

# CARI

2011-2012

वार्षिक प्रतिवेदन  
Annual Report



केन्द्रीय पक्षी अनुसंधान संस्थान

इज्जतनगर - 243 122 (उ.प्र.)

CENTRAL AVIAN RESEARCH INSTITUTE

Izatnagar - 243 122 (UP)



# **CARI**

## **ANNUAL REPORT**

**(2011-2012)**

**CENTRAL AVIAN RESEARCH INSTITUTE**  
**IZATNAGAR, BAREILLY - 243 122 (U.P.)**

The Editorial Board acknowledges Dr. R.P. SINGH, Director for providing valuable guidance and suggestions in bringing out this publication.

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# PREFACE .....

From a humble beginning as Poultry Research Section (PRS) way back in March, 1939 through its upgradation to Poultry Research Division (PRD) in mid 1950's and subsequent elevation to Central Avian Research Institute (CARI) at Izatnagar on the 2<sup>nd</sup> November, 1979, this Institute has emerged as the premier institution of poultry research, post-graduate education and extension activities under a single umbrella in the country. It has been playing a crucial role in providing need-based R&D support for the sustained growth of commercial (organized) poultry sector and also for promoting small scale (unorganized) rural poultry production in view of the need for their co-existence in an agrarian country like ours to meet the ever increasing demand of poultry products and also for augmenting household income and nutritional security to the unprivileged sections of society. Over the years, the Institute has contributed significantly in developing and propagating superior germplasms of diversified poultry species along with improved package of production and processing technology to stakeholders in both public and private sectors across the country.



I feel privileged in presenting the annual report (2011-12), containing mandated activities and progress made under four major research programmes. Consistent improvement has been made through selective breeding and other approaches in economic traits of different breeds/strains/lines of alternate poultry species like quail, turkey, duck, guinea fowl, *desi* (indigenous) fowl, apart from layer and broiler chicken as AICRP component. Emu is a recent introduction to the pool of diversified poultry genetic resources at this Institute. It is worth mentioning that CARIBRO Dhanaraja (an elite multi-coloured commercial broiler) developed at this Institute secured 2<sup>nd</sup> rank at 37<sup>th</sup> RSPPT Centre, Gurgaon. Work related to avian biotechnology pertained to differential expression analysis of candidate genes related to plumage colour in pure lines of quail and immuno-competence in *desi* and exotic breeds of chicken, molecular sexing in diversified poultry species and gene silencing, etc. Other major areas of R&D activity carried out include crude protein requirement of ducks, augmentation of nutrient bio-availability in non-conventional feed stuffs, heat stress amelioration, control of mycotoxicosis and production of designer eggs through dietary interventions; improving reproductive efficiency in ducks, guinea fowls and broiler breeders, novel technology for value-added poultry products, bio- and phyto-contaminants assay and economic analysis of poultry production in Kumaon hill region, etc. Under NAIPs, considerable progress has been made in improving livelihood and nutritional security of target beneficiaries through diversified poultry rearing as a component of integrated farming system.

Furthermore, major issues related to diversified poultry production have been deliberated at length and R&D priorities have been identified for taking up research programmes during 12th plan.

In pursuing academic activities, 7 M.V.Sc. and 4 Ph.D. students were awarded degree in Poultry Science last year. Under outreach programme, 12<sup>th</sup> Farm School on "Importance of feed in poultry production" was broadcast from AIR, Rampur. Specialized training courses on layer, broiler, quail production, poultry diseases and bio-security

measures, hatchery operation, and poultry entrepreneurship development and project formulation covering 20 trainees; 7 batches of training on poultry farm management covering 143 farmers/unemployed youths and 159 army soldiers sponsored by Bihar A.H. Deptt., ATMA and army resettlement training unit were organized. This apart, a total of 621 farmers including 250 women farmers were also imparted training on backyard chicken and duck production at Regional Centre, Bhubaneswar. Dissemination of proven technology was also carried out through consultancy, participation in exhibitions and mass media. Besides, a large number of parent and commercial stocks of diversified poultry species were supplied to beneficiaries across the country.

Research accomplishments of the Institute got recognition at different fora and during the year scientists of the Institute were honoured with over a dozen prestigious awards/recognitions and one of them received advanced training on metagenomic analysis of chicken GIT microbiome at Texas University, USA.

I take this opportunity to place on record my heartfelt gratitude to Dr. S. Ayyappan, Secretary (DARE) and DG, ICAR; Dr. K.M.L. Pathak, DDG (AS) and Dr. S.C. Gupta, ADG (AP&B) for their continued valuable guidance, encouragement and generous support in the overall development of the Institute. Furthermore, support and cooperation received from Dr. C.S. Prasad, Former ADG (AN&P), Dr. Gaya Prasad, ADG (AH), Dr. B.S. Prakash, ADG (AN&P), all the Principal Scientists and other official and staff members of Animal Science Division are thankfully acknowledged.

I congratulate the Scientists and other staff of the Institute for their dedicated work which is reflected in this report and also extend my sincere appreciation and special thanks to the Editorial Board for bringing out this publication in time.

June 8, 2012



**(R.P. Singh)**

Director

# INTRODUCTION

Central Avian Research Institute, the premier Institute of Poultry Research in the country, has crossed the milestone of over three decades since its inception (2<sup>nd</sup> November, 1979) at IVRI, Izatnagar campus under the aegis of the Indian Council of Agricultural Research, as a commodity Institute to provide the need based research, P.G. education, training and extension support in all sub-disciplines of Poultry Science for promoting sustainable diversified poultry production at both commercial and small scale rural poultry production in the country.

The Institute has its main campus at Izatnagar, Bareilly (U.P.) and a Regional Centre at Bhubaneswar (Odisha). The Institute has an administrative building, four blocks accommodating the laboratories of various disciplines, eight experimental farms, hatchery, feed processing unit, semi-automatic poultry processing unit, Agriculture Knowledge Management unit, central library and trainees' hostel-cum-guest house.

Basic, applied and strategic research through multi-disciplinary approach on diversified poultry species is conducted under Avian Genetics and Breeding, Avian Nutrition and Feed Technology, Post-Harvest Technology, Avian Physiology and Reproduction Divisions and Poultry Housing and Management, Technology Transfer and Avian Medicine Sections of the Institute.

## MANDATE

### MAIN INSTITUTE

- To undertake basic, applied and adaptive research in all disciplines relating to production of diversified poultry.
- To develop post-harvest technologies for value addition, quality assurance, efficient processing and marketing of poultry products and by-products.
- To impart specialized training and post graduate education in Poultry Science and its allied fields.
- To transfer the proven technologies to the end users employing efficient and cost-effective methods.
- To provide referral and consultancy services in all aspects of production, processing and marketing (value chain) of diversified poultry.

### REGIONAL CENTRE

- To conduct research on various aspects of duck production using both native and exotic ones.
- To undertake research on backyard poultry production and develop package of practices on various aspects.
- Conservation and maintenance of indigenous germplasm and testing of high yielding birds developed at CARI.
- Popularization of duck farming amongst beneficiaries.

## EXPENDITURE STATEMENT (2011-12)

(Rupees in lakh)

Sl. No.	Heads of Account	Plan		Non-Plan	
		Allocation	Expenditure	Allocation	Expenditure
<b>1. Capital</b>					
a.	Works	97.15	97.15	00.00	00.00
b.	Other	34.36	33.23	06.00	03.04
<b>2. Revenue</b>					
a.	Establishment Expenses	00.00	00.00	1348.93	1305.98
b.	T.A.	09.65	09.65	10.00	06.59
c.	Research and Operational Expenses	267.09	267.09	97.00	96.99
d.	Administrative Expenses	16.91	16.90	263.02	252.45
e.	Miscellaneous Expenses	05.35	05.34	07.10	07.09
	<b>Total</b>	<b>430.51</b>	<b>429.36</b>	<b>1732.05</b>	<b>1672.14</b>

**TARGET AND REVENUE GENERATION (2011-12)***(Rupees in lakh)*

(a) Target		<b>111.00</b>
(b) Revenue generated:		
(i) Sale of Farm Produce	-	93.35
(ii) Sale of Publications	-	00.78
(iii) Licence Fee	-	03.39
(iv) Analytical & Testing Fee	-	00.35
(v) Interest on STD	-	7.10
(vi) Internal Resource Generation	-	2.73
(vii) Miscellaneous Receipts	-	10.29
<b>Total</b>	<b>-</b>	<b>117.99</b>

