitness traits in CB also reduced considerably over the last generation.

The juvenile conformational traits were recorded in all the chicks. The least square means for day old, two and four weeks body weight were 40.32±0.07, 210.45±0.53 and 578.33.44±2.61 g, respectively. The body weight, shank length and breast angle at five weeks were 833.37±2.90 g, 77.87±0.11mm and 76.81±0.11°, respectively. The five week body weight of the control broiler was 605.13±9.05g. An improvement of 67g was recorded in the 5 week body weight over the last generation. The phenotypic and genetic response to selection for the five week body weight over the last seven generations was 9.75 and 18.69 g per generation, respectively (Fig. 3).

The genetic and phenotypic correlations of juvenile growth traits in S-26 generation of PB-2 are given in Table 21.

Table 20. The h2 estimates of juvenile growth traits in S-26 generation of PB-2

Trait	h2(s)	h2(d)	h2(s+d)
Body weight			
2 wks	0.09±0.06	0.55±0.09	0.32±0.05
4 wks	0.17±0.06	0.38±0.07	0.27±0.05
5 wks	0.12±0.06	0.38±0.07	0.25±0.05
Shank length			
5 wks	0.13±0.06	0.39±0.07	0.26±0.06
Breast angle			
5 wks	0.07±0.03	0.02±0.01	0.04±0.02

Table 21. Correlation coefficient in PB-2

Trait	0 BW	2 BW	4 BW	5BW	5SL	5BA
0 BW		0.38	0.14	0.09	0.16	0.13
2 BW	0.20		0.86	0.76	0.67	0.13
4 BW	0.10	0.73		0.96	0.80	0.22
5 BW	0.09	0.63	0.87		0.81	0.25
5 SL	0.11	0.58	0.78	0.81		0.29
5 BA	0.02	0.11	0.14	0.14	0.10	

(above diagonal-genetic, below-phenotypic)

Random Bred Broiler Control Population

During the period G-15 generation of control broiler was regenerated with 50 Sires and 250 Dams. A total of 2976 eggs were set and 1954 chicks were regenerated. Percent fertility was 73.68. Percent hatchability on total eggs set (TES) and fertile eggs set (FES) respectively was 63.65 and 89.1. Fertility and hatchability were improved as compared to previous generation. Juvenile traits performance of control broiler is presented in Table 22. As compared to last generation juvenile body weights were significantly improved in the present generation.

Table 22. Performance of juvenile traits of control broiler (G-15 Generation)

Trait	Mean(G-14)	Mean(G-14)
Body weight (g)		
4 wks	320±0.43	381±0.50
5 wks	520±0.52	570±0.61
6 wks	663±0.65	836±0.90
Shank length (mm)	64.78±0.09	66.18±0.08
Breast angle (0)	75.14±0.06	76±0.06

Time trend of Juvenile body weights in control broiler is presented in Fig-4.

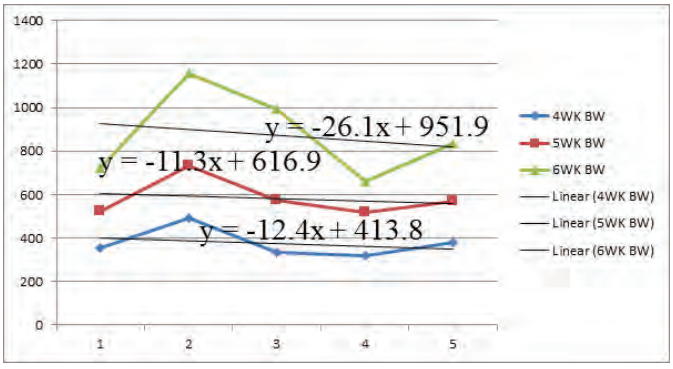


Fig.4. Time trend of Juvenile body weights in Control broiler

Production traits of control broiler are presented in Table 23. As compared to last generation, ASM was increased by 9 days. The 20 wks body weight was decreased by 109 g and 40 wks body weight was decreased by 53 g. The 40 wks egg weight was increased by 2.6 g and 40 wks egg production was similar.

Table 23 Production performance of Control broiler (G-15 generation)

Trait	Mean(G-14)	Mean(G-15)
ASM days	173.6±0.08	182±0.09
Body weight (g)		
20 wks	2405±1.06	2296±0.96
40 wks	3151±1.20	3098±1.10
Egg weight (g)		
32 wks	52.50±0.06	51.23±0.05
40 wks	56.20±0.08	58.60±0.06
Egg production (no)		
40 wks	56.59±0.10	56.0±0.30

Maintenance of gene lines

Naked neck (Na) and Dwarf (Dw) gene lines

The gene lines were evaluated for their juvenile growth traits and production traits in the S-14 generation. The S-14 generation of each gene line was regenerated using 24 sires and 72 dams in three hatches. In naked neck (*Na*) line, 721 chicks were produced with 82.7% fertility, 64.2% hatchability on TES and 77.5% hatchability on FES, whereas in dwarf (*Dw*) line, 355 chicks were produced with 68.6% fertility, 57.2% hatchability on TES and 83.3% hatchability on FES. The fitness traits reduced in both the gene lines compared to the last generation.

Adult naked neck chickens

A pair of dwarf chicken

Table 24. Juvenile traits of gene lines in S-14 generation

Trait	Naked Neck	Dwarf
Body weight (g)		
Day old	40.21±0.12	38.03±0.21
3 wks	284.39±2.31	221.73±3.81
6 wks	970.84±6.66	677.03±8.82
Shank length (mm)		
6 wks	83.58±0.23	71.09±0.35
Breast angle (⁰)		
6 wks	78.14±0.23	75.75±0.29

Table 25. Production traits of the *Na* and *Dw* gene lines in their S-14 generation

Trait	Naked Neck	Dwarf
ASM (days)	174.41±1.91	152.56±1.21
Body weight (g)		
20 wks	2394.25±25.27	2092.63±37.35
Egg weight (g)		
32 wks	56.76±0.40	51.74±0.66
40 wks	61.44±0.43	55.36±0.52
Egg production (No.)		
32 wks	31.79±1.96	47.07±1.54
40 wks	61.39±1.98	74.16±2.20

The six week body weight increased by 118g and 24g in the *Na* line and *Dw* gene line, respectively, compared to their last generation. The h2(s+d) estimates in Na gene line for 3 week body weight, 6 week body weight, shank length and breast angle were 0.35±0.08, 0.38±0.08, 0.38±0.09 and 0.05±0.02, respectively. The genetic correlation between 3 and 6 week body weight was 0.82. The h^2 estimates were low to medium for the juvenile growth traits in Naked neck line.The ASM increased by 15 days in the *Na* line and 12 days in the *Dw* gene line over the previous generation. The body weight in both lines remained stable compared to last generation. The 40 week egg weight was increased in *Na* gene line compared to its previous generation. The egg production reduced by 5 eggs in *Na* while it increased by two eggs in *Dw* gene line.

Maintenance and evaluation of layer populations

Three pedigreed layer chicken lines (IWH, IWI, and IWK) along with the layer control were maintained and evaluated for growth and production performance. Two more lines, IWD and IWF received from AICRP, Hyderabad centre were regenerated through random breeding. Growth and production performance of IWH and IWI in S-4 generation and IWK and Layer Control (LC) in S-12 were recorded. The Least Squares Means (LSM) for body weight, egg production and egg weight are presented in Table 26. The age at sexual maturity in IWH, IWI, IWK and LC were 139.35±0.46 (456), 139.22±0.45 (475),

Table 26. Growth and egg production performance of layer purelines

Traits	IWH (S-4)	IWI (S-4)	IWK (S-12)	Control (S-12)
ASM (days)	139.35±0.46 (456)	139.22±0.45 (475)	136.85±0.42 (604)	150.11±0.49 (405)
Body weight (g)				
16 wks	898.30±5.74 (578)	979.95±6 (528)	1017.15±5.2 (704)	914.01±6.74 (419)
20 wks	1120±7.67 (308)	1144.16±6 (506)	1168.74±5.14 (686)	1177.94±6 (495)
40 wks	1423.81±8 (457)	1345.2±8.1 (457)	1389.89±7(615)	1522.71±8.1(454)
Egg production (no)				
20 wks	5.01 ± 0.26 (269)	6.0± 0.26 (267)	6.82± 0.21 (411)	3.2 ± 0.53 (63)
40 wks	114.45±0.82(461)	116.37±0.82(464)	103.92±0.71(619)	98.06±0.82 (462)
64 wks	254.70 ± 1.54 (399)	257.98±1.45 (357)	232± 1.24 (469)	224.57±1.61 (422)
Egg weight (g)				
28 wks	44.94±0.16 (452)	45.12±0.17(449)	45.80±0.15(598)	46.26±0.17(447)
40 wks	50.74±0.12 (445)	50.59±0.18(451)	52.2±0.15(602)	52.88±0.18(442)
52 wks	54.21± 0.23 (327)	53.77± 0.17(414)	54.82 ±0.20 (562)	55.69±0.16 (406)
64 wks	56.06±0.21 (422)	55.21±0.21 (393)	57.48±0.19 (520)	57.67±0.31 (410)

A pair of layer birds

136.85±0.42 (604) and 150.11±0.49 (405) days, respectively. The LSM of body weight at 16 weeks in IWH, IWI, IWK and Layer Control (LC) were 898.30±5.74 (578), 979.95±6 (528), 1017.15±5.2 (704) and 914.01±6.74 (419)g, respectively. The average egg production up to 64 weeks (EP64) in IWH, IWI, IWK and Layer Control were 254.70± 1.54 (399), 257.98±1.45 (357), 232± 1.24 (469) and 224.57±1.61 (422), respectively. The LSM of egg weight at 28 weeks were 44.94±0.16 (452), 45.12±0.17 (449), 45.80±0.15 (598) and 46.26±0.17 (447) g in IWH, IWI, IWK and LC, respectively. The average shell thickness of IWH, IWI, IWK and CL at 40 weeks was 33.6±0.23, 33.45±0.22, 34.78±0.55 and 33.02±0.26 mm, respectively. IWD and IWF were regenerated through random breeding. The average fertility percentage of IWD and IWF were 88.35 and 86.82%, respectively. The hatchability on TES and FES basis in respective lines was 82.27, 93.0, 78.44 and 91.0%, respectively. The average egg production of IWD and IWF up to 32 weeks was 51.89 and 52.46, respectively.

Molecular Genetics

Functional genomics, epigenetics and gene silencing technology for improving productivity in poultry (National Fellow project)

Expression profiling of BMP3, BMP4, FASN and ACACA genes during embryonic and post-hatch period upto 6 weeks were established in layer and broiler chicken. Methylation pattern of promoters of BMP3, BMP4 and ACVR2B genes in chicken were determined where 53 and 44 CpG dinucleotides were observed to be methylated in 785 bp promoter of BMP3 and 549 bp promoter of BMP4 genes. The CpG dinucleotides in promoter of ACVR2B gene at positions 42nd, 74th, 200th, 209th, 341th, 431st, 515th, 639th and 649th showed differential methylation varied between ages and lines. A significant effect (P≤0.05) of CpG methylation on expression of genes was observed. A total of 3 haplotypes were observed in BMP3 minimal promoter of broiler and layer chicken lines where haplogroups had significant effect on growth rate between day1 to day 14 with the highest growth rate of 11.06 ± 0.29g/day revealed by h1h3 haplogroup. A 1106 bp promoter region of BMP4 gene was amplified for identification of promoter haplotypes and a total of 3 haplotypes were observed where haplogroups had significant effect on body weight at day 42 with showing highest magnitude (949.93 ± 31.34g) by h1h3 haplogroup. A total of 8 haplotypes were observed in 1122 bp promoter of ACVR2B gene where h1h8 and h1h4 had significantly higher body weight at all ages in both the lines. Chicken ACVR2B gene was silenced by RNAi under *in vitro* primary myoblast cell culture system. The five shRNA constructs cloned in pENTR/U6 vector were transfected into chicken fibroblast cells to knockdown the expression of ACVR2B gene. The percent knock down of ACVR2B mRNA due to different shRNA varied significantly (P<0.05) from 87% (shRNA1) to 47% (shRNA5) in comparison to the scrambled shRNA.

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

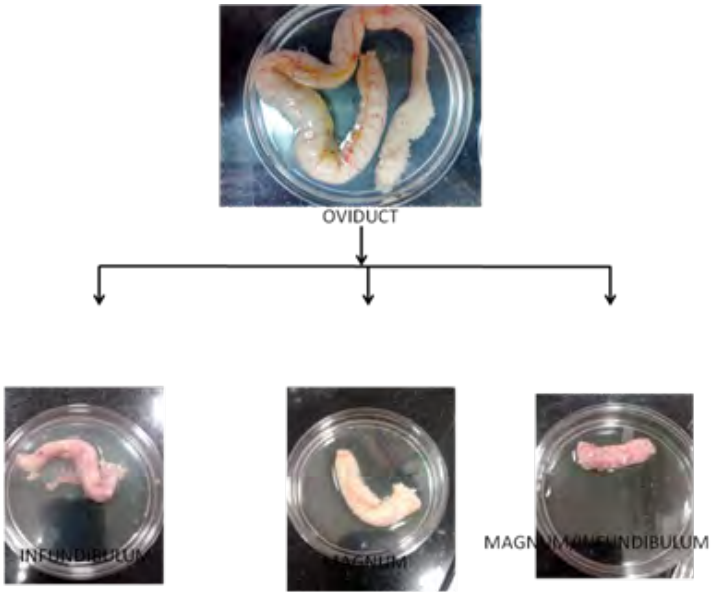
The expression profile of growth hormone receptor gene in 5 tissues such as breast muscle, bursa, heart, spleen and gizzard in Aseel and Ghagus breeds of chicken during early post hatch period was established. The breed-wise expression profile indicated that in Aseel breed, breast muscle showed more than 35 fold expression in male over female birds while in other tissues, fold change of expression was not significantly varied between male and female birds. In Ghagus breed, there was no significant difference of expression between both the sexes in all the tissues studied here. The day-wise expression profile determined that the expression was more than 4 fold in breast muscle on day 1 over 28th day in Ghagus breed while other tissues showed non-significant fold change between day 1 and

day28 (Fig. 53 & 54). In Aseel breed, bursa and heart tissues had more than 3.5 fold higher expression on day 1 over day 28 while other tissues did not show any significant change of expression between two age groups.

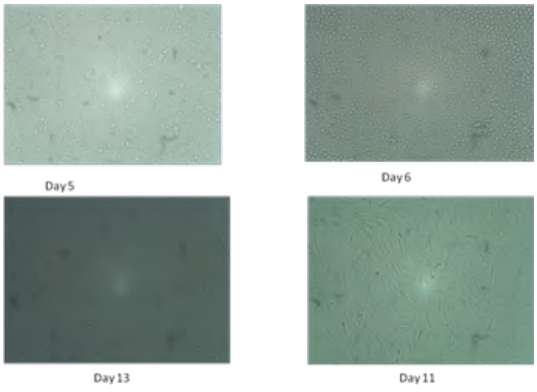
The primary chicken oviductal cell culture was standardized with advanced DMEM/F12 and 10% FBS at 37oC and 5% CO_2 for further in vitro studies. The expression of ovalbumin gene was examined in the cell culture system. The level of expression of ovalbumin gene in terms of 40-Δct in infundibulum, magnaum and, magnum plus infundibulum was 43.2, 35.8 and 41.5, respectively. The level of expression was found to differ non-significantly. The GFP driven expression was also checked in the transfected oviductal cell culture. The level of expression of GFP gene in terms of 40-Δct in oviductal cells derived between types of tissues such as infundibulum, magnaum and magnum plus infundibulum was 49.1, 52.7 and 43.6, respectively. It is concluded that either infundibulum, magnum or both infundibulum and magnum may be used for culturing oviductal cells for expressing ovalbumin gene.

Polymorphism in PB-2

In order to analyse the polymorphism in growth related genes in PB-2, blood samples (n=2500) were collected from young birds of 2-3 weeks of age from S-25 generation and genomic DNA isolation was done. PCR-RFLP of two candidate growth genes viz., IGF-I and apoVLDL-II was done in the S-24 samples. Significant difference in body weights was observed at 2nd and 4th week among the alleles in both these candidate genes. Blood samples (n=3000) were collected from the chicks of S-26 generation.



Types of tissues collected for culture of oviductal cells



Primary cell culture of oviduactal cells of magnum

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

Immune-competence traits in different breeds of chicken (*viz.* Ghagus, Dahlem Red and Nicoabri) were evaluated using peripheral blood cell count ($10^3/\mu l$) and cytotoxic T cell. The cytotoxic T cell count was higher in control compared to treatment group. The breed wise comparison revealed a significant difference ($P<0.05$) between the Nicobari and Dahlem Red. It was found to be highest in Brown Nicobari (3.81±.02) followed by Ghagus (3.76±.02) and least in Dahlem Red (3.73±.02). Sex wise results showed that females (3.78±0.02) were having high Tc cell compared to males (3.75±.02). Significant difference was found in WBC count between Dahlem Red (38.41 ±1.03) with that of Brown Nicobari (35.28 ±1.04) and Ghagus (34.57 ±1.04) in treatment groups. Same trend was observed in the Lymphocytes in the treatment group. However, Granulocytes in the treatment group, Brown Nicobari (11.04±0.35) was found tobe significantly different from Dahlem Red (8.68±0.34) and Ghagus (9.27±0.35). A cutaneous basophil hypersensitivity (CBH), response to phytohemagglutinin-P (100μg/ per bird) to 12 week old birds of different breeds of chicken showed significant difference ($P<0.05$) in the wattle thickness (% increase, after 24 hours) across the breeds and sexes. Highest response was reported in Ghagus (431.14±22.56) followed by Brown Nicobari (269.1±22.66) and least in Dahlem Red (218.42±22.30). Sex wise results showed significant ($P<0.05$) difference in percent increase in wattle thickness in females (342.844±18.81) compared to males (269.59±17.86). Sire effect in different breeds of chicken was found to be non-singnificant.

Haemagglutination inhibition titre (HI $\log_2$ titres $>2^4$), to ND vaccine was found to be highest in Brown Nicobari (9.05±.238), which significantly ($P<0.05$) differred with the Ghagus to booster NDV dose. Sex wise analysis also revealed that females were having higher titre (8.85±0.20) compared to males (8.34±0.19). Sire effect (taking sire as random effect) on Heamagglutination Inhibition assay for Newcastle disease virus in different breeds of chicken was found to be non-singnificant.