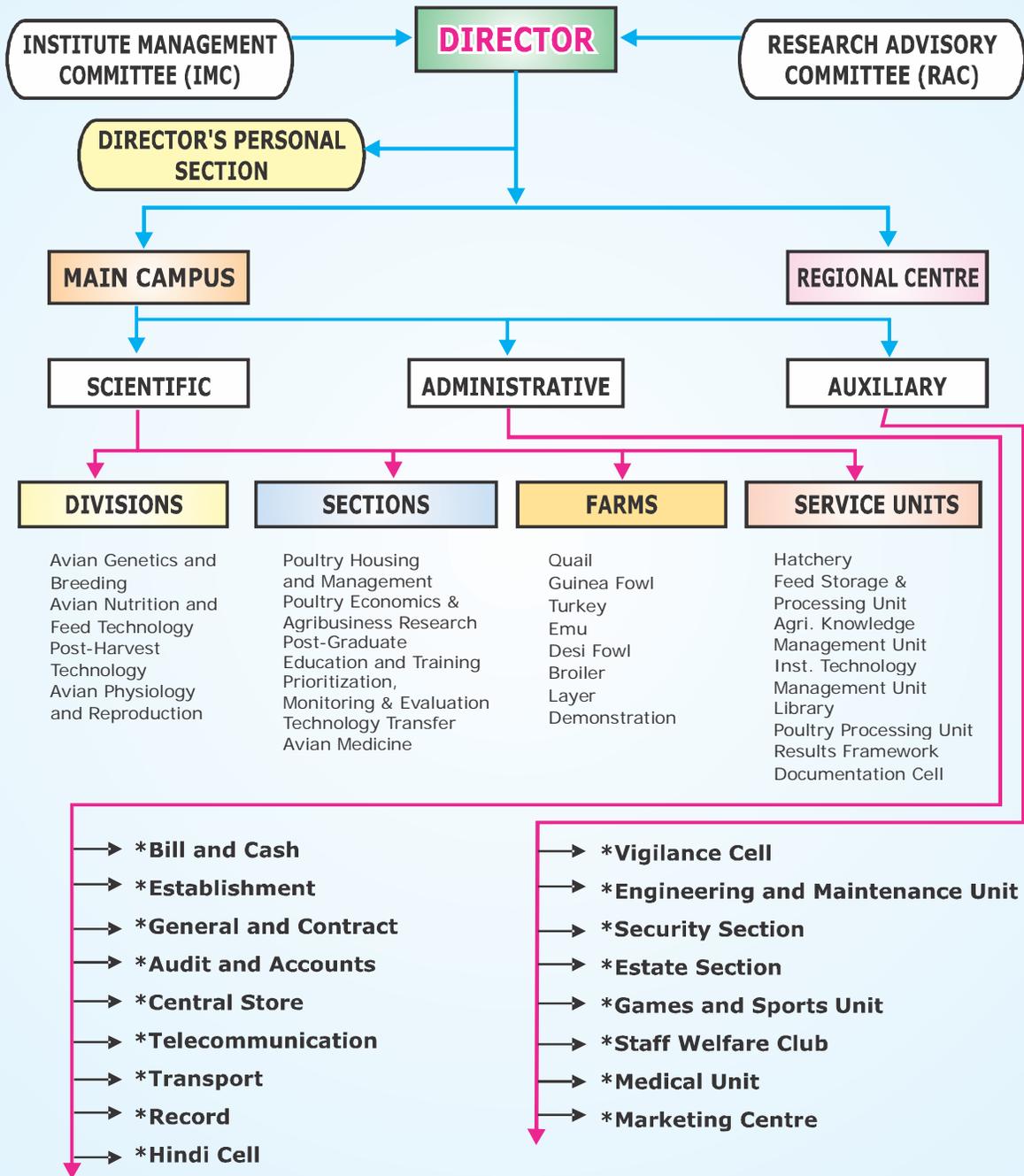
**SANCTIONED AND IN-POSITION STAFF STRENGTH OF CARI (AS ON 31-03-2012)**

<i>Categories</i>	<i>Sanctioned strength</i>	<i>In-position</i>	<i>Vacant</i>
Scientific	40	33 + 1 RMP = 34	6 One (1) Principal Scientist and two (2) Senior Scientists recruited but joining awaited
Technical	61	48**	13
Administrative	31*	31**	3 (F&AO – 1, PA – 1 and Assistant – 1)
Supporting	143	127**	16

\*Post of UDC in revised cadre strength

\*\*Including terminated employees (4 in Technical, 2 Administrative and 2 in Supporting grade)

# ORGANOGRAM



## Productivity Improvement

- Four quail lines namely Pharaoh (CARI Uttam), white breasted (CARI Ujjwal), white feather (CARI Sweta) and white egg shell (CARI Pearl) were utilized to evaluate the combining ability (GCA and SCA) and RE effects for various economic and egg quality traits. Percentage of heterosis varied among different crosses. Most crossbreds were superior to purebreds, except cross CUxCJ and CSxCP. Cross CUxCP had positive and highest value of heterosis percentage for EP at 8<sup>th</sup> week. Cross CJxCP had highest heterosis percentage for egg weight, specific gravity, Haugh unit score and albumen weight, whereas cross CUxCP, CUxCS and CJxCS had highest and positive heterosis percentage for shell thickness, yolk weight and yolk index, respectively.
- Different level of expression of ASIP, EDNRB, MC1R, SLC45A, TYR and MITF candidate genes with respect to the different coloured plumage of Japanese quail indicated their possible role in the plumage colour formation.
- Immunocompetence profiling of Aseel, Kadakanath and WLH chicken demonstrated that the humoral immune response (HA titre) to sheep erythrocytes ranged from 7 to 14, 8 to 15 and 6 to 15 in the three genotypes and the average HA titres were 10.77, 11.78 and 11.83, respectively. Mean serum IgG levels in Aseel, Kadakanath and WLH were 15.44, 13.21 and 9.49 mg/ml, respectively.
- ELISA titres ( $\log_{10}$ ) to ND vaccine were estimated in WLH, Aseel and Kadakanath breeds during 1-6 week of age. Significant difference among breeds and age were observed.
- Comparison of the Aseel (Kagar) and Ankaleshwar breeds for juvenile body weights, gain in body weights and immunocompetence traits (HA titre to SRBC and CMI to PHA-P) indicated that Aseel Kagar was better than Ankaleshwar.
- Various pure strains and strain crosses of Layer were regenerated, maintained and evaluated. Mean estimates of ASM for IWH, IWI, IWC, HJ, JHI and JGHI recorded were 144.47, 145.75, 160.06, 139.23 142.86 and 141.42 days and the corresponding values for hen housed egg production were 185.00, 182.71, 147.89, 178.41, 185.9 and 189.86 eggs, respectively with 50.92 to 52.64 g 40<sup>th</sup> week egg weight.
- The estimates of genetic response per generation were -11.0 g and -4.48 g for body wt. at 16<sup>th</sup> wks of age, 0.16 g and -0.18 g for egg wt. at 28<sup>th</sup> wks of age, 0.03 g and -0.07 g for egg wt. at 40<sup>th</sup> wks of age and 0.19 g and -0.35 g for egg wt. at 64<sup>th</sup> wks of age in IWH and IWI strains, respectively. Average genetic response per generation for egg production up to 40 and 64 weeks of ages were highly significant and positive in both selected strains (IWH and IWI).
- Immunocompetence profile of IWH pure line of AICRP on poultry for egg resolved average humoral immune response against sheep erythrocytes, measured at 6 weeks of age through Haemagglutination (HA) test as  $11.866 \pm 0.131$ .
- Overall average body weight of mixed sexes at 5 weeks in CSML, SML and control were 1162.95 and 1135.38 g, and 758.57 g, respectively. Genetic and phenotypic responses for 5 wk body weight in CSML were 13.50 and 17.9 g per generation, respectively. Corresponding values for SML were 10.21 and 14.577.
- At 37<sup>th</sup> RSPPT (Gurgaon), CARIBRO Dhanraja secured II rank by attaining 1.44 and 1.84 kg body weight at 6 and 7 weeks, respectively. FCR at 0-6 and 0-7 weeks were 1.9 and 2.0 with dressing percentage of 73.67.
- The overall average of body weight at 5 weeks in CSFL and SDL were 1147.47 and 1099.73 g, respectively. The genetic and phenotypic responses to selection for 5-week body weight in CSFL were observed as 14.95 and 19.39 g per generation, respectively. Corresponding values for SDL were 11.49 and 14.72 g.
- Mean 20 wk BW, ASM, 40 wk EW and 40 wk EP recorded for RIR selected strain were 1379.77 g, 160.71 days, 50.33 g and 85.95

eggs, respectively. The mean ASM, body weight, egg weight and egg production at 40-weeks of age for CARI Sonali crossbred was recorded as 147.62 days, 1678.26 g, 50.76 g and 104.07 eggs. The corresponding figures for CARI Debendra crossbred were 145.89 days, 2324.02 g, 52.74 g and 86.91 eggs.

- In guinea fowl, mean body weights at day old, 4<sup>th</sup>, 8<sup>th</sup> and 12<sup>th</sup> weeks of age were 27.48 g, 189.67 g, 535.86 g and 957.91 g in Lavender, 27.03 g, 187.95 g, 533.70 g and 970.19 g in Pearl and 27.11, 172.39, 528.6 and 911.831 g in white plumage variety, respectively.
- Mean semen volume per bird was 55.6 l and 67.7 l in Lavender and Pearl varieties, respectively. In cages, semen volume per bird was more (67.6 l) as compared to 39.2 l on floor. Seasons seem to have significant influence on semen volume as semen volume ranged from 52-60 l, 59-64 l and 48-50 l during June, July and October, respectively in Lavender; while in Pearl, the respective ranges were 62-84 l, 80-92 l and 38-40 l.
- The preadipocyte culture techniques were standardized. shRNA lentivector with GFP clones for myostatin and PPAR genes were prepared. The qPCR for myostatin, PPAR,  $\beta$ -actin and leptin R genes was standardized. The preliminary results showed that the optimum dose was 4 l through i.v. route as the body weights were highest in this group and % knock down of myostatin gene was 69.85 in 4 l i.v. groups vs. 12.05% in 4 l i.m. group. Fluorescent microscopy of blood smear (48 h post injection) and contact smear of heart of injected and uninjected control revealed that injected group had GFP whereas uninjected control did not show the presence of GFP.

## Production Technology

- Probiotic and prebiotic dietary supplementation exhibited up regulation of IL-10, IL-6, IFN-g and iNOS genes in colour broilers. Higher expression of IL-10 in lungs indicated the protective mechanism of host however at 5 wks of age immune response took over by up regulation of IL-6, IFN-g and

iNOS. Growth related genes also showed upregulation in synbionts fed group.