Genetic analysis of innate immune-competence and survivability for identification of genetic markers in indigenous chicken breeds (DST Project)

Differential expression of PRR genes in PBMC by real time qPCR method

Pattern recognition receptors play a critical role in innate immunity as first line of defense against invading pathogens through recognition of pathogen and/or damage associated molecular patterns. Genetic makeup of birds is known to play a role in resistance or susceptibility to various infectious diseases. Therefore, the study was carried out to elucidate the differential expression of PRR and some of the cytokine genes in PBMC of indigenous chicken breeds such as Ghagus and Nicobari and exotic chicken breed, WLH. The stability of expression of reference genes in PBMC of three breeds was first determined using Norm Finder and Best Keeper programs. Norm Finder determined *B2M* and *G6PDH* reference genes as the best combination with stability value of 0.38. Out of total 14 genes studied, expression of ten genes was found to be significantly different among three breeds after normalization with these reference genes. Ghagus breed showed higher level of expression of *TLR1LB*, *TLR7*, *NOD1*, *NOD5*, *B-Lec*, *IFN*β, *IL1*β and *IL*β genes when compared to Nicobari breed. Further, Ghagus showed higher expression of TLR1LB, MDA5, LGP2, B-Lec, IL1β and *IL8* genes as compared to WLH breed. Higher expression of *LGP2* and *MDA5* genes was observed in Nicobari compared to the WLH breed while higher expression of *TLR7*, *NOD1*, *NOD5* and *IFN*β genes was observed in WLH as compared to Nicobari breed. No difference was observed in the expression of *TLR1LA*, *TLR3*, *B-NK* and *IFN*α genes among three breeds. Study revealed significant breed effect in expression profile of PRR and some of the cytokine genes and Ghagus breed seems to have better expression profile of these genes linked to the innate immunity when compared to the WLH and Nicobari breeds.

Table 27. Synonymous (Syn) and non-synonymous (NS) substitutions in four PRR genes

Breeds/Genes	MDA5		TLR1LA		TLR3		NOD1		Total	
	Syn	NS	Syn	NS	Syn	NS	Syn	NS	Syn	NS
WLH	1	3	11	8	6	7	6	5	24	23
Ghagus	8	4	8	8	7	7	4	6	29	25
Nicobari	6	2	16	12	6	10	17	10	45	34
Total	15	9	35	28	19	24	27	21	98	82

Single nucleotide polymorphisms (SNPs) in coding regions of PRR genes in Ghagus, Nicobari and White Leghorn breeds

Coding regions of *TLR1A, TLR3, MDA5, NOD1* and *NOD5* genes were sequenced in Ghagus, Nicobari and White Leghorn (Layer control) breeds by Sanger sequencing. Alignment of coding sequences (cds) of PRR genes with reference sequence (Red Jungle Fowl) revealed significant number of SNPs among three breeds. Altogether highest SNPs (both synonymous and non-synonymous types) were seen in Nicobari breed followed by Ghagus and WLH (Table 27). Among four genes, highest SNPs were seen in *TLR1LA* (2189bp) followed by *NOD1* (2856bp), *TLR3* (2691bp) and *MDA5* (3006bp) genes. Most of the NS substitutions were neutral in effect as predicted by PROVEAN tool. However, two NS substitutions in *TLR1LA* and one in MDA5 genes were predicted to be deleterious on protein function. The domain locations of various NS substitutions in each gene among three breeds were identified using SMART. Part of *NOD5* gene i.e., 1034bp fragment spanning 4543 to 5567 bp of cds region which falls in Leucine Rich Repeat domain of NOD5 gene was also sequenced from all three breeds. Only 5 SNPs; two SNPs which are present in all three breeds, one each in Ghagus and White leghorn breeds and another one in Nicobari and Ghagus breeds were found.

Poultry Nutrition

Effect of variation in dietary CP levels on performance, immune responses and anti-oxidant variables in Vanaraja chicken

An experiment was conducted to study the performance, immune and anti-oxidant responses in *Vanaraja* chicks fed graded levels of CP (12, 14 and 16%) with or without supplementing critical amino acids (lysine, methionine and threonine) similar to the concentration of CAA present in 18% CP control diet. Each diet was fed to 12 replicates consisting of 6 *Vanaraja* birds from d 1 to 42 d of age. Body weight gain and feed efficiency in birds fed 16% CP was similar to those fed the CD (Table 28). Reduction of CP progressively depressed the performance, while supplementation of CAA to low CP diets did not show any effect on these parameters. Dietary variation in CP or CAA did not influence the immune responses (cell mediated response to PHA-P and antibody titres against ND vaccine) at both 21 and 42d of age. Antioxidant responses (glutathione reductase – Fig. 5, glutathione peroxidase, FRAP and super oxide dismutase activities) improved with reduction in dietary CP and in general these responses increased with supplementation of CAA compared to the those fed respective CP diet without amino acid adjustment. These results suggest the importance of supplementing CAA to protein diet to enhance the anti-oxidant response in *Vanaraja* chicks.

Table 28. Performance of Vanaraja chicken fed varied levels of CP and EAA

Protein, %	BWG, g	FI/BWG
18	876.4[a]	2.303[c]
16	854.0[a]	2.346[c]
16+AA	844.7[a]	2.313[c]
14	755.5[b]	2.517[b]
14+AA	778.1[b]	2.507[b]
12	645.1[c]	2.853[a]
12+AA	621.6[c]	2.887[a]
P	0.001	0.001
N	12	12
SEM	11.50	0.027

BWG body weight gain; FI feed intake
a b c means having common alphabets do not vary significantly (P<0.05)

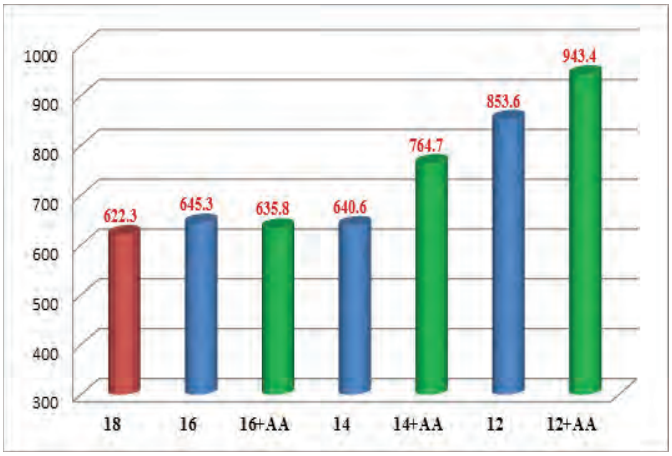


Fig 5. Activity of GSHRx (units/ml) in serum of Vanaraja fed graded levels of CP without and with amino acid balance

Effect of supplementing organic and inorganic selenium with two levels of vitamin E on performance, hatchability, immune responses and anti-oxidant responses in commercial broiler breeders

An experiment was conducted on broiler breeders (52-63 weeks of age) to study the effect of supplementing selenium in two forms (organic - oSe and inorganic - iSe) with two concentrations of vitamin E (50 and 200 mg/kg diet) to each source. A control without supplementation of vitamin E and Se was served as control. Each diet was replicated to 10 times having 20 breeders in each replicate. Measured quantity of feed was offered as per the breed recommendations. Egg production (61.7 – 63.8%), feed efficiency (241-249g/egg), fertility, hatchability and body weight of day old chick were not affected due to the treatment effect (Table 29). However, shell quality (breaking strength and shell thickness) improved with supplementation of Se in both forms and vitamin E at higher concentrations (200 mg/kg). Reduction in lipid peroxidation (Fig. 6) and improved activities of SOD, glutathione peroxidase and glutathione reductase was observed in both forms of Se, but the response was higher at higher concentration of vitamin E in diet. Results indicate that supplementation of Se in combination with vitamin E at 200 mg/kg diet improved anti-oxidant responses in broiler breeders.

Table 29. Effect of feeding inorganic and organic Se (0.30 mg/kg) at two concentrations of vitamin E (50 and 200 mg/kg) on broiler breeders

Treatment	EP	Fertility	Hatchability	SOD	GSHPx	GSHRx	HI
	%			% inhibition	Units/ml		log 2
Basal	63.75	87.29[b]	85.80[c]	4.632[c]	931[b]	1054[b]	9.0[b]
iSe-E50	62.80	90.27[ab]	86.84[b]	5.274[bc]	982[b]	1180[b]	9.2[b]
iSe-E200	61.72	95.59[a]	91.10[a]	5.682[bc]	971[b]	1202[ab]	9.5[ab]
oSe-E50	62.64	95.99[a]	89.99[b]	6.707[ab]	1070[ab]	1475[ab]	9.5[ab]
oSe-E200	62.43	93.56[ab]	91.31[a]	7.293[a]	1190[a]	1706[a]	10.1[a]
SEM	0.443	1.085	0.805	0.257	30.58	80.30	0.122
N	10	6	6	10	10	10	10
P-value	0.716	0.039	0.081	0.004	0.050	0.064	0.046

EP egg production; SOD superoxide dismutase; GSHPx glutathione peroxidise; GSHRX glutathione reductase; HI haemogglutination inhibition
a b c means having common superscript do not vary significantly (P<0.05)

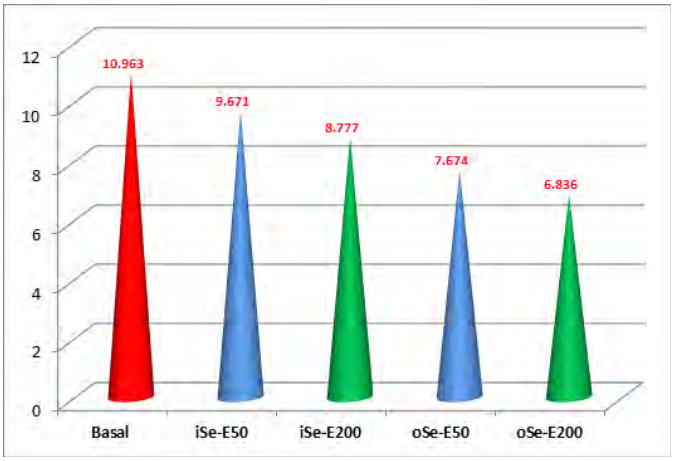


Fig. 6. Lipid peroxidation (nano moles of MDA) in broiler breeders fed organic and inorganic Se with vitamin E

Effect of including tocotrinol (precursor of vitamin E) in diet on performance, immune responses and anti-oxidant responses in commercial broilers

Replacement of synthetic vitamin E (α-tocopherol) (100 mg/kg diet) with its metabolite (tocotrienol) at graded concentrations (2, 4, 6 and 8 mg/kg diet) in commercial broiler diets did not significantly influence the performance (body weight gain and feed efficiency), slaughter (ready to cook yield, relative weights of liver abdominal fat and breast) and immune responses (cell mediated response to PHA-P and antibody titres against ND vaccine) were not affected by reducing the tocotrienol levels to 12.5 / 25 times lower than the vitamin E (α-tocopherol) concentration in diet. Lipid peroxidation was reduced significantly in broilers fed tocotrinol at 4 and 6 mg/kg diet which was similar to those fed 100 mg vitamin E/kg diet (Table 30). The activities of glutathione peroxidase and glutathione reductase were increased in diets containing vitamin E compared to those fed the control diet devoid of the vitamin. Among the levels of tocotrienol, highest glutathione peroxidase was observed at 2mg and glutathione reductase at 4 to 8 mg / kg diet. The results thus suggest that tocotrienol is more effective in improving the anti-oxidant response in broilers even at much lower concentrations (4-8 mg/kg) compared to those fed 100 mg vitamin E/kg diet.

Table 30. Effect of feeding trocopherol and tocotrienol on serum anti-oxidant variables in commercial broilers

Treatment	LP	GSHPx	GSHRx
	nano moles of MDA	units/ml	
Control (no vit E)	8.598^{a}	441^{c}	583^{c}
Vit E 50mg	6.201^{b}	804^{a}	641^{ab}
Vit E 100mg	4.457^{bc}	544^{bc}	606^{c}
Tocotrienol 2mg	6.343^{b}	721^{ab}	560^{c}
Tocotrienol 4 mg	3.638^{c}	431^{c}	776^{ab}
Tocotrienol 6 mg	3.669^{c}	562^{bc}	927^{a}
Tocotrienol 8 mg	4.807^{bc}	543^{bc}	824^{ab}
P	0.001	0.001	0.093
N	10	10	10
SEM	0.298	27.54	39.84

LP lipid peroxidation; GSHPx glutathione peroxidase; GSHRX glutathione reductase
a b c means having common alphabets do not vary significantly (P<0.05)

Effect of supplementing of sprouts from pulses and millets on performance, immune responses and anti-oxidant responses in commercial broilers

Two experiments were conducted by feeding sprouts of millets (ragi, korra, bajra and sorghum) and pulses (green gram, black gram, small gram) at 5% of feed intake to broiler chicken. The BWG was not affected by feeding of millet sprouts. At the end of experiment, the BWG in ragi and korra supplemented groups was higher by about 40g compared to the CD fed group. Though the immune responses were not affected, lipid peroxidation, activities of GSHPx, GSHRx and SOD (Table 31) and FRAP reduced significantly in sprout millet fed group compared to those fed the CD. Supplementation of pulse sprouts significantly improved the feed efficiency in broilers at day 21. However, at the end of experiment, the performance variables were not affected. Supplementation of sprouts significantly reduced LP in liver (Fig. 7). Among the millets, maximum reduction was observed in small gram followed by green gram and black

gram in that order. The actitities of GSHPx and SOD was significantly higher in broilers fed pulse millets compared to those fed the CD.

Table 31. Activity of anti-oxidant enzymes in liver of chicken fed sprouts of different pulses

Treat	GSHPx	SOD
	units/ml	
Control	1277^{c}	3.013^{b}
Black Gram	1406^{a}	3.297^{a}
Green Gram	1380^{ab}	3.092^{ab}
Small Gram	1343^{b}	3.240^{a}
P	0.001	0.020
N	10	10
SEM	10.98	0.037

GSHPx glutathione peroxidase; SOD superoxide dismutase
a b c means having common alphabets do not vary significantly (P<0.05)

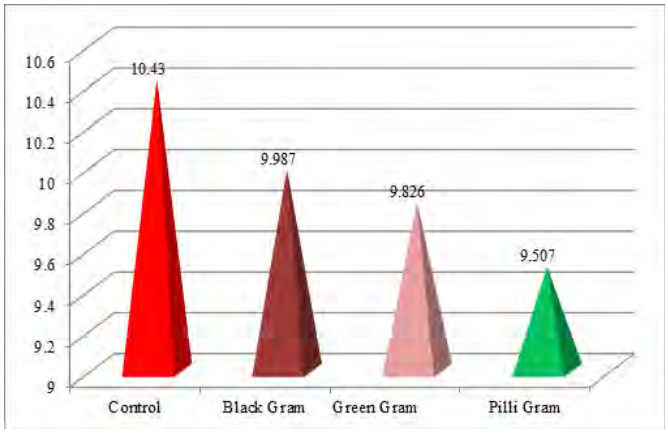


Fig. 7 Lipid peroxidation (nano moles of MDA) in liver of commercial broilers fed sprouts of different pulses

Effect of supplementing graded concentrations of nano Zn on performance, immune responses and anti-oxidant responses in commercial broilers

Nano Zn (nZN) was reported to have higher biological value in chicken. Nano Zn was supplemented at graded reduced concentration (80, 60, 40, 30, 20, 15, 10 and 7.5 mg/kg) and compared with 80 mg Zn from inorganic source. Performance of broilers was not affected, except the FCR at day 21. The feed efficiency was higher in broilers fed 7.5 mg/kg nZn. Lipid peroxidation in spleen and liver reduced in broilers fed nZn (Table 32). Similarly the GSHPx in liver and spleen and the activity of SOD in spleen improved in nZn groups (Fig. 8).

Table 32. Performance of Broiler chicken fed varied levels of Nano Zn during tropical summer

Treat	LP (nano moles of MDA)	GSHRx (units/ml)	SOD (% of inhibition)
iZn-80	14.94^{a}	1717^{d}	2.903^{b}
nZn-80	13.83^{b}	1823^{c}	2.761^{b}
nZn-60	12.77^{cd}	1862^{bc}	2.983^{ab}
nZn -40	11.98^{de}	2043^{a}	2.701^{b}
nZn -30	13.03^{bc}	1903^{bc}	2.722^{b}
nZn -20	11.49^{e}	1908^{bc}	3.496^{a}
nZn -15	11.46^{e}	1944^{b}	3.083^{ab}
nZn -10	11.89^{e}	1889^{bc}	3.038^{ab}
nZn -7.5	12.14^{e}	1952^{b}	3.013^{ab}
P	0.001	0.001	0.052
N	10	10	10
SEM	0.161	12.99	0.060

LP lipid peroxidation; GSHPx glutathione peroxidase; SOD superoxide dismutase
a b c means having common alphabets do not vary significantly (P<0.05)

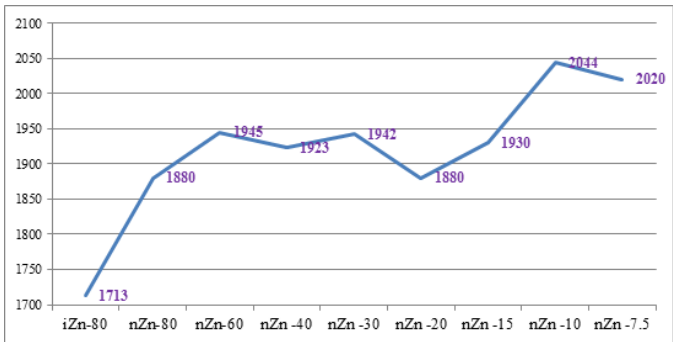


Fig. 8. Activity of GSHPx (units/ml) in broilers ged graded concentrations of nano Zn

Supplemental effect of graded levels of moringa leaf (MLM) and pomegranate peel meal (PPM) on performance, immune responses and anti-oxidant responses in commercial broilers

Two concentrations each of MLM (500 and 1000 mg/kg) and PPM (250 and 500 mg/kg) were supplemented in broiler diet (1-42d of age). Performance was not affected (P>0.05) by supplementing MLM or PPM. Antibody titres against

ND vaccination at day 21 and 42 were higher in broilers fed MLM and PPM compared to those fed the control diet. Lipid peroxidation reduced and activity of GSHPx improved in broilers fed MLM or PPM compared to those fed the control diet. The response was significantly higher in broilers fed PPM compared to MLM.