- Dietary supplementation of ascorbic acid @ 150 ppm, chromium @ 2.49 ppm from 20 mg chromium picolinate, zinc oxide @ 48 or 96 ppm in basal diets (50 or 48 ppm), potassium chloride @ 300 or 600 ppm improved growth performance and immuno-competence during hot and hot-humid summer. These dietary supplements also down regulated expression of HSP70 in liver and/or jejunum.
- A combination of multi-enzyme and phytase was beneficial in improving growth and utilization of nutrients. There is scope of reducing 0.1% available P from di-calcium through phytase supplementation @ 500 FTU/kg diet.
- Solid state fermentation with substrate to moisture ratios of 70:30 (w/v) for wheat bran and 50:50 for de-oiled rice bran with an incubation period of 72 h at 37°C was found best for augmenting availability of protein, energy and phosphorus. Dietary incorporation of these fermented brans up to 7.5 and 5% level, respectively was found beneficial for growth performance, nutrient utilization, immune competence, gut health and feed cost of production in broiler chickens.
- The methodology for production of copper methionine (an organic copper supplement with 17% Cu) was standardized and feeding of such copper chelate @ 100 mg/kg diet was effective in promoting growth, feed conversion, immune-competence and carcass traits and reduction of serum cholesterol in broiler quails.
- Diatomaceous earth, sodium bentonite and zeolite either at 0.5% or 1% level were partially or completely effective in ameliorating adverse effects of aflatoxin in broiler chickens. However, combination of the binders at 0.33% each was most effective in ameliorating the adverse effects of aflatoxin B1 in broiler chickens.
- A diet containing 16% crude protein (CP) was optimum for growth and nutrient utilization of Khaki Campbell ducks during

- grower stage (9-16 weeks) whereas 18% CP was found optimum for egg production.
- A dietary combination of 0.02% Atorvastatin, 0.25% EDTA, 375 mg/kg Niacin, 250 mg/kg -tocopherol and 1.5% fish oil in laying hens diet reduced total egg yolk cholesterol by 19%. Combination of chromium (1000 µg/kg), spirulina (2 g/kg) along with -tocopherol-250 mg/kg and 1.5% fish oil also reduced total cholesterol but it took about 30 days for beneficial effect. Supplementation of fish oil and/or spirulina in the laying hen ration was effective in enhancing n-3 fatty acids in egg yolk.
  - The chicks receiving *in-ovo* injection of growth or humoral group of nutrients had higher body weight (70 g) at 42 days of age. The latter group of nutrients can be used along with *in-ovo* ND vaccines for commercial application.
  - Ascending order of dietary phytohormone supplementation (Isoflavone 20 mg: 18 to 20 wks, 25 mg: 20 to 22 wks and 30 mg: 22 to 25 wks of age) significantly advanced the age of sexual maturity with better synchronization and improved the intensity of lay.
  - Dilution of fresh semen with CARI diluent expressed 88% fertility in Guinea fowl during 2-6 days of fertile period. At 24 hr of storage of semen, CARI diluent showed 59% fertility during 2-6 days of fertile period.
  - Collection of semen and AI in ducks were standardised which resulted better fertility in female ducks.
  - The expression of HSP-70 gene in broiler and layer chicken's gastrointestinal tract (proventriculus, duodenum, jejunum and ileum) assessed under varied stressed conditions viz. heat stress: 39-41°C, RH 60% for 3 hr; feed withdrawal: 3 hr daily for 4 days; restraint: 3 hr daily for 4 days showed upregulation and was highest in duodenum during all these stressed conditions. However, the same was down-regulated in jejunum segment in both sexes of broiler chicken which were administered protein synthesis blocker (cycloheximide) and exposed to heat stress.
  - River sand can be an alternate litter material during mild winter months, whereas, combination of saw dust and rice husk can be used during severe winter months for better production and immunity in turkey.
  - Parthenogenetic turkey females showing male behaviour had significantly low serum progesterone. Cage birds had higher progesterone level than those kept on floor. Black turkey males had significantly higher serum testosterone level than white variety males. Parthenogenetic adult males had lower testosterone level than their counterparts (normal males) of black or white variety. Low dam progesterone level and higher expression of Gata-4 or Sox-2 gene could be the indicator for delay in the parthenogenetic development in turkey.
  - 38 genes responsible for early development, growth, immunity and sexual development were sequenced and the accession numbers were obtained from NCBI, USA and EMBL, UK.

### Processing Technology

- The functional chicken scrolls containing 20% soya nuggets could be safely stored till 3 and 8 weeks of refrigerated (4±1 C) and frozen storage (-18±1 C), respectively while, functional chicken meat pellets made with 15% soya nuggets could be safely stored till 2 and 6 weeks of refrigerated (4±1 C) and frozen storage (-18±1 C), respectively.
- Egg *tikka* prepared with coatings containing mashed potato, refined rice flour, bread crumbs, black pepper and salt was organoleptically most acceptable and had a refrigerated shelf life of 20 days in vacuum and 18 days in aerobic packaging with satisfactory microbiological and organoleptic quality. The cost of formulating egg *tikka* weighing about 80 g was calculated as Rs. 5.60.
- Heavy metal (As, Pb, Cd, Mb.) residues were detected in all the samples of poultry feed, egg and tissues of poultry whereas residues of pesticides (eldrin, dieldrin, BHC, DDT, chloropyriphos, monocrotophos) were noticed in about 7% of the analyzed samples with higher levels found in feed and adipose tissue. Drug (TC, CTC, enrofloxacin) residues were found relatively higher levels in liver

samples. Among the locations of eastern region studied, samples collected from Kolkata and Jamshedpur contained higher levels of residues than those from other areas. The levels of residues detected in samples were, however, within the permissible limits.

- Quantification of *Salmonella* in chicken eggs collected from selected poultry farms and marketing channels ranged between  $1 \times 10^5$  to  $1 \times 10^6$ . *Campylobacter* were observed in the range of  $1.2 \times 10^4$  to  $1.0 \times 10^5$  cfu/egg with higher level of both of these pathogens in eggs collected from marketing channels as compared to fresh farm eggs.

### Transfer of Technology

- The contractual arrangements in the Kumaon hill areas involving different functionaries viz. NGO—operating the mother hatchery, the SHGs—Nursery operator rearing DOCs till 3-4 weeks and the members of the SHGs—involved in backyard/family poultry rearing were studied. The coloured plumage chicks (in order of preference) Kuroiler > CHABRO > CARI Nirbheek > Vanaraja were reared by the farmers. The average annual income generation was Rs. 5440 per family with a BC ratio of 2.94. The most efficient channel for marketing of eggs was Producer → Egg Transporter → Retailer → Consumer; and that for chicken was Producer → Commission agent → supplier → Retailer → Consumer. The share of marketing cost in consumer's rupee was over 4% in the prevalent broiler marketing channels. The consumer's price for dressed chicken varied from Rs. 180-200/kg in the Kumaon hills.
- Integration of scavenging chicken rearing with the horticulture was found to control insects and pests up to nearly 80% especially in guava and banana orchard and also in some vegetable crops. In return the need of the supplementary feeding was almost nil for scavenging chicken groups. Feeding of *Azolla* cultivated in ponds and earthworm obtained as the by-product of the vermi-compost was reduced feeding cost.

- The 12<sup>th</sup> Farm School on "*Kukkut Utpadan mein Ahar ka Mahatva*" was organized through Prasar Bharti, Akashwani Rampur during September-October 2011 in which a large number of farmers belonging to U.P. and Uttarakhand were registered and participated.
- Seven sponsored and regular short-term training programmes on poultry production management were organized for 159 army soldiers, 70 farmers of Bihar and 73 other farmers and unemployed youth.
- A farmers' awareness programme on poultry farming was organized at Gajrola Farm, Amriya, Pilibhit through discussions/lectures/question-answer session between poultry scientists and farmers.
- A Press Meet on "Scope of Self-Employment for Youth in Poultry" was organized at the Institute by the courtesy of India News Communication Ltd., Noida.

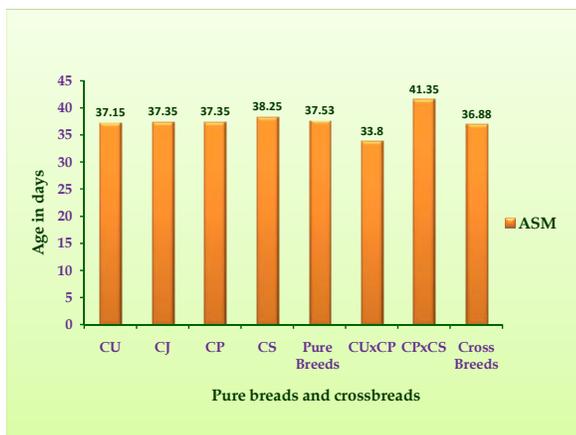
### Post-Graduate Education

- During 2011-2012, 45 students were on roll for different PG degree courses in Poultry Science discipline of Deemed University, IVRI, Izatnagar, of which 7 M.V.Sc. and 4 Ph.D. students were awarded degrees in Poultry Science.
- Fourteen major credit, 11 minor credit, 8 ORW, 11 pre-thesis submission and one faculty seminars were organized by Post-Graduate Education and Training Section of the Institute.
- Nine specialized short-term training courses were organized on various aspects of poultry production wherein 20 trainees participated from different parts of the country.