Table 33. Effect of feeding *moringa* leaf meal (MLM) and pomegranate peel meal (PPM) on performance and carcass variables in commercial broilers

Treatment	BWG, g	FE	ND, log 2	
Control	2337	1.572	3.44^{b}	8.33^{b}
MLM 500g	2363	1.608	4.44^{a}	9.00^{a}
MLM 1000g	2352	1.557	4.11^{a}	9.22^{a}
PPM 250g	2387	1.602	4.22^{a}	9.33^{a}
PPM 500g	2333	1.616	3.89^{ab}	9.22^{a}
P	0.906	0.234	0.011	0.009
N	9	9	9	9
SEM	18.93	0.009	0.097	0.102

MLM moringa leaf meal; PPM pomegranate peel meal; BWG body weight gain; FE feed efficiency (feed intake / body weight gain); ND Newcastle disease

$^{a\,b\,c}$means having common superscript do not vary significantly (P<0.05)

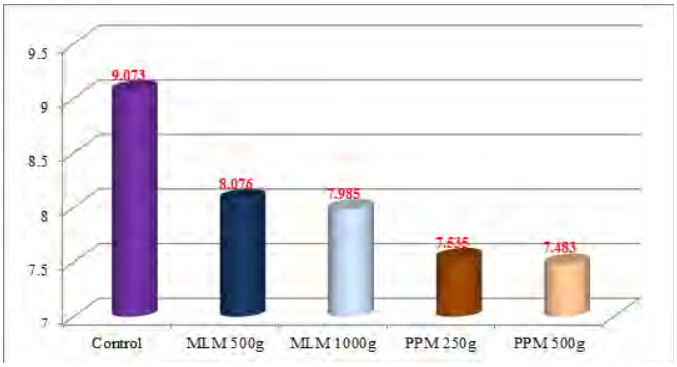


Fig 9. Effect of supplemning MLM and PPM on LP in broiler chicken

Optimization of dietary protein concentration for minimising nitrogen excretion and economising on feed cost: Protease supplementation in Vanaraja chick diet containing guar meal

A feeding experiment was conducted to evaluate response of Vanaraja chicks to protease supplementation to diets containing guar meal (12%) at marginally low CP content of 16%. The protease used was from a commercial source and the dosage was 60mg/kg diet (300 units/kg). A total of 336 Vanaraja chicks were divided into 4 treatment groups with 14 replicates of 6 chicks each. The chicks were fed a control diet, control diet with protease, guar meal based diet or guar meal based diet with protease supplementation. All the diets were *isocaloric* and *iso-nitrogenous*. The levels of lysine (4.78% of CP); and TSA, threonine, valine and tryptophan were maintained in ideal ratio to lysine (81.8, 72.7,76 and 18.2%, respectively). Accordingly, the levels fed were lysine (0.87%), TSA (0.71%), threonine (0.63%), valine (0.66%) and tryptophan (0.16%). The response of chicks was evaluated in terms of performance, feed efficiency, slaughter traits, serum biochemical profile etc. The body weight and feed conversion efficiency at early age of 3 wks were reduced with guar meal inclusion in diet, while no such effect was observed thereafter. Protease supplementation improved growth rate at 6 and 7 wks of age and feed conversion efficiency from 4thwk onwards. Serum biochemical profile, DM digestibility, CP retention and slaughter variables were not affected, except for increased abdominal fat weight with guar inclusion in diet.

Table 34. Effect of protease supplementation to guar meal based diets on Vanaraja chickens

Guar meal, % in diet	Protease	Body wt., g, Wk 7	Feed intake, g 0-7wk	FCR, 0-7wk	RTC Wt.%	Abd.fat, %	DM dig.,%
-	-	939.75^{b}	1928.58	2.26^{a}	60.41	1.09^{b}	79.036
-	+	990.45^{a}	1900.31	2.10^{b}	59.57	1.67^{a}	78.650
12	-	934.88^{b}	1893.11	2.24^{a}	60.09	1.56^{a}	78.291
12	+	997.57^{a}	1909.77	2.10^{b}	60.80	1.38^{ab}	77.161
	n	14	14	14	18	18	6
	P	0.0001	0.772	0.000	0.731	0.001	0.893
	SEM	6.9628	12.331	0.0177	0.3897	0.0581	.84823

Table 35. Effect of supplementing herbal extracts on biomass production of 050 strain of *Saccharomyces cerevisiae* at 30 ppm concentration of inorganic Se

	M. koenigil		*C. sativum*		*M. aquatica*		*A.sativum*		*Z. officinale*	
	CFU/ml	Log10	CFU/ml	Log10	CFU/ml	Log10	CFU/ml	Log10	CFU/ml	Log10
Control	$0.15x10^9$	8.19	$0.15x10^9$	8.19	$0.15x10^9$	8.19	$0.15x10^9$	8.19	$0.15x10^9$	8.19
0.5 ml	$0.10x10^9$	8.01	$0.23x10^9$	8.37	$0.69x10^9$	8.84	$0.12x10^9$	8.08	$0.14x10^9$	8.16
1 ml	$0.16x10^9$	8.21	$0.15x10^9$	8.16	$0.62x10^9$	8.79	$0.16x10^9$	8.21	$0.22x10^9$	8.34
1.5 ml	$0.19x10^9$	8.30	$0.14x10^9$	8.14	$0.38x10^9$	8.58	$0.14x10^9$	8.14	$0.68x10^9$	8.83

Production of chelated selenium, zinc and copper through yeast cells and their supplemental effect on performance and anti-oxidant status in broiler chicken: Study to optimize the *Saccharomyces cerevisiae* biomass production.

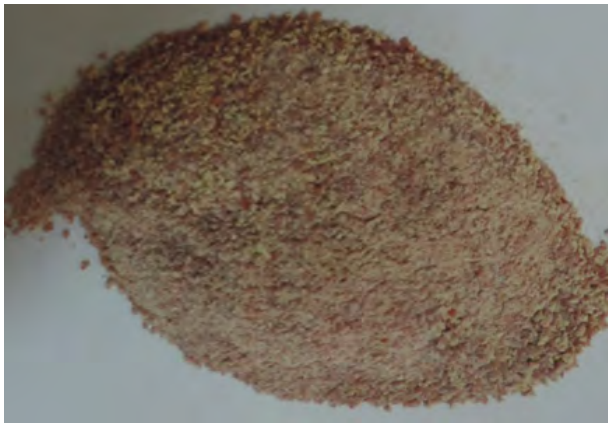
Based on the leads of the previous year experiments, the *Saccharomyces cerevisiae* (strain 050) was found to grow well compared to other strains at 30 ppm inorganic Se concentration. Subsequently, the experiments were conducted to optimize the yeast cell biomass production in order to increase the organic Se yield through supplementing herbal extracts of *Murraya koenigii, Coriandrum sativum, Mentha Aquatica, Alium sativum* and *Zingiber officinale* (potential natural anti-oxidants). *Murraya koenigii, Coriandrum sativum, Mentha aquatica, Alium sativum* and *Zingiber officinale* weighed and known quantity was subjected for grinding. The extract was filtered and autoclaved before using in the YEPD broth to grow the *Saccharomyces cerevisiae.*

Murraya koenigii, Coriandrum sativum, Mentha aquatic, Alium sativum and, *Zingiber officinale* were processed and added into the growth media containing 050 strain of *Saccharomyces cerevisiae* (Table 35). Adding the extracts of *Murraya koenigii* without inorganic Se inhibited the growth of the yeast cells. Whereas, adding the same in presence of inorganic Se improved the growth of yeast cells. It suggests that the extract of *Murraya koenigii* complement the growth of the yeast cells in presence of inorganic Se. In case of *Allium sativum*, contrary trend was recorded for the growth of yeast cells compared to *Murraya koenigii.* The addition of *Mentha aquatic* and *Zingiber officinale* extracts were found to be most effective in accelerating the growth of yeast cells in presence of inorganic Se. These two herbs are being used for the production of organic Se with higher biomass yield.

The organic Se which is produced in the laboratory is being used for supplementing in the poultry diets for evaluating the efficacy of organic Se. Two experiments were conducted to record the performance and anti-oxidant status in the birds.

Evaluating the efficacy of the organic Se in chicken

A total of 160 day-old chicks of *Vanaraja* were randomly distributed in to four dietary groups having 8 replicates with 5 chicks in each replicate. Four diets were formulated to contain 0 ppm of organic Se (Control), 0.2 ppm of organic Se (Diet II), 0.3 ppm organic Se (Diet III) and 0.4 organic Se (Diet IV). The experiment was continued till 5 weeks of age. It was recorded that the final body weight of the birds fed diet supplemented with organic Se at 0.3 ppm was significantly ($P<0.05$) higher compared to those fed with other diets (Table 36). In the 2ndexperiment, which was conducted in commercial broiler chicks, the higher body weight and better feed efficiency were recorded among the birds fed the diet supplemented with 0.2 and 0.3 ppm of the organic Se compared to the other diets (Tables 37 and 38). Further, the serum glutathione reductase activity was recorded ($P<0.05$) higher among the groups fed the diet supplemented with organic Se (0.3 ppm) compared to those fed the diet supplemented with inorganic Se (Table 39). However, the glutathione peroxidase activity did not differ among the various treatment groups.



Selenized yeast

Table 36. Effect of feeding diet supplemented with organic Se during 3 and 5 weeks of age in Vanaraja chicken

Treatment	3 weeks			5 weeks		
	BWT	FI	FCR	BWT	FI	FCR
Control	425.9	852.5	2.008	772.0[b]	1688	2.188
0.2 PPM	445.0	855.3	1.930	801.5[ab]	1743	2.180
0.3 PPM	467.8	868.4	1.870	841.2[a]	1779	2.118
0.4 PPM	450.6	850.8	1.897	808.0[ab]	1727	2.140
P-Value	0.25	0.89	0.28	0.05	0.14	0.41
N	8	8	8	8	8	8
SEM	7.32	8.40	0.026	8.98	13.96	0.016

Table 37.Effect on body weight (g) among the broiler chicken fed diets supplemented with organic or inorganic Se up to 6 weeks of age

Treatment									
		Organic Se (ppm)			Inorganic (PPM)				
Week	control	0.2	0.3	0.4	0.2	0.3	0.4	SEM	P value
1	93	101	89	93	92	91	94	1.30	0.33
2	324	331	311	319	314	316	315	2.47	0.42
3	712	741	718	727	708	713	712	4.95	0.61
4	1222	1246	1255	1251	1214	1242	1251	7.77	0.76
5	1711	1756	1772	1766	1713	1730	1728	12.20	0.77
6	2132	2249	2226	2204	2142	2196	2209	13.10	0.19

Table 38. Effect on FCR (feed intake/body weight) among the broiler chicken fed diets supplemented with organic or inorganic Se up to 6 weeks of age

Treatment									
		Organic Se (ppm)			Inorganic (PPM)				
Week	control	0.2	0.3	0.4	0.2	0.3	0.4	SEM	P vale
1	0.987	0.900	1.018	0.960	0.920	0.989	0.978	0.01	0.190
2	1.136	1.112	1.188	1.158	1.142	1.160	1.187	0.01	0.170
3	1.091	1.067	1.091	1.092	1.094	1.106	1.092	0.01	0.270
4	1.215	1.210	1.206	1.225	1.212	1.212	1.183	0.01	0.930
5	1.336	1.342	1.343	1.348	1.345	1.371	1.358	0.01	0.990
6	1.482	1.478	1.480	1.495	1.490	1.491	1.474	0.01	0.820

Table 39.Effect on anti-oxidant parameters among the broiler chicken fed diets supplemented organic or inorganic Se at 6 weeks of age

Treatment									
		Organic Se (ppm)			Inorganic (PPM)				
	control	0.2	0.3	0.4	0.2	0.3	0.4	SEM	P vale
GSH Px(units/ml)	179.3	297.1	220.4	230.6	237.4	250.6	250.1	14.7	0.56
GSH Rx (units/ml)	248a	266ab	463b	353ab	281ab	299ab	280ab	18.9	0.03

GSH Px: Glutathione peroxidase, GSH Rx: Glutathione reductase

Study to determine the growth of yeast cells in presence of different sources of inorganic Zn

The *Saccharomyces cerevisiae* – strain 050 was subjected for growth in the broth containing varying sources of inorganic Zn i.e., Zinc sulphate, Zinc chloride and Zinc nitrate at 30, 60, 90 and 120 ppm and incubated at 32° C for 48 h and subjected for the determination of biomass produced from each of the flasks. It was recorded that the addition of increased concentration of inorganic Zn to the media depressed the growth of yeast cell compared to the control. Further, it was recorded that among all the sources of inorganic Zn, zinc sulphate was found to be better as it produced more biomass compared to other sources (Table 40).

Table 40. Growth of yeast cells as influenced by different sources of inorganic Zn

Biomass yield for *Saccharomyces cerevisiae*– strain 050				
	Empty weight (g)	Pellet wt (g)	Biomass (g/50 ml)	g/Lt
Zinc Sulphate				
0 PPM	12.84	13.17	0.334	6.69^{b}
30 PPM	12.91	13.22	0.310	6.30^{b}
60 PPM	12.89	13.19	0.302	6.04^{ab}
90 PPM	12.89	13.16	0.268	5.35^{a}
120 PPM	12.95	13.21	0.261	5.23^{a}
SEM				0.16
P value				0.01
Zinc Chloride				
0 PPM	12.91	13.22	0.309	6.17^{b}
30 PPM	12.83	13.14	0.312	6.24^{b}
60 PPM	12.90	13.17	0.269	5.37^{ab}
90 PPM	12.89	13.14	0.254	5.08^{ab}
120 PPM	12.94	13.17	0.232	4.63^{a}
SEM				0.21
P value				0.03
Zinc Nitrate				
0 PPM	12.87	13.21	0.336	6.71^{b}
30 PPM	12.45	12.76	0.313	6.26^{b}
60 PPM	12.89	13.15	0.260	5.21^{ab}
90 PPM	12.86	13.12	0.253	5.06^{ab}
120 PPM	12.87	13.03	0.166	3.32^{a}
SEM				0.35
P value				0.03

Table 41. Effect of feeding diets with or without QPM on performance in Dahlem Red birds

	NM 100%	75% NM + 25% QPM	50% NM + 50% QPM	25% NM + 75% QPM	0% NM + 100% QPM	SEM	P value
Hen day egg production (%)							
Period 22-25 wks	59.52	58.45	61.75	60.37	62.01	1.45	0.88
Period 26-29 wks	63.74	65.24	61.25	64.20	63.07	2.11	0.75
Egg weight (g)							
Period 22-25 wks	45.79	43.50	43.75	45.04	46.24	0.529	0.36
Period 26-29 wks	49.48	49.93	50.09	49.60	48.80	0.395	0.87
Feed efficiency (g/g)							
Period 22-25 wks	0.292	0.321	0.380	0.372	0.381	0.013	0.08
Period 26-29 wks	0.353	0.330	0.385	0.456	0.387	0.011	0.11
Egg quality parameters							
Egg Density	1.08	1.08	1.08	1.08	1.08	0.01	0.45
Breaking strength (N)	20.31	23.29	24.23	21.06	21.53	0.71	0.38
Haugh unit	62.24	68.13	69.52	69.46	69.26	1.08	0.11

Effect of dietary supplementation of biofortified maize (QPM) on performance of brown layers

The study was conducted to determine the effect of feeding quality protein maize (QPM) based diets on performance and egg quality parameters in laying Dahlem Red birds. For the purpose, 175 birds (21 –29 weeks age) were randomly divided into 5 dietary groups each having 7 replicates with 5 birds each. Five diets were formulated to contain 100% normal maize (NM; Diet I), 75% NM + 25% QPM (Diet II), 50% NM + 50% QPM (Diet III), 25% NM + 75% QPM (Diet IV) and 0% NM + 100% QPM (Diet V). It has been observed that the hen housed egg production and egg quality parameters (egg density, egg breaking strength and haugh unit) did not differ (P>0.05) among the various dietary groups.

Development of nutritional package of practices for backyard chicken production

A survey of 120 farmers belonging to Telangana, Tripura, Rajasthan and Himachal Pradesh was conducted. A total of 150 crop and 150 gizzard samples of scavenging poultry birds were collected from four different locations and DPR farm (15 growers and 15 adults at each location) during rainy season and analysed for physical composition of crop contents and different proximate principles and minerals. During winter season also, 150 crop and 150 gizzard samples were collected and analysed according to the same protocol. The chemical analysis of winter samples is in progress.

During rainy season, average Dry Matter, CP, Calcium and Total Phosphorus in the crop content of growers of DPR was 45.78, 13.20, 3.52 and 0.12%, respectively while in scavenging birds it was 44.10, 8.56, 1.32 and 0.08%, respectively. Average Dry Matter, CP, Calcium and Total Phosphorus in the crop content of adult poultry birds of DPR was 46.40, 12.77, 4.86 and 0.08%, respectively, while in scavenging adult birds it was 43.48, 7.41, 1.10 and 0.08%, respectively. Average Dry Matter, CP, Calcium and Total Phosphorus in the gizzard content of growers of DPR was 45.43, 12.38, 3.61 and 0.038%, respectively, while in scavenging birds it was 61.09, 4.82, 1.22 and 0.064%, respectively. Average Dry Matter, CP, Calcium and Total Phosphorus in the gizzard content of adult poultry birds of DPR was 58.08, 10.92, 5.06 and 0.028 % respectively while in scavenging adult birds it was 61.73, 7.35, 1.42 and 0.078%, respectively. After partitioning of crop content it was observed that scavenging grower birds consumed 75.79% grains, bran and kitchen waste, 7.35% insects and worms and 16.66% green forages, while scavenging adult birds consumed 77.79%

grains, bran and kitchen waste, 4.01% insects and worms and 18.20% green forages. During winter season, proportion of insects and worms was less and the birds were kept of grains, bran, kitchen waste and green forages. Maximum amount of green forage was consumed by Himachal Pradesh birds and the least by Telangana birds. Maximum insects and worms were consumed by Tripura birds and the minimum by Himachal Pradesh birds.

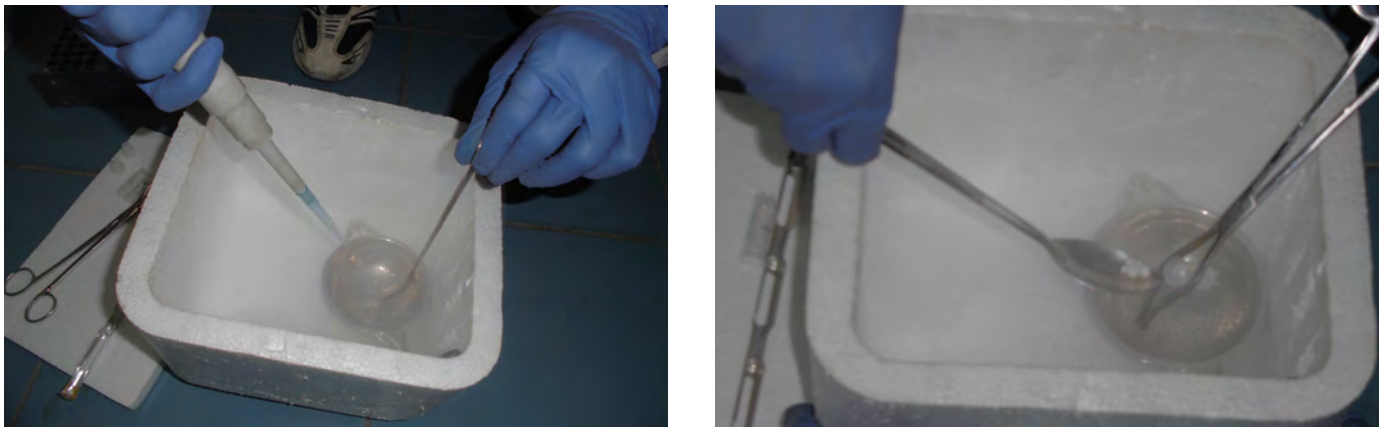
Avian Physiology

Evaluation of dimethylformamide as cryoprotectant during chicken semen cryopreservation

A study was carried out to evaluate the effect of cryoprotectant dimethylformamide (DMF) and two different diluents in cryopreservation of chicken semen by pellet method (vitrification). Semen from PD-1 line males was used for cryopreservation using DMF at 6% and 9% concentrations with two semen diluents (Lake and Ravie diluent (LR) and TES/NaCl diluent). Semen was evaluated pre and post cryopreservation for progressive motility, live and abnormal sperm. Semen pellets were stored in cryovials for atleast seven days before examination and insemination. Thawed semen was inseminated into hen's vagina using a dose of 150 million sperm in 0.1ml volume. Insemination was repeated six times at four days interval. Freshly collected and inseminated semen served as control. Eggs collected post inseminations were incubated and fertility recorded. All the parameters studied were significantly less ($P<0.05$) in cryopreserved semen. Semen diluted in Lake and Ravie diluent had significantly ($P<0.05$) higher post thaw live sperm percent and fertility than TES/NaCl diluent. DMF concentration at 6% produced higher ($P<0.05$) sperm motility than at 9%. The percent fertility in control, 6% LR and 9% LR were 77, 1.19 and 1.38, respectively. There were no fertile eggs from the semen cryopreserved using TES/NaCl diluent. In conclusion, DMF is a poor semen cryoprotectant for preserving PD1 chicken semen by pellet cryopreservation method.