## PRODUCTIVITY INCREASE IN SELECTED AVIAN SPECIES

### QUAIL

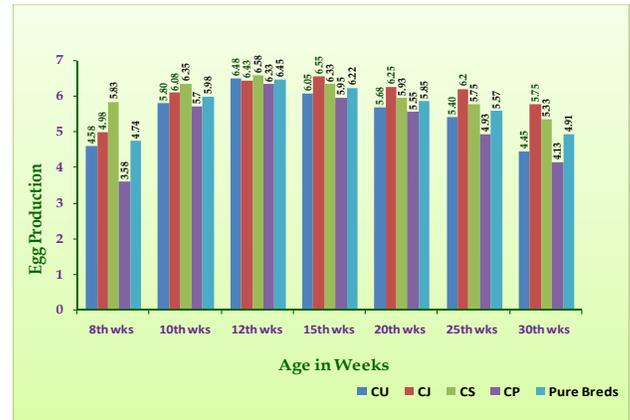
A 4x4 complete diallel experiment using four Japanese quail lines viz. broiler quail line (CARI Uttam), white breasted line (CARI Ujjwal), white feather line (CARI Sweta) and white egg shell line (CARI Pearl) was undertaken to evaluate efficiency of pure and crossbreeding performance with respect to age at sexual maturity (ASM), egg production (EP) 8<sup>th</sup> to 30<sup>th</sup> week and external and internal egg quality traits. Degree of expression of selected candidate genes were quantified by using specific primer pairs for candidate genes of interest in semi-quantitative PCR for the estimation of their involvement of feather colouration in Japanese quail and their probable association with laying characteristics of the bird. The ASM and EP at specified weeks and egg qualities at 10<sup>th</sup> week of age revealed significance difference among genetic groups and mating system. In case of ASM, crossbred CUxCP showed earliest age of 33.80 days (Fig. 1). Crossbreds also performed better incumulative EP than the purebreds (Fig. 2), whereas egg qualities were comparable among them. In general, most of the crossbred had better egg quality traits like egg weight, specific gravity, Haugh unit score and albumen weight than the pure breeds.



**Fig. 1:** Age in sexual maturity in different quail pure breeds and crossbred varieties

Negative value of heterosis percentage for ASM showed that crossbreds were superior to purebreds. Significant GCA and SCA under Griffing's model suggested that the improvement

of crossbreds may be brought about by modified RSS method of selection. Reciprocal differences



**Fig. 2:** Egg production in different quail varieties

suggested the use of specialized sire and dam line for profitable commercial layer quail production. As a whole, crossbreds were superior to purebreds in ASM, EP and egg quality traits and Griffing's method of combining ability analysis was better than Hayman's method. In pure lines, CARI Ujjwal showed highest weekly egg production, whereas, cross between CARI Uttam and CARI Pearl performed better as layer with respect to the hen day egg production.

Molecular analysis of the candidate genes showed different level of expression between different plumage colours, suggesting their role in the coloration of feathers. But their association with the laying abilities needs further exploration.

### GUINEA FOWL

**Regeneration of guinea fowl varieties:** Three purebreds i.e., Pearl (P), Lavender (L) and White (W); one cross bred population i.e., PearlxLavender (PL) and one indigenous population (IND) were used to produce different purebred (P, L and W) and six crossbred groups (PLxL, INDxW, PxIND, LxIND, LxPL and INDxPL). The individuals having higher body weights at 12 weeks of age from purebred Pearl and Lavender populations along with birds showing typical Pearl and Lavender plumage pattern from crossbred populations were used to reproduce pearl and lavender population, respectively. White

population was reproduced from white purebred variety only.

Mean body weights at day-old, 4<sup>th</sup>, 8<sup>th</sup> and 12<sup>th</sup> weeks of age were 27.48 0.10, 189.67 1.81, 535.86 4.99 and 957.91 6.60 g in Lavender, 27.03 0.11, 187.95 2.19, 533.70 5.98 and 970.19 8.85 g in Pearl, and 27.11 0.18, 172.39 3.11, 528.6 5.18 and 911.831 6.34 g in white varieties, respectively.

**Carcass traits in guinea fowl:** Carcass traits were studied in guinea fowl at 8<sup>th</sup>, 12<sup>th</sup>, 16<sup>th</sup>, 20<sup>th</sup> and 32<sup>nd</sup> weeks of age. The dressing yields were 70.29, 75.42, 75.33, 74.38 and 73.34%, respectively.

**Optimizing A.I. technique in guinea fowl:** Some initial observations were made regarding artificial insemination in guinea fowl. Mean semen volume per bird was 55.6 l and 67.7 l in Lavender and Pearl varieties, respectively. In cages, semen volume per bird was more (67.6 l) as compared to 39.2 l on floor. Training of the males improved the semen volume. Similarly, semen collection after 4-5 days interval yielded more semen as compared to alternate day collection. Season seems to have significant influence on semen volume as semen volume ranged from 52-60 l, 59-64 l and 48-50 l during June, July and October, respectively in Lavender; while in Pearl, the respective ranges were 62-84 l, 80-92 l and 38-40 l.

**Effect of season on gonadal development in guinea fowl:** Guinea fowl is seasonal breeder and lays eggs in summer months only. Hence, the growth in ovary and testis was studied in the birds from hatch at different weeks of age and in birds from different hatches. Results showed that the birds hatched later (September to October) have slower growth of gonads as compared to those hatched early (May to July).

**Long term selection in guinea fowl:** Two populations of guinea fowl i.e., Pearl and Lavender, which were subjected to long term selection for high 12<sup>th</sup> week body weight were evaluated for different selection parameters. Overall average number of sires, dams and progenies were 9.13, 51.60 and 441.40 in Pearl and 8.69, 50.54 and 614.23 in Lavender, respectively. In overall period, the average effective population size, rate of inbreeding and cumulative inbreeding was 31.00, 0.016 and

0.245 in Pearl and 29.62, 0.019 and 0.244 in Lavender. During overall selection period, the expected, effective and standardized selection differential was 158.02, 158.45 and 1.30 in Pearl and 174.96, 174.01 and 1.55 in Lavender, respectively.

The direct response to selection in selected trait i.e., 12 week body weight in Pearl was 10.14 g per generation, while in Lavender, it was 12.81 g/generation in overall period of selection. In overall period, the correlated response in 0 day, 4 week and 8 week body weight were 0.136, 3.09 and 5.83 g in Pearl and 0.168, 3.57 and 7.24 g in Lavender and all the responses were significant. Heritability estimates were moderate to high for the body weight at 12<sup>th</sup> weeks of age as well as other weeks of age. The time trends in heritability estimates of body weights at different weeks of age were non-significant in all periods of selection including over all period. Phenotypic as well as genetic correlation estimates were low to high, but positive between the body weights at different weeks of age. The time trends in phenotypic as well as genetic correlation estimates between body weights at different weeks of age were non-significant in most of the short periods of selection as well as over all period.

## DESI FOWL

A total of 987 Aseel Peela, 998 CARI Red, 456 Nicobari and 762 Kadakanath, 142 Aseel Kagar and 138 Gene pool lines chicks were hatched, brooded and reared. All the breeds of native chicken were maintained in pure form without any selection for conservation purpose and utilized for production of commercial scavenging chicks for utilization under rural poultry production. Highest fertility (80.67%) was observed for gene pool line followed by Aseel Kagar (74.11%) and Nicobari (70.99%). Hatchability on fertile egg set (FES) was highest in Nicobari (83.33%) followed by CARI Red (82.92) and Aseel Peela (78.58%). A total of 14788 viz. 6240 CARI Nirbheek, 3696 Hitcari, 2727 CARI Shyama and 2125 Upcari chicks were hatched and supplied to various NAIP projects and KVK's for rural poultry production.

## Juvenile growth and gain in body weight of Ankaleshwar and Aseel (Kagar)

Juvenile body weights and gain in body weights were compared for Ankaleshwar and

Aseel (Kagar) breeds of Indian native chicken. Day-old body weight for males and females were 31.43 and 29.89 g, respectively and on 10<sup>th</sup> week these birds attained the weight of 612.98 and 465.42 g. These values for Aseel (Kagar) males and females were 33.00 and 32.53 g on day-old and 628.15 and 495.65 g on 10<sup>th</sup> week. Sex dimorphism was observed from day-old for Ankaleshwar and for Aseel (Kagar) from 2<sup>nd</sup> wk onwards. Significant difference was observed between females of both the breeds but males showed significant difference only at day-old age. Significant difference between males and females of Ankaleshwar and Aseel (Kagar) in body weight gain from 0-6 wk and 0-10 wk were observed. Greater body weight gain was noticed at 7 to 10 week of age than at 0 to 6 week of age. Total body weight gain from 0 day to 10 week of age in Ankaleshwar and Aseel (Kagar) males were 581.28±4.19 and 672.63±6.40 g, respectively which showed that body weight gain (0 to 10 wk) in males of Aseel (Kagar) was greater than Ankaleshwar. Similar trend was followed by females of both the breeds.

#### **Immunocompetence status of Ankaleshwar and Aseel (Kagar)**

The humoral immune response (HA titre to SRBC) differed significantly ( $P < 0.01$ ) between genetic groups. Significantly ( $P < 0.01$ ) higher titre value was observed in Aseel (Kagar) with mean titre value ( $\log_2$ ) of 5.09±0.18 and 4.81±0.15 for male and female, respectively and the corresponding values for Ankaleshwar were 4.08±0.16 and 3.96±0.16. Sex dimorphism for humoral immune response was absent in both the breeds. CMI to PHA-P differed among the breeds. Significantly higher value was observed in Aseel (Kagar) male (0.303±0.005) and female (0.293±0.006) compared to Ankaleshwar male (0.270±0.006) and female (0.268±0.006). Comparison of the Aseel (Kagar) and Ankaleshwar breeds for juvenile body weights, gain in body weights and immunocompetence traits (HA titre to SRBC and CMI to PHA-P) indicated that Aseel Kagar was better than Ankaleshwar.