Effect of dimethylacetamide and sucrose on post thaw sperm quality and fertility of vitrified chicken semen

The effect of cryoprotectant dimethylacetamide (DMA) alone and in combination with non permeating osmoprotectant sucrose by pellet cryopreservation of chicken semen was studied. Semen from PD-1 line males was pooled and cryopreserved with DMA at 6% and 9% concentrations alone and along with sucrose (100 mM) and 0.5% BSA in Lake and Ravie diluent. Pellets were formed by plunging the semen mixture drops directly into liquid nitrogen and stored in cryovials for a minimum of seven days before examination and insemination. Semen samples were evaluated pre and post cryopreservation for progressive motility, percent live and abnormal sperm. Thawed semen was inseminated into PD2 line hens (14 birds/treatment) using a dose of 200 million sperm in 0.1ml volume. Insemination was repeated five times at four day intervals. Freshly collected and inseminated semen served as control. Post insemination, eggs were collected and incubated for obtaining fertility data. Sperm progressive motility, live sperm



Chicken semen cryopreservation by vitrification method

percent and fertility were significantly less (P<0.05) in cryopreserved semen treatments. There was no difference in abnormal sperm percent between fresh and cryopreserved samples. DMA at 6% level produced higher (P<0.05) sperm motility than other cryopreserved semen treatments. The average percent fertility for control, 6%DMA, 9%DMA, 6%DMA+Sucrose and 9%DMA+Sucrose were 66, 3, 9, 10 and 8, respectively. No fertile eggs were obtained ten days after first insemination in cryopreserved semen treatments. In conclusion DMA alone and in combination with sucrose used for cryopreserving chicken semen by pellet method resulted in lower fertility.

Studies on short term storage of chicken semen for optimal fertility

As per the objective, the fertility and hatchability of spermatozoa were to be observed after storage of semen for 0 hrs, 6hrs and 24 hrs. with different supplements and diluent BPSE. For this, semen was collected from PD-1 roosters. The semen was diluted with extender, BPSE along with supplements Vit. C (10mg), Vit. E (100μM) and $CaCl_2$ (4mM) concentrations. The diluted samples were artificially inseminated in to PD-2 females and the eggs were collected for 30 days and analysed for fertility and hatchability. There were three treatment groups as stated above and one control group of birds. Twenty birds were taken in each group. Insemination was done at 0 hr., 6hrs and 24hrs. of storage of diluted semen in all the four groups of birds. The eggs were collected after a gap of one day and the collection was continued for one month. It was observed that in control group the fertility was 68.42% and hatchability was 90.25% at 0hr. Both fertility and hatchability started declining as the storage time increased from 6hrs. to 24 hrs. The fertility and hatchability were observed to be 46.66% and 89.01%, respectively at 6hrs. and at 24hrs. fertility was 6.1% and hatchability was 92.30% in control group. When 10mg Vit.C was supplemented with BPSE at 0hr., the fertility was found to be 48.3% and hatchability was 78.57% and there was significant decline in both the parameters as the storage time increased to 6hrs. and then to 24hrs. However, it was observed that on supplementation of Vit.E (100μM), the fertility was 65.33% and hatchability was 89.63% at 0hr. followed by 57.51% and 90.84% at 6hrs. and 20.55% & 92.30% at 24hrs., respectively. It was further observed that when Calcium Chloride was supplemented at a concentration of 4mM, the fertility and hatchbility were 54.46% & 90.51% and 50.22% & 91.07% and 11.82% & 59.09% at 0hr, 6hrs and at 24hrs. storage of semen, respectively. Besides this, Acrosome reaction was also observed at different concentrations of supplements (Vit.C-10, 30, 50mg), (Vit. E @ 100, 200, 300 μM) and ($CaCl_2$ @ 4, 6, 8mM). 20 birds were kept in each group at different concentrations. In Vit.C supplemented group, it was observed that at 0hr. storage of semen, the Acrosome reacted spermatozoa ranged between 83 to 85% and at 6hrs. the figure ranged between 74 to 76%. There was a declining trend when the storage time increased in all the groups. However, there was no specific trend observed between different concentrations of the same supplement. Vit. E and $CaCl_2$ supplementation also showed similar results as that in the case of Vit.C supplemented group.

Role of plasma Leptin, Ghrelin and GH in regulation of physiological functions of chicken during summer season

One hundred no. of PD-3 (Dehlam Red breed) line chickens of 16 weeks of age were selected. The average body weight of the chickens was 900 g. They were divided in to two groups. Each group contained fifty birds, ten replicates consisting of five birds in each replicate. The control group was provided with grower's feed @100g/hen/day. The supplemented group was also provided with the same quantity of feed along with fermented yeast culture (*Saccharomyces cerevisiae*) @ 1.25g/kg of feed. Later on from 20 th week, Layer feed was provided to the hens. The chicks were maintained individually in cages. The experiment was conducted for 35 weeks. During summer period, experiment continued for 8 weeks. During post summer period only egg production parameters were recorded and experiment continued till birds attained 35 weeks of age.

Hormones leptin and ghrelin were estimated

in the plasma samples, and was observed that level of these hormones increased significantly ($P<0.05$) during summer period in the control group. On supplementation of fermented yeast culture, the level of these hormones decreased significantly in the treatment group. Concentration of plasma MDA, cholesterol and free fatty acids were also estimated. The concentration of plasma MDA and cholesterol was higher in the control group. On supplementation of fermented yeast culture, the levels decreased in the treatment group. During post summer period also, supplementation of yeast culture continued, this period coincided with the laying period. During summer period, supplementation of fermented yeast culture could not cause significant difference between the groups for feed intake and body weight parameters. But during post summer period, supplementation of fermented yeast culture, resulted in decrease in feed intake for the treatment group ($P<0.01$) when compared with the control group. This did not result in significant difference in body weight and egg weight when compared between the groups. Hence, it increased feed efficiency of the treatment group.

RNA extracted from brain, liver and magna tissue samples, cDNA was synthesized, primers were tested and first standardization of PCR assay for Leptin, Ghrelin, GH receptors, MMP3 and housekeeping gene Actin was done. Real Time PCR results revealed that the relative expression of the hormone receptors for the treatment group was down regulated when compared with the control group. RT-PCR for the other three genes, SCD, FAS are in progress.

The attainment of 50% egg production potential was earlier in the treatment group, the peak egg production was observed at 30th week for both the groups. Higher egg production percentage was observed for the treatment group. It was observed that up on supplementation, egg production increased when the birds attained 26-31 weeks of age when compared with the control group. Fertility and hatchability parameters were also observed to be more for the treatment group. After 32 weeks, a negative effect was observed on egg production potential of the treatment group.

It was observed that, supplementation caused an increase in egg related parameters by decreasing the level of plasma hormones and oxidative parameter MDA and cholesterol during summer period. Histopathological studies of the jejunum portion of the digestive tract showed that mild to medium necrosis was observed in both the groups. Supplementation of FYC @ 1.25g/kg could not change the necrotic status of the jejunum.

Avian Health

Disease monitoring in pureline chicken

Disease incidence and mortality pattern: Routine data on incidence of diseases and factors influencing disease occurrence in pure lines was collected. During the period, the major causes of mortality were heat stress, colibacillosis, chronic respiratory disease, coccidiosis, laryngotrachitis and gout. Prevalence of gut lesions were determined. Ileal diverticulitis in an Aseel chick and occurrence of proventriculo-ventricular intussception in native and synthetic breeds of chicken were investigated.

ALV eradication: Under ALV eradication from pure lines, a total of 2799 birds which include PD-1 (472), PB1(223), IWK (715), IWH (454), IWH (559), Naked Neck (229) and Dwarf (147) were screened. The overall prevalence of ALV infection was 5.28% (148/2799). All the positive birds were culled and flocks were regenerated from ALV free birds.

Susceptibility of Nicobari chicken line to *E. coli* infection: An experiment was conducted to determine the susceptibility of Nicobari fowl to *E. coli*. A total of 20 birds were inoculated with *E. coli* and found that 65% (13 out of 20) birds showed lesions of *E. coli* infection. This data indicate Nicobari brown chicken susceptible to *E. coli* infection.

Optimum age of Infectious bursal disease (IBD) vaccination: The study was conducted to determine the optimum age of Infectious bursal disease (IBD) vaccination in Vanaraja chicks for effective protection based on transfer rate of maternal antibodies from parent birds to chicks and decaying rate of IBD antibody titre in the chicks. Serum samples were collected at weekly

intervals from 31st – 40th week of age randomly from each of 20 birds in a flock of 1000 Vanaraja female parent birds which were vaccinated at 18th - 20th week of age. Infectious bursal disease vaccine antibody titres were estimated by using indirect ELISA. The observed persistence of IBD antibody mean titres from 31st - 40th week were 2707, 3121, 3550, 2613, 3085, 3365, 2486, 3054, 2391 and 1553, respectively and that vary significantly ($P<0.05$) among different ages. Serum samples were collected from day-old chicks of 31st, 35th and 40th week parent birds and IBD maternal antibody transfer rate was calculated. The estimated transfer rate in the chicks was found to be 96%, 38% and 68%, respectively and which significantly ($P<0.05$) varied at different ages of parent birds. Serum samples were collected periodically from chicks at ages 1, 3, 5, 7, 10, 14, 18, 21, 24, 28, 31 and 35 days hatched from 31st week parent birds. The decaying mean of IBD maternal antibody titre was calculated by using indirect ELISA. The highest antibody titre was observed in day-old chick (2604), least or almost no mean antibody titre was observed on 35th day. Break through titre of maternal antibody titre for intermediate vaccine was 125 and found to be on 12-13th day. Hence, the predicted day suitable for vaccination was calculated as 12-13th day.

Persistence of NDV antibody in parents: The persistence of mean antibody titre from 31st-40th week parent birds (9.4, 7.9, 8.0, 8.0, 8.8, 7.0, 7.5, 8.4, 7.3, and 8.9) was significantly different ($P<0.05$). The estimated transfer rate of maternal antibodies from parent birds to chicks was 88%, 90% and 80% at 31st, 35th and 40th week of age, respectively. The decaying mean maternal antibody titre (log2) in chicks of 31st week parent birds was 8.3 at day one and became approximately half (3.5) at 14th day. Subsequently, the titre decreased to 1.8 at 21 day and became zero at 31st day.

Risk factors associated with occurrence of diseases: Various factors contributed to the disease occurrence were multiple age flocks, overcrwding of birds, cold stress, feed restriction stress and heat stress. The total number of hatches housed in the farm were 115 belonging to 72 flocks. The high number of age groups resulted in vaccne roll overs, disease spread for longer duration in the farm.

Disease Diagnosis and Health Care: Health care measures including diagnosis, vaccination and medication were undertaken to all the flocks maintained at ICAR-DPR.

Isolation and molecular identification of Infectious Bronchitis (IB) virus genotypes in poultry

The present study was carried out to determine the prevalence of variant strains of IBV in poultry flocks in different regions of India and to study the S1 gene of the Indian isolates of IBV by sequencing and phylogenetic analysis in order to better understand the epidemiology and the factors behind the occurrence of new outbreaks.

Samples of trachea, lungs, kidney, cecal toncils and oviduct were obtained from 166 IB suspected flocks in different regions of the country. Samples were subjected to virus isolation using embryonated eggs and identified by RT-PCR. The S1 gene of isolates was amplified and sequenced. A total of 33 IBV isolates were isolated from 166 samples processed and the details are presented in the Table 42.

Based on the Phylogenetic Analysis of S1 sequence, 33 isolates were classified as four groups such as IBV Mass type (MA5/H120), IBV Nephropathogenic Type (4/91, 793B), IBVQX type and Other IBV strains. The details are shown in Phylogenetic Tree (Fig.10).

The results of the study showed the high prevalence of variant IBV such as IBVQX, IBV nephropathogenic and other variant strains in all major poultry producing areas in India. Therefore, a reasonable vaccination strategy including variant genotypes should be adopted.

Table 42. Prevalance of IBV in different regions across the country

Region	Samples Received	Samples Processed	Samples Positive	Percentage Positive
North	36	36	05	13.89
South	78	78	16	20.51
West/Central	25t	25	06	24.00
East	27	27	06	22.22
Total	166	166	33	19.88

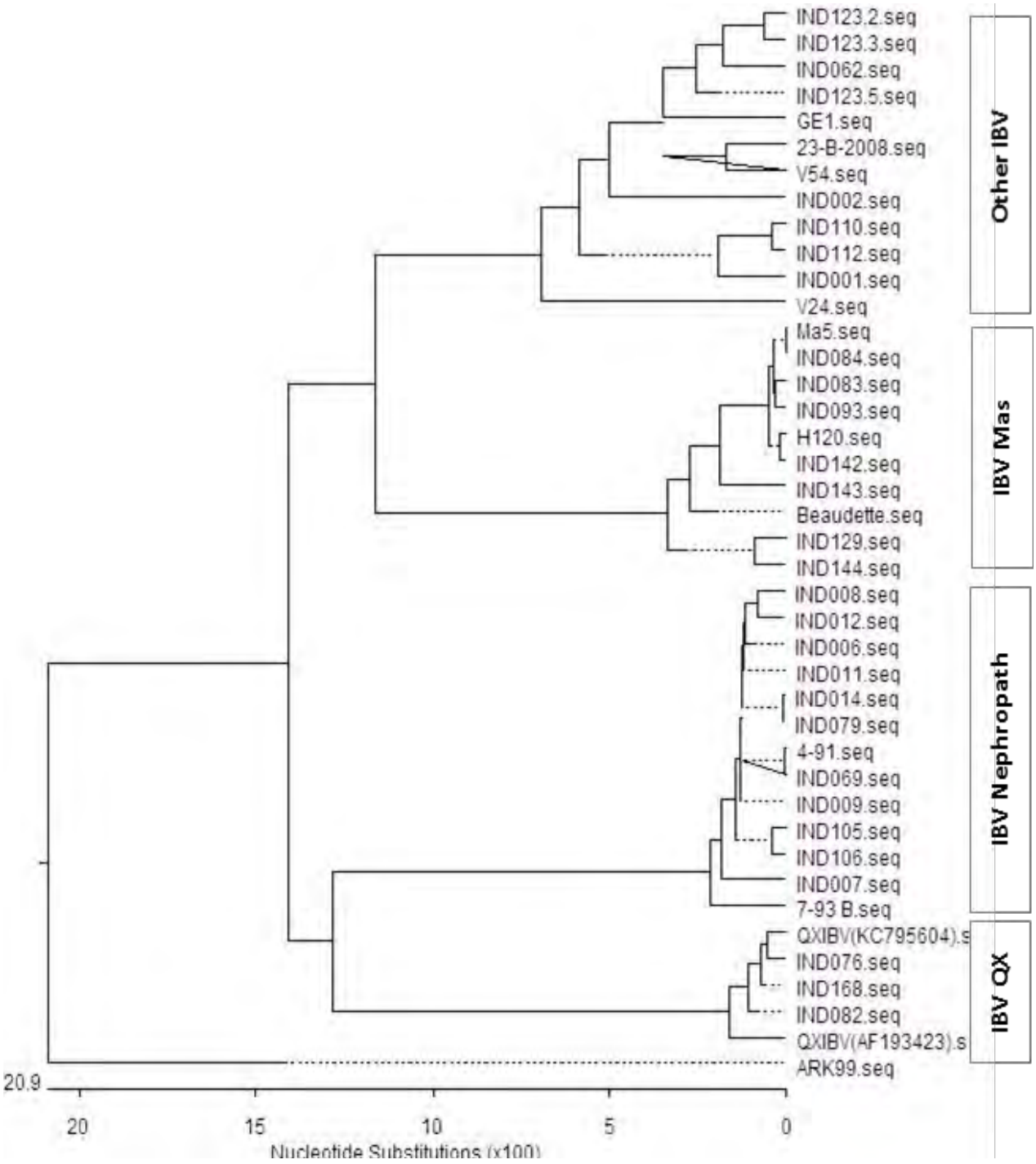
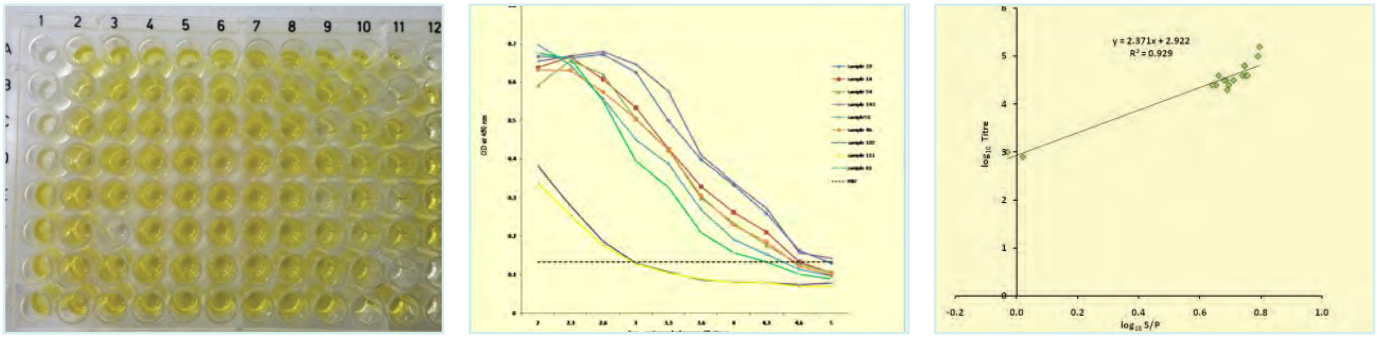


Fig. 10 Phylogenetic Analysis of S1 sequence, 33 isolates of IBV

Development and Validation of Concanavalin A- Sandwich-ELISA for the detection of antibodies against Newcastle disease virus (NDV) in the serum of chicken

Concanavalin A (Con A), a lectin interacts with carbohydrate moieties of viruses and provide stable and sensitive detection when used as a capture agent. Indirect ELISA methods need purified Newcastle disease virus (NDV) or recombinant antigens for adsorption, whereas use of Con A as capture agent will enable the use of non-purified and non-concentrated virus as antigen replacing costly and time-consuming virus purification step. Con A based sandwich ELISA with non-purified NDV whole virus antigen with single serum dilution format has been developed and validated (Fig.11). The optimum concentrations of the capture agent, Con A and non-purified antigen preparations were determined by checker-board titration. Briefly, microplates were coated with predetermined optimum concentration of ConA (1 mg/ml; 50μg per well) and incubated for 18h at 4˚C. After washing, allantoic fluid with Newcastle disease virus (NDV) La-Sota (HA titre, 2^{10}) at a constant predetermined dilution (1: 2; 50μl) was coated and incubated for 45 min at 37˚C, followed by blocking with 2 % bovine serum albumin for 45 min at 37˚C. The antigen coated plates were used in the detection of antibody titre against NDV in serum samples at single serum dilution of 1:500. Then, wells were added with goat anti-chicken IgG horseradish peroxidase conjugate and incubated for 1h at 37˚C, followed by addition of TMB substrate and the plates were read spectrophotometrically at 650 nm. ELISA antibody titres were determined by standard serial dilution of positive sera and endpoints were calculated by a subtraction method. By using positive negative threshold curve (PNT), intercept and slope of the standard curve were calculated. Total of 271 random chicken serum samples were analyzed for antibodies against NDV by Haemagglutination inhibition assay (HI), indirect ELISA and compared with the Con A- S- ELISA developed in this study. The Con A-S-ELISA showed a high coefficient of correlation (r=0.85, n=60, P<0.01) and an agreement of r=0.80 with the commercially available Indirect-ELISA. The relative sensitivity and specificity were 95% and 93%, respectively in comparison to HI test. Hence, the developed Con A-S-ELISA is a simple, easy and cost-effective tool for monitoring serum antibody levels against NDV.



A B C

Fig. 11 A. Con A-S- ELISA for NDV serum antibody estimation. B. Standard serial dilution method of determining predicted ELISA titre with a positive- negative threshold (PNT) baseline. C. Regression analysis of end-point titre of sera samples and their corresponding log10 S/P ratio at 1:500 serum dilution. Correlation coefficient and regression equation are shown

Exploring medicinal plants as alternatives to antibiotic growth promoters (AGP's) in broiler production

Isolation of enteropathogenic cultures

Liver samples from 15 post-mortem chicks (<2 weeks of age) were collected aseptically for isolation of enteric pathogens. The swab samples were placed in nutrient broth and incubated at 37°C overnight. A loopful of enriched nutrient broth culture was then streaked onto Mac Conkey agar (MCA) and Esin Methylene Blue (EMB) agar plates and incubated at 37°C for 18-24 hours, aerobically. Colony morphologyon MCA revealed flat, dry, pink colonies with a surrounding area of precipitated bile salts and are lactose fermenters. Colony morphology on EMB agar revealed smooth, circular, black or green color colonies with metallic sheen confirming *Escherichia coli*. All the isolates were gram-negative, short plump rod shaped bacteria, arranged in single, paired or in short chains. Biochemical characterization of all the 15 isolates was done. IMViC (Indole, Methyl Red, Voges Proskaeur and Citrate) tests revealed IM positive and remaining negative. All the isolates showed positive for carbohydrate(glucose,sucrose) fermentation test. Urease and Nitrate tests were positive and TSI slant showed acid but with gas production.

Antimicrobial susceptibility studies of the herbal/plant extracts

The aqueous, alcoholic extracts (methanol) and ether extracts (Petroleum ether) from shade dried herbal powders of ginger, turmeric, garlic, tulsi, amla, and dried powders of cinnamon and clove were prepared. *In vitro* antimicrobial susceptibility of these extracts revealed alcoholic extracts of cinnamon, turmeric and ether extracts of cinnamon, ginger, clove and turmeric were effective for *E. coli* cultures (Fig. 12). No effect was seen with aqueous extracts. Minimum Inhibitory Concentration (MIC) was determined for the antibiotic tetracycline which is used commonly as antibiotic feed additive (Fig. 13) at our farm and MIC determined for herbal formulary (Fig. 14) and the dosage was defined for undertaking *in vivo* drug trial for gut health promotion and as alternative antimicrobial.

In vivo experimental trial using alternate AGP

An experimental trial with alternate AGP's was conducted in Krishibro 300 birds divided into six groups with 5 replicates of 10 each were considered from day 0 to day 42. Group 1 was given basal diet alone with no antibiotic and no formulary. Group 2 was given basal diet and antibiotic Chlortetracycline. Different formularies of A, B, C and D were administered along with basal diet in different groups of 3, 4, 5 and 6 respectively. *Ad lib* water supply was given to the birds. Routine vaccination schedule for Krishibro broilers was followed.

The body weight of the birds was recorded at weekly intervals and the average daily gain (ADG) was calculated. Feed intake (FI) was measured per cage at the end of every diet composition change. FCR was calculated among different groups. The body weight of the birds which died was considered and corrected FCR was calculated. During the entire experimental period mortality was recorded. The above mentioned growth and performance parameters were shown in Table 43. Group 3 given Formulary A showed better FCR and decreased mortality than the remaining groups. No toxic/side effects were noticed after administration of the formularies in the diet as an alternate source of AGP since all haemato-biochemical estimations were within the normal range for broilers.

Blood samples were collected from single bird of each replicate on 21st day and 42nd day to assess the immune response of the birds against NDV using hemagglutination inhibition test (HI). The clotted blood was centrifuged and the serum was separated and stored at -20°C until subsequent analysis. The HI titers were determined and better immune response was found in all the groups. Enumeration of microbes of *E. coli, Lactobacillus, Salmonella* were performed and the microbial counts showed highest lactobacillus count in antibiotic fed group whereas the herbal formularies also showed better lactobacillus count than group 1. The gut health status in the formulary fed groups was better than group 1 and slightly lower than antibiotic fed group.

Table 43. Performance of broilers in different groups

Parameters	Groups					
	I	II	III	IV	V	VI
Initial B.wt (g)	45±0.2	40.0±0.2	45.5±0.5	45.5±0.3	45.5±0.5	45.1±0.5
Final B.wt (g)	1325.9±62.2	1332.6±31.9	1506.4±29.5	1371.8±35.3	1428.8±31.4	1406.3±22.3
ADG (g)	30.5±1.5	30.8±0.8	34.8±0.7	31.6±0.8	32.9±0.7	32.4±0.5
TFI/bird (g)	2427.9	2690.6	2522.4	2227.3	2338.1	2541.5
ADFI (g)	57.8	64.1	60.1	53.0	55.7	60.5
FCR (g feed:g gain)	1.9	2.1	1.7	1.6	1.7	1.9
Mortality (%)	28	4	2	12	6	6

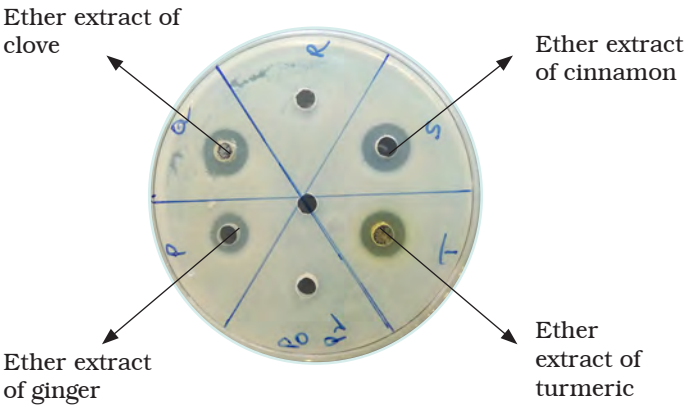


Fig. 12 Antimicrobial sensitivity for different herbal ether extracts

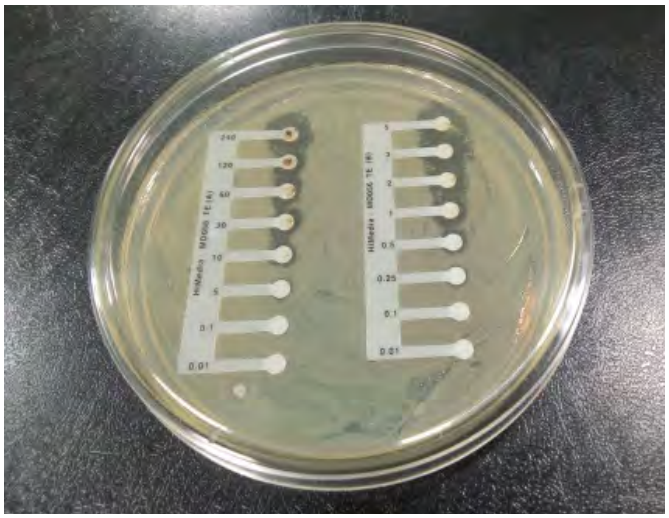


Fig. 13 MIC of antibiotic (tetracyclines)

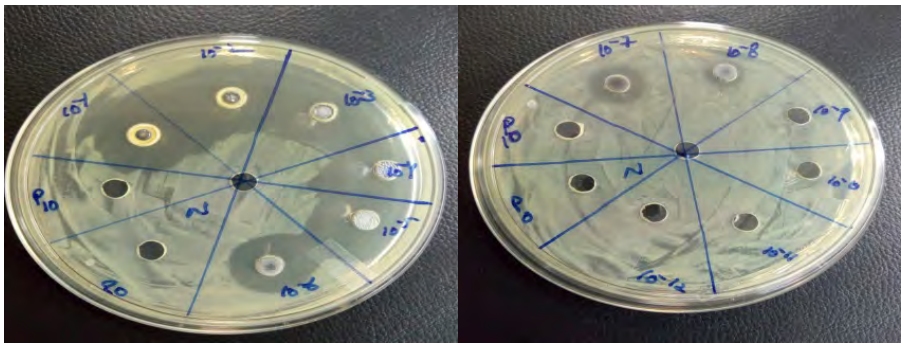


Fig. 14 MIC of herbal extract

3. Technologies Assessed and Transferred

Germplasm supply

The popular rural chicken varieties Vanaraja, Gramapriya, Srinidhi etc. developed by the Directorate reached majority of states in the country due to their physical characteristics, greater adaptability to the diversified agro-climatic conditions and production potential with minimum investment. About 95,870 hatching eggs were supplied to different organizations and NGOs.

Table 1. Germplasm Supplied during 2016-17

Sl. No.	Particulars	Number
I	**DPR**	
A.	**Hatching Eggs**	
	Krishibro	453
	Vanaraja	18041
	Colored Gramapriya	48148
	White Gramapriya	6930
	Srindhi	6678
	Control Layer (CT)	1260
	Colored broiler (CB)	1470
	Layer	12890
	Total	**95870**
	Embryonated eggs	21692
B.	Day Old Chicks	
	Krishibro	7628
	Vanaraja	122623
	Colored Gramapriya	78706
	White Gramapriya	
	Srindhi	10361
	Aseel	686
	Total	220004
C	Parents	
	Krishibro	280
	Vanaraja	24296
	Gramapriya	12178
	Srindhi	2814
	Total	**39568**
D	Grownup birds	1706
	Net Total (A+B+C+D)	**378840**
II	AICRP on Poultry Breeding	**710889**
III	Poultry Seed Project	**438822**
	Grand Total (I+II+III)	**1528551**

Mera Gaon and Mera Gaurav Program

Under the Mera Gaon Mera Gaurav programme, five groups of scientists of the Institute have adopted ten villages to carry out the various activities. Further, the survey work is underway to adopt more villages in neighboring districts. The villages selected are inhabited mostly by tribals having small land holdings (< 1 acre of land) and landless labourers. Majority of the villagers are engaged in agricultural and animal husbandry activities. The households are also having the native chickens reared in their backyards. Under this programme, improved backyard chicken varieties were distributed in selected adopted villages for growing them in their backyard to improve the nutritional and socioeconomic condition of the resource poor tribal population. Further, newly evolved crosses of rural chicken were also distributed in the adopted villages for evaluating their performance in the backyard condition.

Poultry India 2016

ICAR-DPR participated in Poultry India 2016 exhibition organized by IPEMA at Hitex, Hyderabad from 24-26 November 2016. DPR stall attracted the attention of all 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 5 thousand farmers, technocrats and scientists visited the stall in 3 days.

Regional Farmer Fair

Regional Farmer Fair "Kshetriya Krishi Kumbh – 2016" was organised during 28-30 November 2016 by ICAR-IIFSR at GIC Campus, Muzaffarnagar. Honourable Union Minister of State for Agriculture, Dr. Sanjeev Balyan inaugurated the event. More than 100 stalls of ICAR Institutes, private firms and vendors were erected in the exhibition. Technical sessions were also organised for the benefit of farmers. More than 400

DPR at regional farmer fair

farmers visited the DPR stall, where information regarding different backyard poultry birds developed by the Directorate was displayed. Printed literature was provided to the farmers and the queries raised by the farmers regarding poultry husbandry were answered. A majority of the queries were about hands-on training regarding backyard poultry production and availability of germplasm developed by the Directorate in Western Uttar Pradesh. Dr. Gaya Prasad, Vice Chancellor, SVPUAT, Meerut and other dignitaries also visited the stall and appreciated the efforts being made by the Directorate for uplifting the economy and nutritional status of the resource poor farmers by way of backyard poultry production.

Training Programme for Agripreneurs

ICAR-DPR in collaboration with National Institute of Agricultural Extension Management (MANAGE), Hyderabad organized two Refresher Training Programmes on "Modern poultry management for established Agripreneurs" during 12–16 July and 16-20 August 2016. The program was sponsored by MANAGE, Hyderabad under Agri-Clinics and Agri-Business Centres (AC&ABC) scheme. A total of 38 agripreneurs from different states attended the training programme. The participants were exposed to various aspects of poultry production such as breeding, nutrition, management and health care practices. The training module had practical demonstrations and hands-on experience in farm and hatchery operations. A field visit to a commercial poultry unit of 4 lakh layer capacity was arranged for the benefit of the participants. The participants expressed satisfaction on the training program and methodology adopted during the training programme.

Sponsored training programme

A training programme on "Poultry Health management and disease control" was organised during 26-28 September 2016, which was attended by 10 participants. The programme was sponsored by M/s Intervet India Pvt ltd.

Model Training Course

A model training course on "Advances in Poultry Health and Disease management" was organized from 15 - 22 November 2016. The course was sponsored by the Directorate of Extension, Govt. of India and attended by 21 senior veterinary officers from different states.

Krishi Unnati Mela

ICAR-DPR participated in Krishi Unnati Mela 2017 organized by ICAR-IARI, New Delhi during 15-17 March 2017. Hon'ble Union Minister of Agriculture and Farmers Welfare Shri Radha Mohan Singhji inaugurated the event on 15 March 2017. Technical sessions were also organised for the benefit of farmers. More than 450 farmers visited DPR stall where information on different backyard poultry birds viz., Vanaraja, Gramapriya, Srinidhi and Krishibro was displayed. Printed literature on the backyard varieties was provided to the farmers and the queries raised by the farmers regarding poultry husbandry were answered. Many farmers and rural youths were interested in adopting backyard poultry production as their livelihood. Dr. Trilochan Mohapatra, Secretary, DARE and DG, ICAR and other dignitaries also visited the stall and appreciated the efforts being done by the Directorate for uplifting the economy and nutritional status of the resource poor farmer by way of backyard poultry production.

4. Training and Capacity building

The staff of the Directorate participated in the training programmes/workshops organized by different organizations 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 in Training and Capacity building activities

Sl. No.	Particulars of training	Official (s)	Duration	Venue
1	Training Programme on "Impact Assessment of Agricultural Extension"	Dr. S.K. Verma, Sr. Scientist	6-10 June 2016	ICAR-NAARM, Hyderabad
2	ICAR sponsored short course on "Recent models and methods for analysis of farm animal data for devising suitable breeding and management strategy"	Dr. K. S. Rajaravindra, Scientist	11-20 July 2016	ICAR-CSWRI, Avikanagar
3	Networks: Basics and Management	Shri V.V. Rao, ACTO	25-30 July 2016	IASRI, New Delhi
4	National Training program on Good Laboratory Practices	Smt. Minakshi Dange, ACTO	17 – 22 October 2016	NDRI, Bangalore
5	Workshop on "Mighty Egg: Realizing translational potential of egg bioreactor" sponsored by Dept. of Biotechnology, Govt. of India	Dr. T.R. Kannaki, Scientist	27-28 October 2016	TANUVAS, Chennai
6	Workshop on Small Holder Poultry – Challenges and opportunities, jointly organized by CARI and GalvMed	Dr. S. V. Rama Rao, Pr. Scientist	2 December 2016	New Delhi
7	Management development program on " Leadership Development"(a pre RMP program)	Dr. N. Anand Laxmi, Pr. Scientist Dr. R.K. Mahapatra, Pr. Scientist	19-31 December 2016	NAARM, Hyderabad
8	Second Workshop of Nodal Officers/ Officers In-charge, Data Management of ICAR Research Data Repository for Knowledge Management Initiative	Dr. Santosh Haunshi, Sr. Scientist	24-25 January 2017	NASC Complex, New Delhi
9	Management development program on Science Administration and Researach Management	Dr. U. Rajkumar, Pr. Scientist	6-17 February 2017	ASCI, Hyderabad

5. Awards and Recognitions

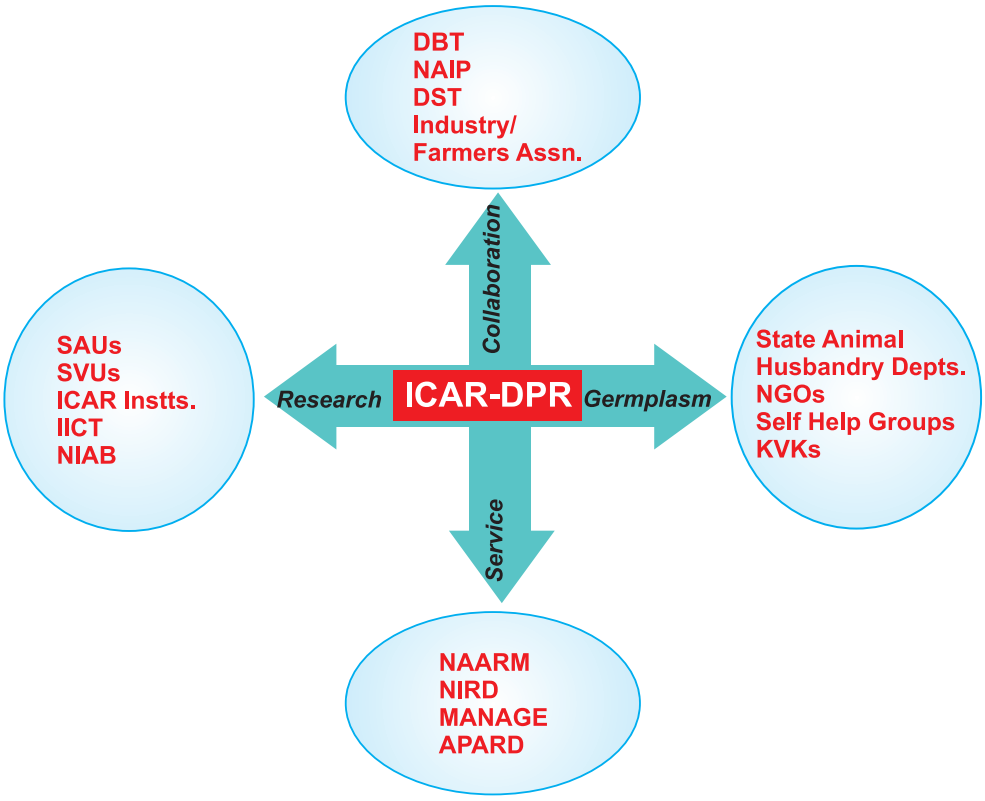
- ICAR-DPR awarded third prize of Town Official Language Implementation Committee-2, Hyderabad for the Institute.
- Dr. Satheesh Kumar, P., Dr. T.K. Bhattacharya and co-workers received best poster presentation award in the XIII National Conference of Indian Society of Animal Genetics and Breeding, held at ICAR-IVRI, Izatnagar, Uttar Pradesh during 19-20 January 2017.
- Dr. T.R. Kannaki, Scientist received best poster presentation award in III AAHP Convention and National symposium on Poultry Health and welfare, ICAR-CCARI, Goa, 20-21 October 2016.
- Dr. T.K. Bhattacharya, National Fellow has been conferred with distinguished scientist award-2016 by Venus International Foundation, Chennai.
- Dr. T.K. Bhattacharya, National Fellow has been conferred with the Fellow of National Academy of Agricultural Sciences (NAAS), New Delhi.
- Dr. U. Rajkumar, Principal Scientist received the 'Reviewer Excellence Award' from the editor of Indian Journal of Animal Research (ARCC journals).
- Dr. M.V.L.N. Raju, Principal Scientist received the 'Reviewer Excellence Award' from the editor of Indian Journal of Animal Research (ARCC journals).
- Dr. Santosh Haunshi, Sr. Scientist received the 'Reviewer Excellence Award' from the editor of Indian Journal of Animal Research (ARCC journals)
- Dr. T.R. Kannaki received second best Oral presentation award in XXXIII Annual conference of Indian Poultry Science Association & National Symposium, Guwahati, Assam, November 3-5, 2016.pp 301 (for the research paper)
- Dr. T.K. Bhattacharya, National Fellow received the 'Reviewer Excellence Award' from the editor of Indian Journal of Animal Research (ARCC journals)

Dr. T.R.Kannaki receiving best research poster award at AAHP 2016, Goa

Dr. T.K. Bhattacharya receiving National Fellow award at NASC, New Delhi

6. Linkages and Collaboration

The Directorate is well equipped with the state of art infrastructure facilities for conducting advanced research in the fields of Poultry Genetics and Breeding, Nutrition and Health. The facilities available at this Institute were utilized by the students of institutions like PVNRTVU, Hyderabad; PJTSAU, Hyderabad; KVAFSU, Bangalore and JNTU, Hyderabad for carrying out their dissertation works. The scientists of the Institute guided the research works of the students as Co-chairmen/members of the students' advisory committee. The library facilities were also utilized by the faculty and students of the local Institutions. Several trainees/students from neighboring Institutions like NAARM, SVVU, PJTSAU, TANUVAS, MANAGE, NIRD etc. visited the Directorate to have an exposure to the applied aspects of poultry farming, research and extension. The Directorate is having links with various SAUs, SVUs and ICAR institutions across the country. The Directorate is supplying germplasm through State Animal Husbandry Departments, NGOs, KVKs etc., besides two network research programmes (AICRP and Poultry Seed Project).