#### **ALL INDIA COORDINATED RESEARCH PROJECTS ON EGG AND MEAT**

##### **Improvement for egg production**

**Reproductive performance:** Two pure selected strains of WLH and two control populations i.e.,

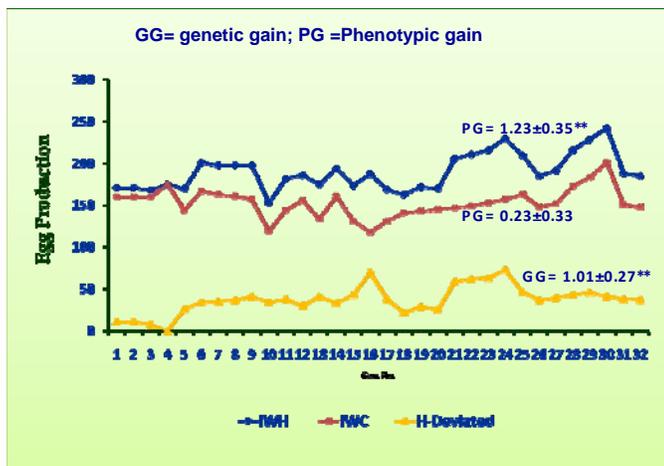
IWH and IWI; IWC (control populations and PDP control populations), respectively along with other strain crosses i.e., HI, JHI, JGHI were regenerated for the production of S<sub>31</sub> generation of selection. The reproductive performance revealed that the fertility was within the range of 87.35 to 96.02% in various pure strains and crosses. The hatchability on fertile eggs transferred basis was within the range of 57.56 to 74.65%.

##### **Means of economically important traits:**

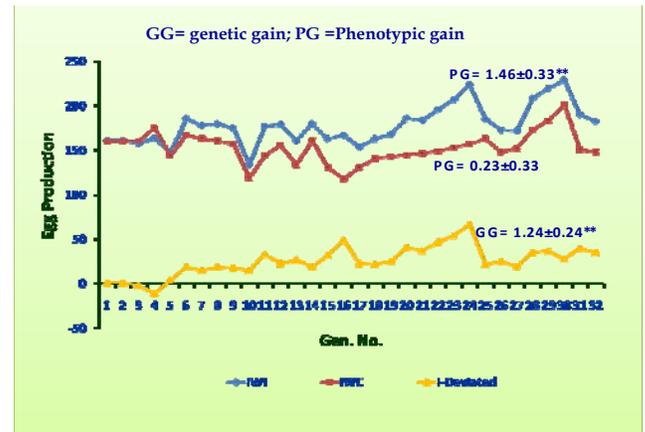
Genetic selection was undertaken on the pure line pullets of IWH, IWI and IWC and JHI and JGHI strain crosses. Average age at sexual maturity observed with the estimates within the range of 139.23 to 160.06 in the above pure strains and strain crosses. The estimates of body weight recorded at various age intervals were estimated. The body weight at 40<sup>th</sup> weeks of age was within the range of 1315.29 g to 1500.92 g in the above pure strains and strain crosses. The estimates of initial egg weight at 28<sup>th</sup> weeks of age were within the range of 46.73 g to 48.14 g, at 40<sup>th</sup> weeks of age 51.00 g to 52.64 g and at 64<sup>th</sup> weeks of age 55.56 g to 58.23 g in these pure strains and strain crosses. Egg production recorded up to 40<sup>th</sup> weeks of age, the estimates were within the range 74.95 (IWC) to 96.70 eggs in IWH, IWI pure strains; the estimates in strain crosses were within the range 96.21 to 99.70 eggs; on hen housed basis.

Egg production recorded up to 64 wks of age with the estimates of 185.00, 182.71, 147.89, 178.41, 185.9 and 189.86 eggs on hen housed basis in IWH, IWI and IWC pure strains and HI, JHI and JGHI strain crosses, respectively. The corresponding estimates on hen day basis in the above mentioned strain crosses were 201.31, 199.82, 174.16, 213.03, 206.57 and 205.25 eggs, respectively while on survivor basis the estimates were 198.00, 195.30, 180.62, 213.34, 206.14 and 196.54 eggs. The results of annual egg production records again proved the superiority of pure strains and strain crosses over control population by 37.11 and 34.82 eggs in pure strains (IWH and IWI) and in the range of 30.52 to 41.97 eggs in strain crosses (HI, JHI and JGHI) on the basis of 64-week egg production (H.H. basis). Frequency distributions for egg production up to 64 wks of age also revealed the efficiency of index selection where 3.81 to 13.85% of the pullets laid more than 240 eggs in comparison to only 0.76% in control population.

**Genetic gain due to selection:** Average response per generation for various economic traits up to 64 wks of age were estimated on genetic and phenotypic scales. On genetic scale, the average response per generation for body weight at various age intervals i.e., 16<sup>th</sup>, 40<sup>th</sup> and 64<sup>th</sup> wks of ages and ASM were negative and highly significant only for body weight at 40<sup>th</sup> and 64<sup>th</sup> wks of ages and also for ASM in both the selected strains. The estimates of average response per generation for egg weight at various age intervals were positive in IWH strain and negative in IWI strain which were highly significant for egg weight at 40<sup>th</sup> and 64<sup>th</sup> wks of ages only in IWI strain. Average response per generation for egg production (EP) both up to 40<sup>th</sup> and 64<sup>th</sup> weeks of ages was positive and highly significant in both selected strains. In the selected strains, the estimates of response were -11.0 g and -4.48 g for body wt. at 16<sup>th</sup> wks of age, -3.93 g and -3.89 g for body wt. at 40<sup>th</sup> wks of age and -25.07 g and -19.07 g for body wt. at 64<sup>th</sup> wks of age in IWH and IWI strains, respectively; the average response/generation were 0.16 g and -0.18 g for egg wt. at 28<sup>th</sup> wks of age, 0.03 g and -0.07 g for egg wt. at 40<sup>th</sup> wks of age and 0.19 g and -0.35 g for egg wt. at 64<sup>th</sup> wks of age in IWH and IWI strains, respectively. The estimates of average genetic response per generation for egg production up to 64 weeks of ages was highly significant and positive in both selected strains; the estimates were 1.01 and 1.24 eggs per generation up to 64 wks of age in IWH and IWI strains, respectively (Fig. 3-4).



**Fig. 3:** Average response per generation for 64 wk EP (IWH)



**Fig. 4:** Average response per generation for 64 wk EP (IWI)

### Improvement of Rhode Island Red for development of multicoloured strains

**Reproductive performance of RIR strains:** The reproductive performance of RIR selected ( $RIR_s$ ), control ( $RIR_c$ ) and crossbred strains for  $S_{29th}$  generation were recorded. The fertility in  $RIR_s$ ,  $RIR_c$ , CARI Sonali (HR) and CARI Debendra (CD) strains was 90.39, 93.54, 89.04 and 83.54%, respectively, and was better than previous generation. The hatchability (fertile eggs transferred basis) was 64.93, 76.64, 63.44 and 63.08% in corresponding strains. The two new breed crosses AseelxRIR and KNxRIR were also produced. The fertility was 85.48 and 86.19%, respectively in both the crosses and hatchability on fertile egg transferred basis was 62.55 and 64.59%, respectively.

**Comparative performance of RIR pure and crossbred strains:** The chicks of selected ( $RIR_s$ ) and control ( $RIR_c$ ) strains hatched in 28<sup>th</sup> generation were kept for brooding and growing. The body weight at 20 wk of age in  $RIR_s$ ,  $RIR_c$  pure strains and HR and CD breed crosses were 1379.77 4.67, 1102.19 8.75, 1534.65 11.21 and 2326.02 7.73 g, respectively. The corresponding body weight at 40 wk of age were 1741.49 5.95, 1436.22 10.94, 1678.27 16.78 and 2268.6837.48 g. Average age at first egg were 160.71 0.33, 182.19 0.67, 147.62 0.67 and 145.89 1.58 days in  $RIR_s$ ,  $RIR_c$ , HR and CD strains, respectively. Egg weight at 40<sup>th</sup> wk of age was 50.33±0.08, 47.68 0.16, 50.76 2.63 and 52.74 4.13 g in  $RIR_s$ ,  $RIR_c$ , HR and CD strains, respectively. Egg production up to 40 wk of age was 85.95 0.52, 53.02 1.09, 104.07 1.56 and 86.91 1.91 eggs in

RIR<sub>s</sub>, RIR<sub>c</sub>, HR and CD strains, respectively. During current year, the body weight and egg production upto 72 wks were also recorded. Egg production recorded up to 64 wks of age with the estimates of 162.99, 128.11, 180.71 and 165.36 eggs in RIR<sub>s</sub>, RIR<sub>c</sub>, HR and CD strains, respectively and the corresponding figures at 72 wks were 176.37, 141.55, 199.39 and 183.52 in RIR<sub>s</sub>, RIR<sub>c</sub>, HR and CD strains, respectively.

**Response to selection:** The RIR selected strain was maintained, evaluated, selected and regenerated for S<sub>28th</sub> generation of selection. Part period egg number up to 40-wk of age was taken as criterion of selection using Osborne family index. The ASM declined significantly to the tune of -1.00 0.29 days per generation. There was indication of highly significant positive gain in egg weight and 20 wk body weight with significant decline in 40 wk body weight.

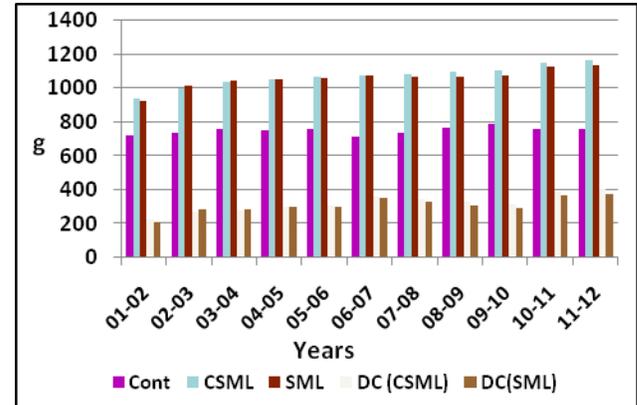
On genetic scale, the average response per generation for 40 wk egg number was observed to be highly significant and positive with the estimates of 1.05 0.14 eggs. The ASM declined significantly to the tune of -0.54 day per generation, which is not undesirable in such type of selection experiment. There has been highly significant positive genetic gain to the tune of 0.09, 11.95 and 10.54 g per generation in 40<sup>th</sup> wk egg weight, 20 and 40 wk body weights, respectively. Average regression coefficients for most of the economic traits in control population were found to be non-significant indicating its stability in eliminating the environmental trend.

### Broiler lines

So far, ten generations of selection based on 5-week body weight have been completed in Coloured Synthetic Male Line (CSML), Synthetic Male line (SML), Coloured Synthetic Female Line (CSFL) and Synthetic Dam line (SDL).

**Performance of synthetic broiler sire lines:** Fertility percentages were 81.69, 85.01 and 75.76 in CSML, SML and control lines. Hatchability percentage on TES and FES were 71.48 and 87.50, respectively in CSML and 74.67 and 87.84 in SML. In Control line, a total of 525 chicks was hatched with % fertility of 75.76 and hatchability % based on TES and FES were 59.62 and 78.70. With the genetic and phenotypic gains of 13.50 2.26 and 17.95 1.78 g/generation, CSML achieved 1162.95 2.41 g at 5-wk of age (Fig. 5). Corresponding values for SML were 10.21 3.874

and 14.577 2.601 and 1135.38 7.52 g. The phenotypic response for 5-week body weight in the control population was non-significant (3.497 1.789 g/generation) with mean of 758.57 8.18 g at 5 wk. The age at first egg in CSML and SML were 165.2 and 176 days, respectively. The average egg production up to 40 week in CSML was 63.4 eggs/bird, respectively.



**Fig. 5:** 5-weeks body weight and DC in in selected male lines and control

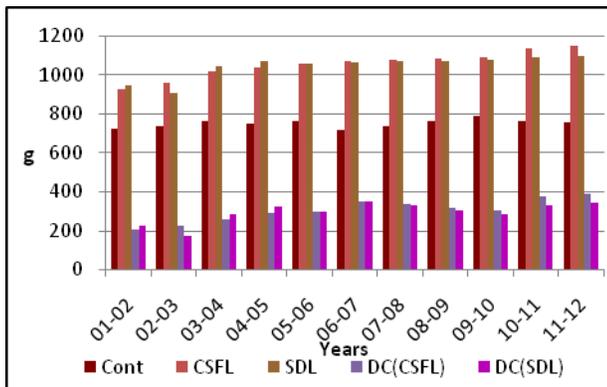
**RSPPT results:** At 37<sup>th</sup> RSPPT (Gurgaon), CARIBRO Dhanraja secured II rank by attaining 1.440 and 1.840 kg body weight at 6 and 7 weeks, respectively. FCR at 0-6 and 0-7 weeks were 1.9 and 2.0 with dressing percentage of 73.67.

**Performance of synthetic broiler dam lines:** The fertility percentage was 82.01 and hatchability percentage based on TES and FES was 69.82 and 85.30, respectively in CSFL. Corresponding values in SDL were 83.63, 73.18 and 87.5 per cent, respectively. The overall average of body weight at 5 weeks in CSFL and SDL were 1147.47±2.97 and 1099.73±3.05 g, respectively. The genetic and phenotypic responses to selection for 5-week body weight in CSFL were 14.95 2.48 and 19.39 1.90 g per generation, respectively. Corresponding values for SDL were 11.49±4.71 and 14.72±3.89 (Fig. 6).

The age at first egg in CSFL and SDL were 164.6 and 174 days, respectively. Average egg production up to 40 week in CSFL and SDL were 66.1 and 58.2 eggs/bird, respectively.

**Other broiler stocks:** The frizzle stock was crossed with naked neck for production of CARIBRO Tropicana which have both naked neck and frizzle genes. Besides, two other commercial stocks namely IC3 and IR3 are also maintained in

the Experimental Broiler Farm. The mean body weight at 5-week of age in IR-3, IC-3, CARIBRO Tropicana, naked neck coloured and naked neck white were  $1136.09 \pm 6.68$ ,  $921.01 \pm 5.49$ ,  $980.86 \pm 13.37$ ,  $1153.53 \pm 4.21$  and  $1111.06 \pm 6.39$ , respectively.



**Fig. 6:** 5-week body weight and DC in selected females lines and control

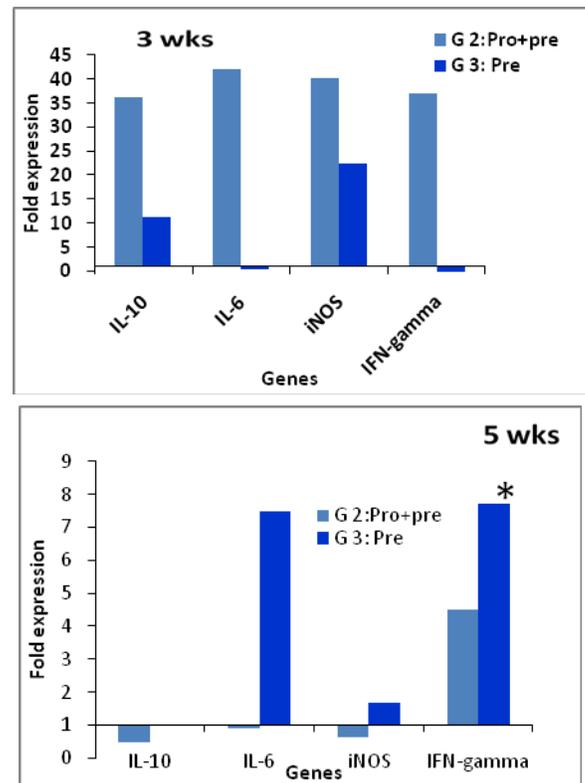
### AVIAN BIOTECHNOLOGY

The molecular analysis of differential expression revealed that the selected candidate genes were related to the appearance of plumage colour of different lines of Japanese quails. All the selected genes revealed different level of expression with respect to the differently coloured plumage, when subjected to semi-quantitative polymerase chain reaction, indicating their possible role in the colour formation or colour manipulation of the feathers in Japanese quails. But their involvement in the laying ability and egg quality of the Japanese quails needs further research and study.

### Gene expression profiling under synbiotics feeding in broilers

mRNA expression analysis of various important immunity related genes such as cytokines (IFN- $\gamma$ , IL-6 and IL-10) and iNOS genes were analysed in various organs in CSML chicks. Results revealed that at 3-week of age, combination of pre and probiotic influenced the expression of immune related genes more as compared to prebiotic alone. However, at 5-weeks of age only pre-biotic supplementation had more effect on expression profiles of immune related genes. At 3-weeks of age, IL-10 was highly upregulated in lungs in pre and probiotic combination, whereas other genes were down regulated. In thymus, picture was reverse where all the genes were upregulated. In spleen higher

upregulation of various genes was observed in prebiotic group. At 5-weeks of age all the immune related genes except IL-10 were upregulated in thymus in prebiotic group. Lungs showed upregulation of all the genes except IL-10 in both the groups. In spleen, pro-inflammatory cytokine IL-6 was highly up-regulated in prebiotic group. Influence of pre and probiotic feeding on innate immune genes such as TLR 4 and iNOS revealed that at 3 and 5 weeks of age, thymus showed the upregulation of TLR 4 gene under both the supplemented groups. At 3 weeks of age, expression of TLR 4 gene was highly upregulated in pre+probiotic feeding. Both pro and pre-biotic supplemented broiler chicken exhibited higher expression of iNOS gene at 3 weeks of age in thymus and spleen, however at 5 week only pre-biotic fed group showed upregulation (Fig. 7).



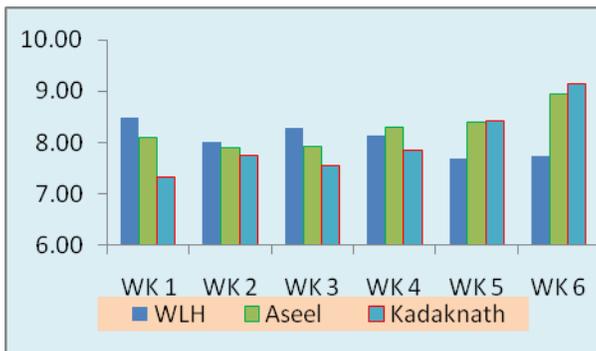
**Fig. 7:** Expression profile of various immunity related genes in thymus under different groups at 3 and 5-wks of age

Corresponding to the expression profiles of various genes higher CMI response to ND vaccine was observed in prebiotic group than in pre and probiotic group.

It is concluded, that prebiotic supplementation was better than in combination with probiotic for modulating genes and thereby indicating host genome and nutrition interaction.