Collaboration of ICAR-DPR with different agencies

7. AICRP on Poultry Breeding and Poultry Seed Project

All India Coordinated Research Project on Poultry Breeding

AICRP on Poultry Breeding was reoriented towards rural poultry from the year 2014-15. At present it is being 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 and elite layer and broiler germplasm and develop package of practices for village poultry and entrepreneurships in rural, tribal and backyard areas. In addition, KVASU, Mannuthy and AAU, Anand centres are maintaining two elite layer germplasm (IWN and IWP). KVAFSU, Bengaluru, GADVASU, Ludhiana; OUAT, Bhubaneswar and CARI, Izatnagar are maintaining four elite broiler strains (PB-1, PB-2, CSML ans CSFL). Two pedigreed random bred control populations (one for layer and the other for broiler) were evaluated and reproduced at Directorate of Poultry Research, Hyderabad. Samples of hatching eggs from these populations were sent to different centers of the AICRP on Poultry Breeding at the time of regeneration. As per the decision taken by the Council, the strains maintained at different AICRP centers and DPR were duplicated at various AICRP centres to be utilized in case of exigencies and as a resource population by the centre for three and four way crossing. The strains being duplicated at different AICRP centres are IWF at Mannuthy, IWD and IWK at Anand and M1 and M2 at Jabalpur centre.

The KVASU, Mannuthy centre has evaluated the S-1 generation of native chicken germplasm up to 40 weeks of age. Egg production of native chicken germplasm up to 40 weeks of age was 72.08 eggs with average egg weight of 41.77g. Egg production increased by 2.25 eggs but egg weight has come down by 1.88 g in the S-1 generation as compared to previous generation. High fertility (93.99%) and hatchability (98.75 and 90.60% on FES and TES) was observed in S-2 generation. Age at sexual maturity was 156.77 days in S-2 generation. Besides, the centre evaluated IWN and IWP strains up to 64 weeks of age in S-29 generation along with layer control population. In this generation, hen housed egg production up to 64 weeks of age decreased by 1.8 eggs in IWN (254.9) while it remained almost same in IWP (261.2) strain and decreased by 3.5 eggs in control population (174.1) on phenotypic scale as compared to previous generation. Average genetic response for 64 weeks hen housed egg production was 4.77 and 1.65 eggs, respectively in IWN and IWP strains during the last ten generations (S-20 to S-29). Hen housed egg production up to 72 weeks of age in sample population of IWN (301.2) and IWP (304.1) strains came down by 1.6 and 4.2 eggs, respectively. The centre has generated the revenue of Rs. 64.256 lakhs, which was 194.72% of the total expenditure on feed (Rs. 33.00 lakhs). The centre has supplied a total of 136743 number germplasm during the year. There was considerable improvement in revenue generation and germplasm supply of this centre as compared to previous year.

At AAU, Anand, chicks of S-0 generation of native birds, RIR breed, F1 cross (IWN X Native) and three way cross (F1 X RIR) were evaluated for production traits up to 40 weeks of age. Egg production up to 40 weeks of age was higher in native chicken (74.1) as compared to RIR (62.6), while body weight and egg weights at 40 weeks of age were higher in RIR breed. S-1 generation of Native and RIR breed and their F1 and three way crosses were regenerated and evaluated upto 16 wks. Fertility of native chicken (82.69%) was lesser as compared to RIR breed (87.15%). As a whole, fertility in this generation has come down compared to previous generation. However

hatchability (FES) was better in native chicken (84.95%) as compared to RIR breed (78.29%). Body weight was improved in S-1 generation both in native and RIR as compared to previous generation. Egg production up to 64 weeks of age was higher in IWN (211.05) than IWP (197.87) strain in S-13 generation. Genetic response for egg production up to 64 weeks of age in IWN and IWP strains were 0.43 and 0.776, respectively over the last 10 generations. The centre has also evaluated IWD and IWK strains up to 64 weeks of age in S-5 generation. The centre has generated the revenue of Rs. 26.72 lakhs, which was 76.78% of the expenditure on feed cost. This was better compared to previous generation. The centre supplied a total of 39474 germplasm during the present year.

At Bengaluru centre, a total of 1317 day old chicks of local indigenous chicken were housed for evaluation after purification. The average body weight of local native chicken at day one and 8 weeks were 30.43 and 477.84 g, respectively. The feed efficiency at 8 weeks in local native chicken was 3.1. During the current year, production traits of PB-1, PB-2 and Control lines were evaluated in S-8 and S-21 generations respectively. The S-9 and S-22 generations of PB-1 and PB-2, along with control line were regenerated and evaluated for juvenile traits. A total of 3161, 1953 and 94 good chicks were hatched in PB-1, PB-2 and control populations, respectively. The body weight at 5 weeks in PB-1, PB-2 and Control lines were 1046.35±2.89, 1017.89±3.73 and 719.85±15.21g, respectively. Average selection differential in PB-1 and PB-2 improved by 71.88 and 66.82 g, respectively. The ASM recorded in PB-1 (S-8) and PB-2 (S-21) and Control lines was 181.16±0.38, 180.78±0.50 and 187.37±1.90 days, respectively. The average phenotypic and genetic response of body weight at 5 weeks over 9 generations in PB-1 was 6.43 and 5.34 g, respectively. The corresponding values over 10 generations in PB-2 were 8.97 and 7.33 g, respectively. The center also participated in RSPT, 2016 at Gurgaon. A total of 1, 52,641 germplasm were supplied to farmers and other stakeholders during the current year. During the year 2016-17, the center generated revenue of Rs. 41.71 lakhs, which is 116.49% of expenditure on feed cost.

Ludhiana Center has initiated evaluation of native chicken germpalsm. A total of 2266 good chicks of local native chicken were hatched. The body weight at 4 and 8 weeks was 352.07 ± 2.79 and 648.58±4.56 g, respectively. The FCR at 8 weeks in local native chicken was very high (4.3). The performance of PB-2 (M) x DESI (F) and DESI (M) x PB-2 (F) (reciprocal) were also recorded. The centre regenerated PB-1 (S-9) and PB-2 (S-41) population. Juvenile traits and production traits up to 52 weeks were also evaluated. The average body weight at 5 weeks was 1157.57±4.3, 1061.62±3.54 and 946.87±19.35 g in PB- 1, PB-2 and Control lines, respectively. The effective selection differential increased in PB-1 by 84.59 g but decreased in PB-2 by 6.91 g as compared to previous generation. The body weight and feed efficiency at 5 weeks increased in PB-1 and PB-2 lines as compared to previous generation. The phenotypic and genetic response over the last 9 generations for 5 week body weight was 10.07 and 24.50 g in PB-1 3.68 and 24 g over last 10 generations in PB-2. The percent fertility was 73.3 and 95.2 in PB-1 and PB-2 lines. The hatchability on total eggs set was 65, 89.4 and 72.3% in PB-1, PB-2 and Control lines, respectively. Centre supplied 57,950 germplasm to the farmers. During the year 2016-17, the center generated revenue of Rs.15.66 lakhs which is 94.32% of expenditure on feed. CARI center has completed purification of local native chicken germplasm. The native chicken with colored plumage and similar phenotypic characters were retained. A total of 542 good chicks with fertility and hatchability (TES) of 94.26% and 89.47%, respectively were produced. The body weight of local native chicken germplasm at 4, 8, 12 and 20 weeks were 185.71±3.13, 510.44±10.87, 1307.50±137.9 and 1483.56±272.06g, respectively. Juvenile traits of S-15 generation and production traits of S-14 generation in CSFL and CSML were recorded. A total of 3815 and 4208 good chicks of CSML and CSFL were produced. The fertility was 85.56% and hatchability percentage on TES and FES was 77.26 and 90.30%, respectively in CSML. A random bred control was also developed for estimation of environmental deviations.

The body weight at 5 weeks of age in CSML, CSFL and control lines were 1222.63±4.65, 1209.32±1.95 and 756.67±7.45 g, respectively. The body at 5 weeks increased in CSML and CSFL as compared to previous generation. The FCR at 0-5 weeks in CSML, CSFL and Control was 2.12, 2.02 and 2.25, respectively. The average effective selection differential decreased over the last generation in CSML and CSFL. The intensity of selection increased in CSML as well as CSFL as compared to previous generation. The phenotypic response per generation was 15.96 and 15.85g in CSML and CSFL, respectively. while genetic response was 14.34 and 14.19 g, respectively.

Bhubaneswar centre has completed purification of native local chicken germplasm and a total of 1441 good chicks of S-1 generation were hatched with hatchability percent of 67.84 and 83.15 on TES and FES basis. The average body weight at 8 weeks was 552.10±12.21 g. The FCR was 4.26. The egg production up to 40 weeks in S-0 generation in native chicken was 14.27. During the period, S-5 generation of CSFL and CSML were raised and evaluated for juvenile traits. During S-5 generation, a total of 3448, 3159 and 300 good chicks of CSFL, CSML and Control lines were hatched. The body weight at 5 weeks of age in CSFL, CSML and Control lines were 1009.77±4.29, 1112.36±6.18 and 769.72±14.88 g, respectively. In the current year, the body weight at 5 weeks remained static in CSFL and CSML. FCR up to 5 weeks of age decreased across three lines in the current generation as compared to previous generation. The phenotypic response of CSML and CSFL over four generations were 111.8 and 68.35, respectively. The genetic response in respective lines was 94.64 and 51.18. Egg production up to 40 weeks in CSFL and CSML were 64.32 and 61.39 in S-4 generation. EP40 has decreased in both the lines. Egg production up to 52 weeks increased appreciably in CSFL as well as CSML. ASM of current generation (S-4) in CSFL and CSML was lesser as compared to previous generation. The mortality percent during 0-5 weeks in CSFL, CSML and control line was 4.91, 5.06 and 6.33, respectively. This center supplied a total of 51,783 germplasm to the farmers. During the year 2016-17, the center generated revenue of Rs. 14.00 lakhs, which is 72.87% of expenditure on feed.

During the present year, Tripura centre evaluated Tripura black, Dahlem Red and broiler dam line up to 20 weeks of age. Three way cross was evaluated from 52-72 weeks during E-1 and up to 20 weeks of age in E-2 generation. The percent fertility ranged from 54.41 to 85.87. The body weight at 8 weeks was 316.44, 544.24, 1044.80 and 550.18 g in Tripura Black, Dahlem Red, coloured broiler dam line and BN cross, respectively, while 20 week body weight was 1105.68, 1720.28, 3240and 1590 g. During first evaluation (E-1), the 72 week egg production was 121.56 and 98.72 eggs under farm and field conditions in BND cross, respectively. During E-2, body weight at 8 weeks was 565.04 and 503.00g under farm and field conditions respectively. During the year, the germplasm supply was 14,023 chicks. The centre realized a revenue of Rs. 7.98 lakhs.

Jabalpur centre evaluated G-7 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 fertility remained above 80% in all the populations. During G-7 generation, the 6 week body weight was 381 and 864g in Kadaknath and Jablpur populations. The hen housed egg production up to 40 weeks of age was 86.8 eggs in JBL population and 50.3 eggs in Kadaknath population. Narmadanidhi produced 69 and 127 eggs up to 40 and 52 weeks at farm. This cross produced 43, 87 and 171 eggs, respectively, at 40, 52 and 72 weeks in field conditions. The germplasm supplied during the year was 69,407. The center realized a revenue of Rs. 22.66 lakhs.

Guwahati centre evaluated native, Dahlem Red, PB-2 and BN populations up to 52 weeks of age. Kamrupa was also evaluated up to 52 weeks of age under farm and field conditions. The fertility remained above 76% in all the populations. The mortality during brooding and growing period was below 3.42% in all the lines. The 5 week body weight was 118.12 g in indigenous population, 1065.39g in PB-2 and 365.17g in Dahlem

Red. Indigenous birds matured early by 2.25 days and Dahlem Red pullets by 1.95 days compared to previous generation. In native population, the egg weight and egg production up to 52 weeks were 39.85 g and 64.90 eggs, respectively. In Dahlem Red, egg production improved by 1 egg. The five weeks body weight was 250.4 g and FCR was 3.1 in BN cross. The age at sexual maturity was 150.65 days in the farm and 172.9 days in the field. The hen housed egg production upto 40 and 52 weeks of age was 47.1 and 87.6 eggs in the farm and corresponding values in the field were 42.1 and 71.6 eggs, respectively. The centre supplied 25,021 germplasm to farmers. The center realized receipt of Rs. 4.27 lakhs during the current year.

Ranchi centre released Jharsim, a dual type chicken variety. The centre evaluated G-5 generation of native population upto 60 weeks of age. During evaluation (E-5) the DBN cross was evaluated upto 60 weeks and during E-6 the cross evaluated up to 20 weeks in farm condition. The fertility ranged from 82.37 to 95.32% in all the lines during current year. The fertility improved marginally in all the lines as compared to previous generation. The hatchability on total eggs set ranged from 65.14 to 78.19% and it improved marginally in all the populations. The hen housed egg production up to 64 weeks was 67.78 eggs in native population during G-5 and it improved by 6.97 eggs compared to previous generation. In BN cross (E-4), hen housed egg production up to 64 weeks of age was 87.51 eggs. The body weights at 4, 8 and 20 weeks were better in DNB cross during E-5 evaluation. The hen day egg production up to 64 weeks of age was more in DNB cross (101.42 eggs) than BND cross (93.17 eggs) during E-5 evaluation under farm conditions. Centre supplied 15,103 germplasm to the farmers. The center realized a receipt of Rs. 8.90 lakhs during the financial year. Palampur centre has evaluated the DND cross under farm and field conditions satisfactorily and it is ready for release. The native germplasm (G-4 generation) was evaluated up to 52 weeks. The Dahlem Red population was evaluated (G-4) upto 52 weeks and G-3 generation was evaluated from 52-72 weeks of age. The Dahlem Red X Native cross was produced and evaluated up to 52 weeks of age. The fertility was good and ranged from 81.33 to 87.22% in all the populations except in Dahlem Red population (61.41%). The hen housed egg production in Dahlem Red was 67.93 eggs up to 40 weeks of age, whereas native population recorded 40.10 eggs. The hen housed egg production upto 52 weeks of age was 103.90, 60.62 and 106.17 eggs in Dahlem Red, native and DRxN populations, respectively. The hen housed egg production in DNxD cross was 65.74 eggs in farm and 39.54 eggs in field conditions up to 40 weeks. This cross produced 148.54 eggs upto 72 weeks of age and showed improvement of 12.96 eggs at farm compared to previous generation. The centre supplied 36,599 chicks of various crosses to farmers. The center realized receipt of Rs. 12.64 lakhs during the financial year.

Udaipur centre evaluated G-6 generation of Mewari breed up to 52 weeks of age and G-7 generation was reproduced. Pratapdhan (BNR cross) was evaluated up to 72 weeks during E-5 and up to 20 weeks in E-6. The fertility ranged from 72.73-87.85 in all the populations. In Mewari population the juvenile body weights at 8 weeks (633g) were marginally reduced during G-6 generation (651g). The pullets matured 3.11 days early as compared to previous (G-5) generation. The hen housed and hen day egg production

Germplasm supplied and revenue generated by different AICRP centers during 2016-17

Centre	G.Supply	Revenue (Rs. Lakhs)
Mannuthy	136743	64.26
Anand	39474	26.72
Bengaluru	152641	33.79
Ludhiana	57950	15.66
Bhubaneswar	51783	14.00
CARI, Izatnagar	33830	30.00
Udaipur	78225	20.69
Jabalpur	69407	22.66
Guwahati	25111	4.28
Palampur	36599	12.64
Ranchi	15103	8.90
Agartala	14023	7.98
Total	710889	261.58

upto 52 weeks were 38.88 and 65.07 eggs, respectively, in S-6 generation. In Pratapdhan, the hen day egg production was 170.89 eggs up to 72 weeks of age. The hen housed and hen day egg production up to 72 weeks has improved in E-5 as compared to E-4 evaluation. A total of 78,225 germplasm was supplied during the current year. The center realized a receipt of Rs. 20.69 lakhs during the current financial year. The 12 AICRP centres supplied 7,10,889 germplasm and an amount of about Rs. 2.62 crores has been generated as receipts during 2016-17.

Poultry Seed Project

"Poultry Seed Project" was evolved with the sole aim 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 the "Poultry Seed Project" during the XI five year plan with six centres, three in the northeastern 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. In addition, one non funding centre is also functioning. 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 Agricultural University, Patna; Chhattisgarh Kamadhenu Viswa Vidyalaya, Durg; ICAR Research complex, Nagaland regional centre, Jharnapani; ICAR-National Organic Farming Research Institute, Gangtok; ICAR Research complex, Manipur regional centre, Imphal; Tamil Nadu Veterinary and Animal Sciences University, Hosur; ICAR-Central Coastal Agricultural Research Institute, Panaji, Goa; ICAR-Central Island Agricultural Research Institute, Port Blair; ICAR-IVRI Regional Station, Mukteswar; Sher-e-Kashmir University of Agricultural Sciences and Technology, Srinagar were added from 2014-15. A non funded Centre was also initiated at 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 seed project was launched on 15th May, 2009. The target set for supplying chicks for mainland and north-east centres during the year under report (2016-17) 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 4,38,822 improved chicken varieties have been distributed in their respective regions/states during the year.

Nine batches of Vanaraja parents were reared during the year at Kolkata Centre. A total of 1135 female parents and 229 male parents of *Vanaraja* are in position at present. The average hen day egg production (HDEP) ranged from 25.03 (55-84 weeks) to 46.38% (24-63 weeks) in *Vanaraja* parents. The fertility rate ranged from 83.96 to 87.87% across the batches. The average hatchability on total eggs set was 72 to 77% in Vanaraja female parents. A total of 63554 chicks of Vanaraja were distributed to farmers of West Bengal and adjoining north eastern states with an amount of Rs. 7.50 lakhs revenue.

Three batches of Vanaraja parents were reared under deep litter system at Patna Centre. The 20 week body weight was 2770.6±51.23 and 1767.74±46.56 g in Vanaraja male and female parents, respectively. The age at sexual maturity was 167 days in Vanaraja female line parents. The HDEP in Vanaraja at 40 weeks of age was 52.57 % with an egg weight of 52.24 g. The average fertility and hatchability (TES) was 86.78 % and 72.68 % in Vanaraja parents. A total of 55,329 improved chicken germplasm was distributed with an amount of Rs. 10.60 lakhs revenue from the Centre.

Two batches of Vanaraja parents are in laying stage and one batch is in growing stage at Durg. The 20 week body weight in male and female lines was 1654.6 and 1125.5 g, respectively. The average HDEP was 46.8 % (24-56 weeks) in

Vanaraja. The peak egg production of 68 % was attained at 36 weeks of age and continued till 56 weeks of age. The average fertility percent in Vanaraja female line was 79.53. The hatchability on total eggs set was 81.31 %. A total of 31,224 improved chicken germplasm of Vanaraja were distributed to 224 farmers covering 85 villages across Chattisgarh. An amount of Rs. 8.86 lakhs revenue was generated from the Centre.

Five batches (3 Vanaraja and 2 Srinidhi) of parents were reared at Jharnapani centre. The body weight at 20 weeks of age in male and female lines was 2218.6±92.43 and 1613.16±37.53 g in Vanaraja and 3382.25±86.40 and 1314.53±28.71 in Srinidhi, respectively. The production of 50% was attained at 36 weeks of age and maintained till 46 weeks of age in both female parents.The peak production of 69% was recorded at 50 weeks in Vanaraja and 72% at 43 weeks of age in Srinidhi. The fertility rate varied from 87 to 93 % in *Vanaraja* and 73 to 93 % in *Srinidhi* female lines. The hatchability on fertile eggs set varied between 61-77 % in *Vanaraja* and 68-82 %, in *Srinidhi* parents, respectively. A total of 81729 improved chicken germplasm was distributed to farmers with 36.61 lakh revenue at Jharnapani. The centre achieved the set targets and effectively popularized the rural poultry farming in tribal and rural areas of Nagaland.

Two batches of Vanaraja parents were reared at ICAR-NOFRI, Gangtok, Sikkim during the year. The body weight of male and female parents of *Vanaraja* at 20 weeks of age was 2040 and 2470 g, respectively. The average HDEP in *Vanaraja* was 52.76 (27-64 weeks) with an average egg weight of 58.04 g. Peak production (50-67 %) was attained at 30 weeks of age and sustained till 58 weeks of age. The average fertility and hatchability (TES) rates in Vanaraja female line were 85.59 and 76.98 % respectively. A total of 71109 improved chicken germplasm (Vanaraja) was distributed to 2702 farmers covering 626 villages across Sikkim. An amount of Rs. 32.87 lakhs revenue was generated from the Centre. The Centre achieved the set targets and popularized the backyard poultry farming in tribal and rural areas of Sikkim.

Two batches of Vanaraja and two batches of Srinidhi parents were reared at Manipur Centre. The body weight at 20 weeks of age in male and female parents of Vanaraja and Srinidhi was 3142.92 and 2104.11 g and 4005.86 and 1532.08 g, respectively. A total of 17428 improved rural chicken germplasm was distributed to the farmers. The Centre has generated Rs. 20.06 lakhs of revenue during the year.The body weight at 20 weeks of age in male and female chicks was 3457.43 and 2128.72 g in Vanaraja and 3842.47 and 1473.42 g in Srinidhi, respectively under field conditions. The centre has conducted training/awareness programs in poultry farming to the farmers.

Two batches of Vanaraja and Gramapriya parents were reared at Hosur Centre. The body weight at 20 weeks of age in male and female parents was 2400 ± 110.7 and 1920.0 ± 38.6 g in Vanaraja and 2389.0 ± 68.4 and 1461.7 ± 28.5 g in Gramapriya, respectively. The HDEP ranged from 53-59 (36-76 weeks) in Vanaraja and 63-78% (36-76 weeks) in Gramapriya, respectively. The fertility ranged from 79 to 94% in Vanaraja and 73-90 % in Gramapriya. The hatchability on total eggs set (TES) was consistent throughout the life cycle reaching up to 90% in Vanaraja and 85 % in Gramapriya. A total of 115956 improved rural chicken germplasm were distributed to 656 farmers in Tamil Nadu. The Centre has generated total revenue of Rs. 23.64 lakhs. The body weight at 12 weeks of age under field conditions was 1390.00 g in Vanaraja and 1013.30 g in Gramapriya, respectively. The centre has achieved the target and effectively disseminated the technologies to end users.

The construction of poultry houses and hatchery are in progress at Goa. One batch each of Gramapriya and Srinidhi parents were reared in the existing facility. The body weight at 20 weeks of age in male and female parents was 2821.67 and 1049.23 g in Gramapriya and 2825.78 and 1133.18 g, in Srinidhi, respectively. The egg production started at 22 weeks of age in both female parents. The production attained about 30 % at 32 weeks of age.

The construction of poultry houses and hatchery is in progress at Port Blair. One batches each of Vanaraja and Gramapriya parents were reared

under deep litter system. The 20 week body weight in male and female lines was 2819.25 ±40.03 and 1813.4±27.29 g in Vanaraja and 2337.1 ±30.52 and 1504.1±18.42 in Gram-apriya, respectively. The age at sexual maturity (ASM) was 168 days. The 40 week HDEP was 50 % in Vanaraja parents. A total 1300 Vanaraja chicks were distributed in Andaman & Nicobar Islands with revenue of Rs. 32745 during the year.

The construction of civil works is nearing completion at Srinagar. One batch of Vanaraja parents are maintained under deep litter system during the year. The body weight at 20 weeks of age was 2423.34±57.91 g in male and 1864.42±16.01 g female parents of Vanaraja. The age at first egg was 181 days. The egg production attained 49 % during 37-40 weeks of age. A total of 2234 Vanaraja chicks were distributed to 90 farmers in four districts of Jammu and Kashmir.

Centre wise distribution of germplasm under Poultry Seed Project during 2016-17

Sl. No.	Centre	Germplasm	Revenue Rs. in lakhs
1	West Bengal University of Animal and Fishery Sciences, Kolkata	63615	7.5
2	Bihar Agricultural University, Patna	55329	10.6
3	Chhattisgarh Kamadhenu Viswa Vidyalaya, Durg	31224	8.85
4	Regional Centre, ICAR Research complex for NEH Region, Jharnapani	81729	36.61
5	ICAR- National Organic Farming Research Institute, Gangtok	71407	32.87
6	Regional Centre, ICAR Research complex for NEH Region, Imphal	17428	20.26
7	Tamil Nadu Veterinary and Animal Sciences University, Hosur	115318	23.77
8	ICAR-Central Coastal Agricultural Research Institute, Goa	223	--
9	ICAR-Central Island Agricultural Research Institute, Port Blair	1300	0.33
10	ICAR-IVRI Regional Station, Mukteswar	0	--
11	Sher-e-Kashmir University of Agricultural Sciences and Technology, Srinagar	2234	--
12	ICAR Research Complex for NEH Region, Umiam, Barapani	0	--
	Total	438822	140.79

8. Publications

Research Articles

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9. Ongoing Research Projects

Insitute Projects

S. No	Project Code	Project Title	PI	Co-PIs
1.	ANSCDPR-SIL201500100050	Development and improvement of male lines for production of backyard chicken varieties for free range farming	U. Rajkumar	M. Niranjan Santosh Haunshi Chandan Paswan S.P. Yadav
2.	ANSCDPR-SIL201500200051	Improvement and evaluation of female lines for backyard/ free range farming	M. Niranjan	U. Rajkumar Chandan Paswan S.P. Yadav
3.	ANSCDPR-SIL201500300052	Genetic characterization and conservation of indigenous chicken germplasm	Santosh Haunshi	U. Rajkumar Chandan Paswan
4.	ANSCDPR-SIL201500400053	Genetic evaluation of elite layer germplasm	Chandan Paswan	R.N. Chatterjee T.K. Bhattarcharya
5.	ANSCDPR-SIL201500500054	Maintenance of coloured broiler populations for intensive and semi intensive broiler farming	B.L.N. Reddy	K.S. Rajaravindra
6.	ANSCDPR-SIL201400100046	Genetic improvement of a synthetic coloured broiler female line (PB-2)	K.S. Rajaravindra	U. Rajkumar B.L.N. Reddy
7.	ANSCDPR-SIL201500600055	Genotyping MHC class I loading complex genes (TAP1, TAP2 and Tapasin) for their association with immunocompetence traits in chicken	S.P. Yadav	T.K. Bhattarcharya T.R. Kannaki R.N. Chatterjee
8.	ANSCDPR-SIL201400200047	Optimization of dietary protein concentration for minimising nitrogen excretion and economising on feed cost	M.V.L.N. Raju	S.V. Rama Rao A.K. Panda B. Prakash
9.	ANSCDPR-SIL201400300048	Assessment of disease incidence, immune competence and disease resistance among pure line chicken populations	M.R. Reddy	T.R. Kannaki
10.	ANSCDPR-SIL201500700056	Exploring medicinal plants as alternative to antibiotic growth promoters (AGP) in broiler production	D. Suchitra Sena	M.R. Reddy T.R. Kannaki B. Prakash
11.	ANSCDPR-SIL201500800057	Disease resistance/tolerance in backyard chicken varieties and strategies for improving vaccine mediated immune response	T.R. Kannaki	M.R. Reddy D. Suchitra Sena K.S. Rajaravindra
12.	ANSCDPR-SIL201400400049	Studies on short term storage of chicken semen for optimal fertility	R.K. Mahapatra	M. Shanmugam M. Niranjan S.K. Bhanja
	ANSCDPR-SIL201500900058	Analysis of fertility and hatchability from cryopreserved semen	M. Shanmugam	R.K. Mahapatra
13.	ANSCDPR-SIL201600100059	Characterization of chicken ovalbumin and growth hormone receptor genes for development of transgenic cassette	T.K. Bhattarcharya	R.N. Chatterjee Chandan Paswan
14.	ANSCDPR-SIL201600200060	Development of nutritional package of practices for backyard chicken production	S.K. Verma	M. Niranjan B. Prakash

15.	ANSCDPR-SIL201600300061	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
16.	ANSCDPR-SIL201700100062	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.K. Verma

Externally Funded Research Projects

SNo	Project Title	PI	Co-PIs
1	Functional genomics, epigenetics and gene silencing technology for improving productivity in poultry (National Fellow)	T.K. Bhattacharya	
2	Adaptation and mitigation strategies in poultry to thermal stress through nutritional and environmental manipulation (NICRA)	S.V. Rama Rao	M.R. Reddy 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	Genetic analysis of innate immune-competence and survivability for identification of genetic markers in indigenous chicken breeds (DST-SERB)	Santosh Haunshi	T.R.Kannaki

10. Consultancy, Patents and Commercialization of Technologies

Commercialisation of Technolgies

The ICAR - Directorate of Poultry Research has-developed three rural chicken varieties suitable for backyard farming (Vanaraja, Gramapriya and Srinidhi) and two varieties for intensive poultry (Krishibro and Krishilayer). The Vanaraja and Gramapriya have been widely distributed across the country and have been extremely popular in the rural areas. In view of their cooured plumage and high production potential, farmers are fetching more remunerative prices by selling the live birds and their produces. There has been huge demand for these chicken varieties from not only small marginal farmers but also organized farmers. Keeping these facts in mind, a national project in the form of 'Seed Project' funded by the ICAR has been initiated during the XI plan for wide and efficient distribution of these backyard varieties of chicken through out the country. The germplasm supplied during 2016-17 was 15,28,551 from three components of the Institute (ICAR-DPR: 3,78,840; AICRP: 7,10,889 PSP: 4,38,822). The embryonated eggs (21,692) were supplied for production of different cell culture vaccines.

Consultancy

Advisory consultancy was extended to M/s Sri Ramadhootha Poultry Research Farm, Ranga Reddy Dist., Telangana on techno scientific advisory services in nutrition and health care of chickens.

Contract research

The facilities of the Directorate were extended for the benefit of poultry industry through the contract research mode of ICAR. One project was in operation during the year, viz. "Infectious bronchitis (IB) virus isolation and molecular identification from field samples" (Intervet India Pvt. Ltd., Pune, Maharashtra).

11. Committees

Annual review meeting of AICRP and PSP

Annul Review Meeting of the AICRP on Poultry Breeding and Poultry Seed Project was organized on 24th and 25th May 2016 at ICAR-NOFRI, Gangtok, Sikkim. Dr. R.S.Gandhi, ADG (AP&B), Dr. R.N. Chatterjee, Director, DPR and Dr. Vineet Bhasin, Principal Scientist, ICAR HQ, participated in the meeting. All the centre incharges of both AICRP and PSP presented the progress of different centres.

Research Advisory Committee meeting

The 10th Meeting of the Common Research Advisory Committee of ICAR-Central Avian Research Institute (ICAR-CARI), Izatnagar and ICAR-Directorate of Poultry Research (ICAR-DPR), Hyderabad was held on 10th and 11th June 2016 at ICAR-DPR, Hyderabad under the Chairmanship of Dr. V. Prabhakar Rao, Former Vice Chancellor, SVVU, Tirupati. The research progress in different disciplines at both the institutes was discussed. Specific recommendations were made for implementation at both the institutes.

Institute Management Committee Meeting

The Institute Management Committee meeting was held on 28th April, 2016, wherein issues related to administrative and financial matters were reviewed and recommendations were made.

Institute Joint Staff Council (IJSC) meetings

The 7th and 8th meetings of 9th Institute Joint Staff Council were held on 9 November, 2016 and 30 March, 2017, respectively.

Institute Research Committee Meeting

Annual IRC meeting for the year 2015-16 and half yearly IRC meeting for the year 2016-17 were held at the Directorate on 26-27 April 2016 and 17 December 2016, respectively. The meeting was chaired by Dr. R. N. Chatterjee, Director and Dr. T. K. Bhattacharya acted as the Member Secretary. Principal investigators presented the achievements of their respective projects. Chairman, IRC suggested measures for overcoming the difficulties in achieving desired targets.

Institutional Animal Ethics Committee (IAEC) meeting

The 18th Institutional Animal Ethics Committee meeting was held on 14 May, 2016. The Committee reviewed the rearing conditions of experimental birds in the ongoing projects. Fresh proposals were examined and approved.

12 Participation in Seminars, Conferences, Meetings and Workshops

Scientists, technical and administrative personnel of the Directorate participated in a number of Seminars, Symposia, Conferences, Meetings, Workshops etc., to present their research findings and their expertise in different fields of Poultry Science and other related disciplines/ institute activities.

Sl. No.	Seminars, Conferences, Meetings and Workshops	Official(s)	Schedule	Venue
1	Symposium on "Next generation sequencing"	Dr. T.R. Kannaki, Scientist	May 5-6, 2016	CCMB, Hyderabad
2	Town Official Language Implementation Committee Meeting	Dr. S.P. Yadav, Sr. Scientist Sri J. Srinivas Rao, Sr. T.O.	June 8, 2016	NIRD, Hyderabad
3	National seminar on "Advances in diagnosis of emerging and re-emerging diseases of Asian species"	Dr. M.R. Reddy, Pr. Scientist	July 15-14, 2016	SVVU, Tirupati
4	Poultry Skill Advisory Board Meeting	Dr. U. Rajkumar, Pr. Scientist	July 22, 2016	ASCI, New Delhi
5	Animal Breed registration certificate	Dr S.P. Yadav, Sr. Scientist	August 23, 2016	Kirshi Bhavan, New Delhi
6	International Conference on "Microbiology, Agriculture and Environmental Sciences-2016"	Dr. S.P. Yadav, Sr. Scientist	Sept., 1-2, 2016	Int. Multidisciplinary Res. Foundation Hyderabad
7	XXV World's Poultry Congress (WPC 2016)	Dr. M.V.L.N. Raju, Pr. Scientist	September 5-9, 2016	Beijing, China
8	In-silico drug discovery and designing insights of protein-ligand interactions	Dr. D. Suchitra Sena, Pr. Scientist	October 1, 2016	Select Biosciences India Pvt. Ltd., Bangalore
9	AAHP-2016, Convention and National Symposium on Poultry Health & Welfare	Dr. R.N. Chatterjee, Director Dr. M.V.L.N. Raju, Pr. Scientist Dr. B.L.N. Reddy, Pr. Scientist Dr. M.R. Reddy, Pr. Scientist Dr. U. Rajkumar, Pr. Scientist Dr. D. Suchitra Sena, Pr. Scientist Dr. Santosh Haunshi, Sr. Scientist Dr. B. Prakash, Sr. Scientist Dr. T.R. Kannaki, Scientist Dr. K.S. Rajaravindra, Scientist Dr. S.K. Bhanja, CTO	October 20-21, 2017	ICAR-CCARI, Goa