### Expression profiling of genes related to immunity in Aseel, Kadakanath and WLH chickens

**Vaccine response and immunocompetence in poultry:** In WLH, the mean HI titres ( $\log_2$  antibody titre) measured at weekly intervals (1 to 6 wk) were  $8.48 \pm 0.28$ ,  $8.02 \pm 0.31$ ,  $8.29 \pm 0.33$ ,  $8.14 \pm 0.30$ ,  $7.68 \pm 0.29$  and  $7.73 \pm 0.29$ , respectively. Differences among weeks were non-significant. However, higher response was observed at first and third weeks, thereafter it revealed decreasing trend. In Aseel, the same were  $8.10 \pm 0.22$ ,  $7.89 \pm 0.18$ ,  $7.92 \pm 0.16$ ,  $8.29 \pm 0.14$ ,  $8.40 \pm 0.16$  and  $8.94 \pm 0.19$ , respectively. Differences among weeks were significant. First week exhibited some maternal response. Subsequently, from second week onwards, the trend was increasing, highest being at 6<sup>th</sup> week. In Kadakanath, mean HI titres ( $\log_2$  antibody titre) were  $7.32 \pm 0.16$ ,  $7.74 \pm 0.13$ ,  $7.56 \pm 0.13$ ,  $7.86 \pm 0.17$ ,  $8.43 \pm 0.17$  and  $9.14 \pm 0.16$ , respectively. Differences among weeks were significant. First peak was observed at 3<sup>rd</sup> week, then decrease at 4<sup>th</sup> week and continuously increasing trend thereafter (Fig. 8).



**Fig. 8:** Vaccine response to NDV vaccine as estimated by Haemagglutination (HI) test in White Leghorn, Aseel and Kadakanath chicken breeds

**Vaccine response evaluation by ELISA:** In WLH, the estimated geometric mean ELISA titres ( $\log_{10}$  antibody titre) measured at weekly intervals (1 to 6 wk) were  $3.20 \pm 0.07$ ,  $2.93 \pm 0.09$ ,  $2.60 \pm 0.12$ ,  $2.43 \pm 0.12$ ,  $2.60 \pm 0.08$  and  $2.79 \pm 0.09$ , respectively with significant ( $P < 0.01$ ) differences among weeks. There was declining trend until 4<sup>th</sup> week and inclining trend thereafter.

In Aseel, the same were  $2.20 \pm 0.11$ ,  $2.12 \pm 0.16$ ,  $2.43 \pm 0.16$ ,  $2.80 \pm 0.09$ ,  $2.82 \pm 0.09$  and  $3.04 \pm 0.08$ , respectively. Differences among weeks were significant. Having declined trend till 2<sup>nd</sup> week, there was an increasing trend in antibody response till 6<sup>th</sup> week. In Kadakanath, the mean ELISA titres were  $2.08 \pm 0.16$ ,  $2.16 \pm 0.14$ ,  $2.38 \pm 0.06$ ,  $2.50 \pm 0.12$ ,  $2.60 \pm 0.08$  and  $2.66 \pm 0.12$ , respectively. Differences among weeks were significant. There was an increasing trend in the vaccine response from first week to 6<sup>th</sup> week.

Both the methods revealed reasonably similar trends in all the three genotypes studied. Therefore, HI being a simple test may be recommended for vaccine response studies in large population.

**Immunocompetence studies:** For immunocompetence profiling of AICRP chickens, sera samples were collected from 112 IWH pure line White Leghorn (WLH) chicks at 6 weeks of age for estimation of antibody response to sheep erythrocytes and levels of serum lysozyme and IgG. The Haemagglutination titre representing humoral immune response averaged  $11.866 \pm 0.131$ . Further work is in progress.

### Sex determination in diversified poultry species by molecular method

It was attempted to develop a simple and accurate system of DNA based sexing method in some of the diversified species of poultry, viz. chicken, quail, duck, turkey and guinea fowl, employing PCR and W-chromosome specific DNA sequences as target sequences, female being a heterogametic (ZW) sex.

Overall four primers were employed. First primer pair (primer set 1) resolved only one female-specific band of approximately 415 bp, in chicken however no amplification was found in other poultry species. Second primer pair (primer set 2) resolved two bands of variable sizes in all species, whereas only one band in guinea fowl. Males in all the species resolved only one band. Third primer pair (primer set 3) resolved only one band of approximately 370 bp in all the females of all the non-ratite species; males did not reveal any amplification. Fourth primer pair (primer set 4) resolved two bands in females and only one band in males in all the non-ratite species. The sizes of common band between male and female

and female-specific band varied in different species.

A multiplex PCR was also developed as a universal method for sex differentiation in various species. It resolved two bands in females and only one band in males (common in females also) in all the species except emu, where no amplification was seen.

### **Simplification of protocol for sex determination in diversified poultry species by molecular method**

Having established successfully the PCR based sex differentiation in diversified species, it was attempted to simplify the procedure for easy adoption and exploitation. Accordingly, attempts were made to use blood lysate directly in the PCR and compare the results with those obtained by using isolated and purified DNA as template in the PCR. Primer set 3 was used in the PCR under identical PCR conditions, except that in one group purified DNA was used as template and in the second group blood lysates from same individuals were directly used as templates. The amplification revealed exactly same band patterns in both the groups. A simple, easy, rapid, cheap and universal system for molecular sexing has been developed for sex differentiation in the non-ratite poultry species and can be exploited in implementing systemic selection and breeding programmes (Fig. 9).

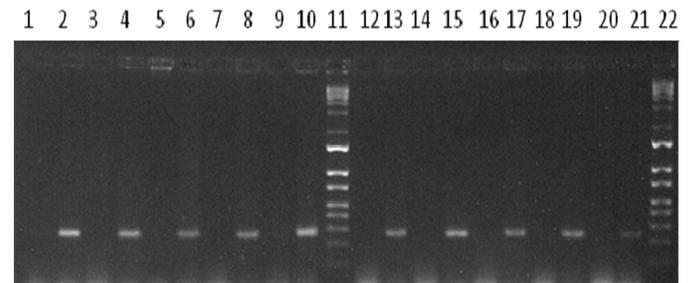
### **NUTRIENT MANAGEMENT**

#### **Ameliorating heat stress of broiler chickens through dietary approaches**

In order to ameliorate heat stress, four nutritional supplements (ascorbic acid, chromium picolinate, zinc oxide and potassium chloride) were tested in coloured broiler chickens during hot (April–May, room temperature  $31\pm 0.8^{\circ}$  to  $35\pm 1.2^{\circ}\text{C}$ , RH, %:  $59.1\pm 1.2$ - $69.6\pm 0.9$ ) and hot-humid summer (July–Sept., room temperature  $25.8\pm 0.31^{\circ}$ - $33.2\pm 0.37^{\circ}\text{C}$ , RH, %:  $85.3\pm 0.7$ - $77.0\pm 0.9$ ).

Supplementation of ascorbic acid at the rate of 150 mg/kg diet was beneficial in improving body weight gain, feed conversion efficiency, eviscerated and breast yield, immunocompetence, electrolyte balance, oxidative enzymes profile and overall welfare during extreme hot and hot-humid summer; however

feed conversion efficiency improved further at 300 mg level during hot-humid summer. The relative expression of HSP70 was down regulated in liver both in hot and hot-humid summer when ascorbic acid was added @ 150 mg/kg in diet.



**Fig. 9:** Simple, easy, rapid, cheap and universal system for molecular sexing for sex differentiation in non-ratite birds. Amplification of sex-specific sequence of 370bp (0.6 kb EcoR1 fragment, EE0.6) from different species of poultry by PCR using DNA extracted by Phenol Chloroform method (lanes from 12 to 21) and blood lysate directly (lanes from 1 to 10).

Lanes (left to right): 1. Guinea Fowl male, 2. Guinea Fowl female, 3. Duck male, 4. Duck female, 5. Turkey male 6. Turkey female, 7. Quail male, 8. Quail female, 9. Chicken male, 10. Chicken female, 11 & 22. 100 bp DNA ladder as molecular size marker, 12. Guinea Fowl male, 13. Guinea Fowl female, 14. Duck male, 15. Duck female, 16. Turkey male 17. Turkey female, 18. Quail male, 19. Quail female, 20. Chicken male, 21. Chicken female.

Dietary supplementation of chromium (as picolinate) was also beneficial. The adverse effects on growth, feed conversion, immunity and oxidative stress profile caused by high ambient temperature during extreme summer (hot and hot-humid) was partially curbed by addition of 20 mg chromium picolinate (2.49 mg Cr) per kg diet. Cr picolinate at 20 or 40 mg/kg in diet down regulated relative expression of HSP70 in liver during hot-humid summer in female birds.

Addition of zinc as zinc oxide @ 48 or 96 mg/kg to basal diets (50 and 48 mg zinc/kg) significantly improved body weight, feed conversion, immune response, oxidative stress profile, and other welfare parameters during both hot and hot-humid summer but results were more encouraging at 96 mg/kg level that too during hot-humid summer. Additional zinc down regulated expression of HSP70 in liver of female birds, while significantly up regulated expression of HSP70 in jejunum of male birds at higher level (96 mg/kg).

Supplementation of potassium chloride 300 or 600 mg (K 157.3 or 314.6 mg/kg) improved body weight, feed conversion, oxidative stress

profile, and other welfare parameters during both hot and hot-humid summer but were more beneficial during hot-humid summer. Potassium chloride at lower concentration down regulated expression of HSP70 in liver as well as jejunum of male birds.

### **Augmenting utilization of high-fibrous feedstuffs in poultry**

The efficacy of various enzyme formulations and their combinations (xylanase, multi-enzyme and phytase) were tried in broiler chickens for augmenting growth performance and nutrient utilization on maize-soybean meal-deoiled rice bran based diet. A combination of multi-enzyme and phytase was beneficial to improve growth and utilization of nutrients, though did not prove economical. However, there is scope of reducing 0.1% available P from di-calcium through phytase supplementation in diet @ 500 FTU/kg diet.