10	Workshop on "Mighty Egg: Realizing translational potential of egg bioreactor" sponsored by Dept. of Biotechnology, Govt. of India	Dr. T.R. Kannaki, Scientist	October 27-28, 2016	TANUVAS, Chennai
11	National Workshop on Doubling the Farmers Income	Dr. U. Rajkumar, Pr. Scientist	November 2-3, 2016	MANAGE, Hyderabad
12	IPSACON 2016	Dr. R.N. Chatterjee, Director Dr. M. Niranjan, Pr. Scientist Dr. M. Shanmugam, Scientist Dr. T.R. Kannaki, Scientist Dr. K.S. Rajaravindra, Scientist Dr. S.K. Bhanja, CTO	November 3-4, 2016	AAU, Guwahati
13	III International Phytate Summit	Dr. S.V. Rama Rao, Pr. Scientist	November 7-10, 2016	Miami, Florida, USA
14	X Biennial Conference of Animal Nutrition Association (ANACON-2016)	Dr. M.V.L.N. Raju, Pr. Scientist Dr. S.K. Verma, Sr. Scientist Dr. B. Prakash, Sr. Scientist	November 9-11, 2016	SVVU, Tirupati
15	Training cum Workshop on Strengthening Extension policy Interface	Dr. U. Rajkumar, Pr. Scientist	November 9-11, 2016	MANAGE, Hyderabad
16	Town Offacial Language Implementation Committee-2 meeting	Dr. R.N.Chatterjee, Director Dr SP Yadav, Sr.Scientist Shri j Srinivas Rao, Sr.T.O.	November 15, 2016	NIRD, Hyderabad
17	International Conference on Statistics and Big data Bioinformatics in Agril. Research	Dr. R.K. Mahapatra, Pr. Scientist Dr. S.P. Yadav, Sr. Scientist	November 21-23, 2016	ICRISAT, Hyderabad
18	NICRA Annual Review Meeting	Dr. S.V. Rama Rao, Pr. Scientist Dr. M.R. Reddy, Pr. Scientist Dr. U. Rajkumar, Pr. Scientist	December 9-10, 2016	NASC, New Delhi
19	National Conference on Challenges in Quantitative Genetics for Improvement of Indigenous Animal Genetic Resources	Dr. R.N. Chatterjee, Director Dr. K.S. Rajaravindra, Scientist	January 19-20, 2017	IVRI, Izatnagar
20	8th National Extension Education Congress-2017	Dr. R.N. Chatterjee, Director Dr. S.V. Rama Rao, Pr. Scientist Dr. M. Niranjan, Pr. Scientist Dr. R.K. Mahapatra, Pr. Scientist Dr. B. Prakash, Sr. Scientist	January 28-31, 2017	Society of Extension Education, Agra and NAARM, Hyderbad

13. Distinguished Visitors

- Dr. T. Mohapatra, Secretary, DARE and Director General, ICAR, New Delhi
- Smt. V. Usha Rani, Director General, MANAGE, Hyderabad
- Dr. H. Rahman, Dy. Director General (AS), ICAR, New Delhi
- Dr. J.K. Jena, Dy. Director General (Fy), ICAR, New Delhi
- Dr. K.K. Saharia, Member, ICAR Governing Body
- Dr. B.S. Prakash, ADG (AN & P), ICAR, New Delhi
- Dr. D. Rama Rao, Director, NAARM, Hyderabad
- Dr. V. Praveen Rao, Vice Chancellor, PJSTAU, Hyderabad
- Dr. V.V. Kulkarni, Director, NRCM, Hyderabad
- Dr. V. Ravindra Babu, Director, IIRR, Hyderabad
- Dr. K. Vara Prasad, Director, IIOR, Hyderabad
- Dr. Vilas Tonapi, Director, IIMR, Hyderabad
- Dr. R.N. Srinivasa Gowda, Former Vice Chancellor, KVAFSU, Bidar
- Dr. A. Padma Raju, Former Vice Chancellor, ANGRAU, Hyderabad
- Dr. R.P. Sharma, Former Director, DPR, Hyderabad
- Dr. K. Kondal Reddy, Registrar, PVNRTVU, Hyderabad
- Dr. V. Ravinder Reddy, Dean, PVNRTVU. Hyderabad
- Dr. P. Sudhakar Reddy, Registrar, SVVU, Tirupati
- Dr. Sarath Babu, Incharge, NBPGR, Hyderabad

Dr. T. Mohapatra, Secretary, DARE and DG, ICAR and other dignitaries visiting the new campus

14. Personnel

Research & Management Position

Dr. R.N. Chatterjee, Director

Scientific Staff

Dr. S.V. Rama Rao, Pr. Scientist
Dr. M.V.L.N. Raju, Pr. Scientist
Dr. B.L.N. Reddy, Pr. Scientist
Dr. M.R. Reddy, Pr. Scientist
Dr. N. Anand Laxmi, Pr. Scientist
Dr. M. Niranjan, Pr. Scientist
Dr. U. Rajkumar, Pr. Scientist
Dr. R.K. Mahapatra, Pr. Scientist
Dr. D. Suchitra Sena, Pr. Scientist
Dr. Santosh Haunshi, Sr. Scientist
Dr. S.K. Verma, Sr. Scientist
Dr. S.P. Yadav, Sr. Scientist
Dr. B. Prakash, Sr. Scientist
Dr. M. Shanmugam, Scientist
Dr. T.R. Kannaki, Scientist
Dr. K.S. Rajaravindra, Scientist
Dr. Chandan Paswan, Scientist

National Fellow

Dr. T.K. Bhattacharjya, National Fellow

Technical Staff

Dr. S.K. Bhanja, C.T.O.(Farm Manager)
Dr. R.V. Rao, C.T.O.
Sri V.V. Rao, A.C.T.O.
Smt. Minakshi Dange, A.C.T.O.
Sri D. Pratap, Sr. Tech. Officer
Sri J. Srinivas Rao, Sr. Tech. Officer
Sri A. Ravi Kumar, Tech. Officer
Sri G. Rajeshwar Goud, Tech. Officer
Sri A. Subrahmanyam, Tech. Officer
Smt. N.R. Dhanutha, Sr. Tech. Asst.
Sri Md. Maqbul, Sr. Tech. Asst. (Driver)
Sri M. Pantulu, Tech. Asst. (Driver)
Sri Md. Yousufuddin, Tech. Asst. (Driver)

Administrative staff

Sri A.V.G.K. Murthy, A.O.
Sri C. Bagaiah, A.F. & A.O.
Smt. R.T. Nirmala Veronica, A.A.O.
Sri R. Sudarshan, J.A.O.
Smt. T.R. Vijaya Lakshmi, Assistant
Smt. M. Kamala, Assistant
Sri Rajesh Parashar, U.D.C.
Sri L.V.B. Prasad, U.D.C.

Secretarial Staff

Smt. O. Suneeta, P.S.

Skilled Supporting Staff

Sri G. Vijay Kumar
Sri Syed Mujtaba Ali
Sri D. Ashok Kumar
Sri N. Manyam
Sri K. Charles
Sri G. Narsimha
Sri Manzoor Ahmed
Sri D. Srinivas
Sri M. Narsing Rao
Sri V.Ravinder Reddy
Sri P. Shankaraiah
Sri K. Venkataiah
Sri D. Shiva Kumar
Smt. K. Vimala

Promotions

Smt. R.T. Nirmala Veronica, Assistant has been promoted as A.A.O. w.e.f. 01-04-2016.

Smt. T.R. Vijaya Lakshmi, U.D.C. has been promoted as Assistant w.e.f. 19-07-2016.

Smt. M. Kamala, U.D.C. has been promoted as Assistant w.e.f. 19-07-2016.

Sri Rajesh Parashar, L.D.C. has been promoted as U.D.C. w.e.f. 20-07-2016.

Sri L.V.B. Prasad, L.D.C. has been promoted as U.D.C. w.e.f. 20-07-2016.

Transfers

Dr. S.K. Verma, Sr. Scientist has been transferred to ICAR – Central Institute for Research on Cattle, Meerut on 31-03-2017.

15. Other Relevant Information

Experimental Hatchery

Experimental 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 95,870 hatching eggs, 22,0,004 day old chicks, 39,568 parents and 1,706 grown up birds were sold/ supplied to the farmers across the country. In addition 21,692 embryonated eggs were made available for diagnosis and vaccine production to different organizations.

Experimental farm

The experimental poultry farm which is lifeline for the Directorate is located inside the campus and is divided in to two units Pureline and Commercial farm units. All pureline experiments are conducted at Pureline unit, whereas the commercial one is mandated for supplying commercial germplasm from the parent lines developed at this Directorate. During the year, a new cage house has been constructed with a capacity of 710 female and 180 male breeder cages and a brooder house of 1000 square feet has been added as a vertical extension which will help immensely in increasing the housing space for birds. The average livestock reared in the experimental farm was 23,234. From the Farm Unit a total of 17,71,494 eggs were produced during the year out of which 6,68,184 were hatching eggs and 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 types at feed processing unit of the Directorate. During the year, a total of 828.37 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 and to the Nehru Zoological Park in Hyderabad.

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 generating revenue. The grown up 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 are used in statistical analyses of research data generated in 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 Organisation. 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 networks from BSNL to all the users on LAN with 20 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.

Bio-metric 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.

Hindi Cell

The Directorate conducted four quarterly meetings of Official Language Implementation Committee (OLIC) on 30 June 2016, 08 September 2016, 09 December 2016 and 25 March 2017, in which different issues related to effective implementation of Hindi Language in Institute were discussed. The Directorate also conducted four Hindi workshops, on 30 June and 17 September 2016, 16 December 2016 and 23 March 2017, for upgrading the skills of staff in their day to day official work in Hindi. During this year, two officers were awarded under Hindi incentive scheme for their efforts in maximum usage of Hindi in routine official work.

The Directorate celebrated Hindi Fortnight from 14-29 September 2016 and Hindi Day on 14th September 2016. Poultry terminology dictionary (English to Hindi) and Srinidhi brochure (Hindi) were also released.

The Directorate received TOLIC award (Third prize) from DG, NIRDPR, Rajendranagar, Hyderabad on 15 November 2016 for the best implementation of Official language in the institute for the year 2015.

Institute Technology Management Unit (ITMU)

Institute Technology Management Unit was established during XI plan. During the period under report, a trademark for chicken variety developed at the Directorate was obtained from Indian Trademark office, Chennai (GRAMAPRIYA®, Trademark No.1868091). Trademark applications for other chicken varieties are under process. Objection raised against trademark VANARAJA™ at the trademark office was defended by submitting documents showing the earliest proof of usage of the name "VANARAJA" by the Directorate. One Patent application for the technology invented at the Directorate has been filed with Indian Patent Office. Research publications of the Directorate from the years 2005-2012 have been compiled and documented with ITMU. Prior art searches for patents were performed. Monthly reports were submitted to ZTMC at CIFT, Cochin. One Scientist from the Directorate has undergone IPR PG-diploma course conducted by NAARM-HCU.

Library and Information Centre

The Institute has a well-organized library that is much helpful to the scientists, technical staff as well as other regular visitors. To cater to the needs of scientists, research scholars and technicians working in different disciplines, the library subscribed sixteen foreign and eight Indian journals and seven hundred and more reference books on different aspects of poultry science and livestock are available. Staff of the institute are also utilizing services of Cera e-granth project and j-gate consortia for research articles. In addition, daily news papers in Hindi, Telugu and English (two from each language), Employment news and magazines are being procured for the benefit of the staff and visitors.

Besides, the library also is equipped with good reprographic facilities like color and black & white copiers and binding facilities.

Institute Foundation Day

The 30th Institute Foundation Day was celebrated on 1 March, 2017. Dr. V. Praveen Rao, Vice Chancellor, Professor Jayashankar Telangana State Agricultural University, Hyderabad was the Chief Guest of the function. On this day, the Chief Guest delivered the Foundation Day lecture. Dr. R. P. Sharma, Former Director, ICAR-DPR and Dr.

V. V. Kulkarni, Director, ICAR-National Research Centre on Meat, Hyderabad were the Guests of Honour. The Chief Guest released Institute publications and distributed the prizes to the winners of different sports organized during Annual Sports of the Institute. Besides this, National Science Day was also celebrated on 28 February, 2017. On this occasion, Dr. (Mrs.) Kalpana Sastry, Director, ICAR-NAARM delivered an expert lecture on Intellectual Property Rights.

Swatch Bharath Abhiyan

The Swatch Bharath Abhiyan was launched by the Government of India to inculcate the habit of keeping the surroundings clean and tidy. Accordingly, the Directorate's staff actively participated in cleaning the institute premises every Wednesday. Swachhta Pakhwada was conducted from 16 - 30 May 2016, 2 October 2016 and from 16-30 October, 2016. During the Pakhwada celebrations, different activities were organized. Swachhta Pledge was taken by all the staff members of the institute. For spreading awareness among the school students, visit to two nearby schools was organised for cleaning drive. Staff members also visited adopted villages for spreading awareness among the villagers and cleaning the common areas in the village. A compost pit was made in the institute premises. A Guest Lecture by Dr. R.B.N. Prasad, Retd. Chief Scientist, IICT was arranged at the institute. Swachh Bharat Quiz was organized. A human chain was formed by all the staff of the institute to spread awareness among the common citizens of the city.

Independence Day and Republic Day

ICAR-DPR celebrated the Independence Day on 15 August 2016 and Republic Day on 26 January 2017. On these occasions, the Director hoisted the national flag and addressed the gathering. In his address, the Director congratulated the untiring efforts in achieving the targets of the institute. He also stressed upon the need for constant and enthusiastic efforts by all the staff to achieve further heights in future.

Games and Sports

The contingent of the Directorate participated in the ICAR sports meet organised by ICAR-NAARM, Hyderabad held at Railway Grounds, Secunderabad from August 22-26, 2016.

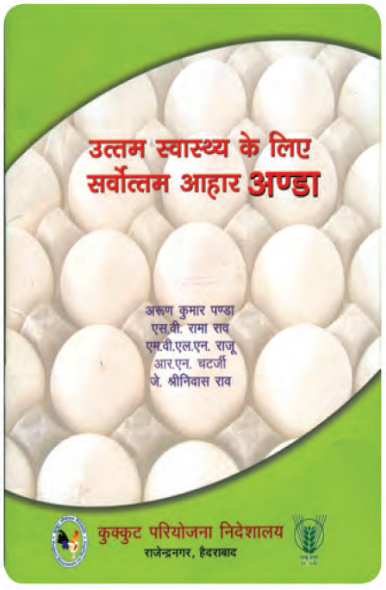
Foundation stone laid for new campus

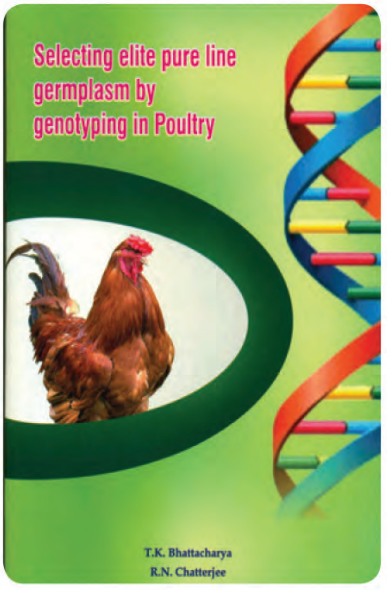
Dr. Trilochan Mohapatra, Secretary (DARE) and Director General (ICAR) laid the foundation stone of 'Animal House' at the new campus of the Directorate at Budvel, Hyderabad on 31st August 2016. Dr. Mohapatra was accompanied by Dr. H. Rahman, Deputy Director General (Animal Science); Dr. J. K. Jena, Deputy Director General (Fishery Science); Directors of local ICAR institutes, Dr. V. Prabhakar Rao, former Vice Chancellor, SVVU, Tirupati; Dr. A. Padma Raju, former Vice Chancellor, ANGRAU, Hyderabad; Dr. R.P. Sharma, former Director, PDP and other distinguished dignitaries.

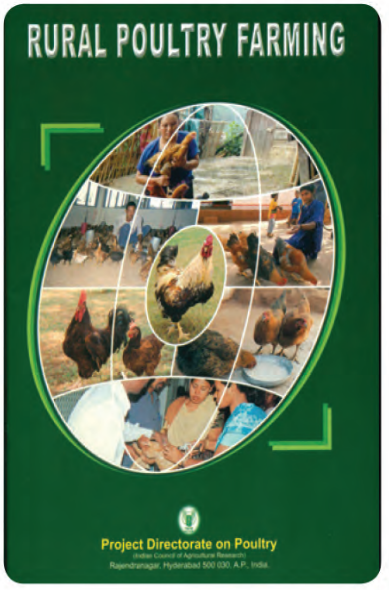
In his address to the staff, Dr. Mohapatra appreciated the Institute activities and advised to utilize the new facility being created at the new campus to cater to the need of the farmers. Dr. H. Rahman, DDG (Animal Science) appreciated the Institute activities by highlighting the role of the Institute in popularizing the backyard poultry in the country. Other dignitaries also spoke on the occasion. Dr. R.N. Chatterjee, Director conveyed the gratitude to the Vice Chancellors of PVNR Veterinary University and ANGRAU, Hyderabad for providing land to the Institute.

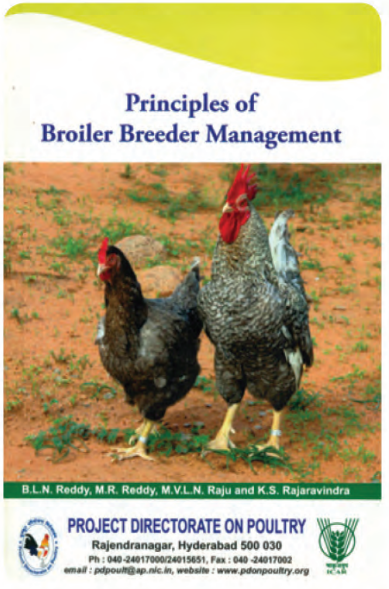
A glimpse of foundation laying cermony for the Animal House by Dr. T. Mohapatra, DG, ICAR

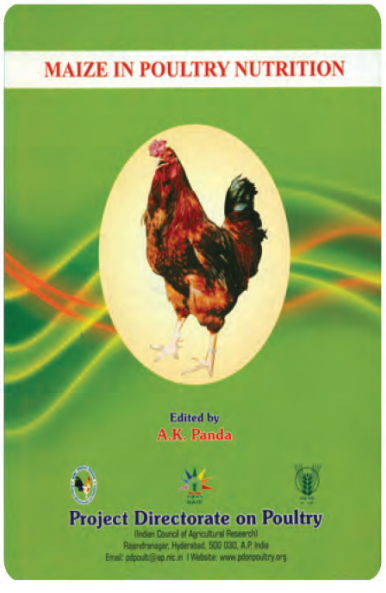
DPR Publications

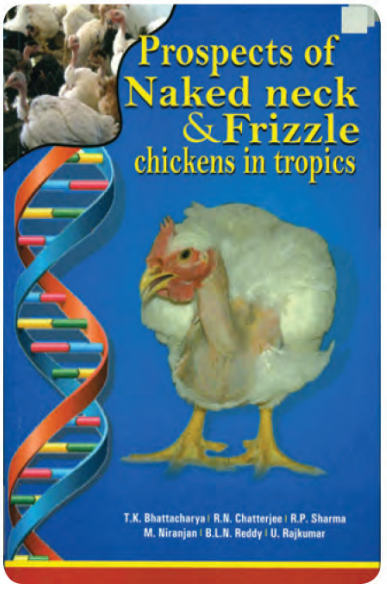


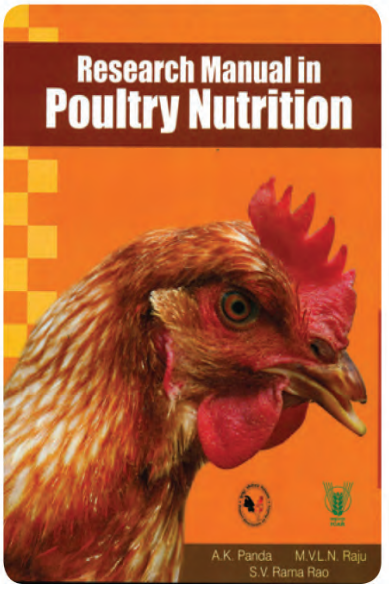












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