Solid state fermentation with substrate to moisture ratios (w/v) of 70:30 for wheat bran and 50:50 for de-oiled rice bran with an incubation period of 72 h at 37°C were found best for augmenting availability of protein, energy and phosphorus. Dietary incorporation of fermented wheat bran and de-oiled rice bran up to 7.5 and 5% level, respectively, found beneficial for growth performance, nutrient utilization, immune competence, gut health and feed cost of production in broiler chickens.

### **Precise nutrient supply and use of organic zinc and copper in the diets of poultry**

A dietary combination of 40 mg Zn and 16 mg Cu per/kg diet was found optimum for bone morphometry, mineralization and utilization of different minerals. However, utilization of these elements (Zn and Cu) was realized from better organic sources (propionate) than their inorganic (sulphate) counterparts.

The methodology for production of copper methionine (an organic copper supplement with 17% Cu) was successfully standardized and feeding of such copper chelate at the rate of 100 mg/kg diet was more effective in promoting growth, feed conversion, immune-competence and carcass traits and reduction of serum cholesterol in broiler quails than inorganic supplements.

### **Management of mycotoxicosis in poultry**

Efforts were made to prevent stored feedstuffs from mould growth and management of mycotoxicosis in birds through dietary approaches.

In an *in vitro* culture study with various concentrations of citric acid (0.00, 0.05, 0.10, 0.15, 0.20, 0.25, 0.30, 0.35, 0.40, 0.45 and 0.50%) each at four moisture levels (11, 13, 15 and 17%) on aflatoxin production in poultry feed, charged with spores of *Aspergillus parasiticus* NRRL 2999, for a period of one month revealed that at 13% moisture level complete inhibition of AFs was achieved at 0.45% level, while at 15 and 17% moisture levels, citric acid @ 0.50% of diet inhibited 91 and 69%, respectively.

Supplementation of butylated hydroxyl anisole (BHA-2000 ppb) or ascorbic acid (500 ppb) in the diets of broiler chickens partially ameliorated the adverse effects of aflatoxicosis (total AF 1.0 mg/kg).

Aflatoxin B1 at 300 ppb in the diet from 0-6 weeks of age impaired live weight gain, feed intake and nutrient utilization efficiency and also caused atrophy of bursa of Fabricius, hypertrophy of liver and histopathological changes of liver characterized by marked destruction of hepatic cords, dilatation, congestion of central veins, mild adenomatous necrotic foci and mild to moderate deposition of fats in the hepatic parenchyma of broiler chickens.

Diatomaceous earth, sodium bentonite and zeolite either at 0.5% or 1% level were partially or completely effective in ameliorating the different adverse effects of aflatoxin in broiler chickens. Among the above adsorbents, diatomaceous earth was less effective in comparison to sodium bentonite or zeolite. However, combination of the binders at 0.33% each was most effective in ameliorating the adverse effects of aflatoxin B1 in broiler chickens.

### **Utilization of alternate feed resources in poultry**

With the aim to explore non-conventional feedstuffs, some newer feed resources (roasted guar korma and maize germ meal) were evaluated for their feeding value in broiler chickens.

Addition of high protein (47%) roasted guar korma in isocaloric and isonitrogenous diets

at 10% level adjusted with all nutrients including amino acids did not exert any adverse effect on growth, nutrient utilization efficiency, carcass traits, and development of visceral organs, survivability and immune response of broiler chickens. High protein roasted guar korma can safely be incorporated up to 10% level in the diet of broiler chickens with affecting growth, nutrient utilization, immune competence and feed cost of broiler production.

Maize germ meal is an oil rich (ether extract 44% and protein 14.52%) byproduct, obtained during processing of maize for starch. Its dietary incorporation up to 7.5% level was found beneficial for growth performance, nutrient utilization, immune competence, and for reduction of feed-cost of broiler production. Therefore, it can be included up to 7.5% to improve dietary energy concentration.

### **Dietary manipulation for production of low cholesterol egg rich in omega-3 fatty acids**

Work was carried out on the enrichment of eggs with certain specific nutrients or agents that have functional and therapeutic properties.

A dietary combination of 0.02% Atorvastatin, 0.25% EDTA, 375 mg/kg Niacin, 250 mg/kg -tochopherol and 1.5% fish oil in laying hens diet reduced total egg yolk cholesterol by 19%. Combination of chromium (1000 µg/kg), spirulina (2 g/kg) along with -tochopherol-250 mg/kg and 1.5% fish oil had similar effect in reducing total cholesterol but it took about 30 days for beneficial effect. Supplementation of fish oil and/or spirulina in the laying hen ration was effective in enhancing n-3 fatty acids in egg yolk.

### **PHYSIOLOGICAL INTERVENTION**

#### **Molecular mechanism of ova capturing and interventions to improve egg size and number during early laying phase in broilers**

Work carried out on improving the reproductive efficiency in broiler breeder hens indicated that a gradual increase in dietary phytoestrogen supplementation around sexual maturity [20 bppm isoflavone-18 to 20 wks, 25 ppm isoflavone-20 to 22 wks and 30 ppm isoflavone-22 to 25 wks with a withdrawal period in between at 25 to 29 wks and at 32-40 wks] brought about significant advancement in age at sexual maturity of hens (Fig. 10a), enticed more

hens into the laying cycle, shifted the peak egg production phase earlier. Besides, more than 15 eggs/hen were obtained at 40 wk stage by following this dietary supplementary strategy. Likewise a fixed dosing of phytoestrogen [25 ppm isoflavone-18 to 25 wks; with a withdrawal period in between at 25 to 29 wks and at 32-40 wks] resulted in earlier sexual maturity, higher egg number with remarkably zero incidences of double yolk eggs till 30 wks (Fig. 10b) . Both these treatments increased the early rate of egg laying which was sustained throughout the trial resulting in realization of more hatchable eggs/hen.

Phytoestrogen supplementation by both regimen also optimized the egg size to desired levels suitable for hatching. As often it is observed that larger eggs from broiler breeder hens do not hatch well causing valuable loss of hatching eggs to the producer.

Phytoestrogen preparations employed in the final trial were supplemented in broiler breeder ration specifically formulated devoid of soy or soy based products. This could be the reason for the higher magnitude obtained in laying intensity when compared to results obtained in trials of preceding years. Soy free ration fed to control hens may have magnified the difference achieved in egg number. Further the dose attempted in this trial did not result in any incidence of prolapsed cases in laying hens, a feature was observed in a few hens in earlier study wherein a higher content (50 ppm) of phytoestrogen was employed. It can be generalized that through different regimens of dietary supplementation of phytohormone, a gradual physiological prioritization of maturation of reproductive events follows a specific trend i.e., first prioritizes advanced age of sexual maturity followed by increased egg number and then enlarged egg size. Further higher level supplementation may lead to induction of prolapsed cases.

#### **Evaluation and improvement of reproductive efficiency in guinea fowl and chicken**

A significant higher body and genital tract (ovary and oviduct) weight was found in breeding season in all the three varieties of guinea fowl (white, pearl and lavender). Body weight was significantly lower in white variety than others. Similar pattern was followed by ovary weight only in breeding season. Irrespective of guinea fowl

varieties, estrogen and progesterone profile was recorded more than double in breeding season than non-breeding. No significant difference was found in serum estrogen/progesterone profile among the three varieties of guinea fowl in non-breeding season. The same trend was noticed in breeding season. Total egg production (41 to 72 weeks of age) per bird recorded in white, pearl and lavender was 110, 108 and 116 eggs, respectively.

A study was carried out in order to adjust the frequency of insemination in guinea fowl to maintain maximum fertility under artificial insemination. Fertility of fresh (0 hr) and 24 hr stored semen (3-5°C) was determined using A.I. technique. Hens were inseminated once in 12 days with 100 million spermatozoa per insemination after diluting the semen with normal saline, CARI diluent, BPSE, Lake's and quail semen diluents.

At 0 hr of storage, CARI diluent expressed 88% fertility during 2-6 days of fertile period whereas other diluent showed fertility between 72-78% in the same fertile period. At 24 hr of storage of semen CARI diluent, BPSE and lake's diluent showed 59, 52 and 48% fertility, respectively during 2-6 days of fertile period.

Using 24 hr stored semen, normal saline and quail semen diluent exhibited no fertility. In comparison to 2-6 days of fertile period, a significant reduction in fertility was noticed during 7-12 days of fertile period in both freshly ejaculated and 24 hr stored semen in all the diluents examined. Overall, CARI diluent expressed good fertility than others.

### **Role of heat shock protein on the efficiency of digestive system under normal and stressed conditions in poultry**

The expression of HSP-70 gene in gastrointestinal tract (proventriculus, duodenum, jejunum and ileum) of 3 and 6 weeks old broilers was assessed under varied stressed conditions viz. heat stress: 39-41°C, RH 60% for 3 hr; feed withdrawal: 3 hr daily/4 days; restraint: 3 hrs daily/4 days. HSP-70 gene expression was up-regulated and observed highest in duodenum during all stressed conditions. Among different stress conditions, feed withdrawal appeared to be most potent stressor as evident by the significantly higher HSP-70 gene expression in

male and female broiler chickens at 3 weeks of age whereas, restraint stress was most potent at 6 week of age.

The expression of HSP-70 gene was noticed up-regulated in jejunum during heat stress condition in male and female broiler chicks in both age groups. The mRNA expression of HSP-70 gene was observed down-regulated in jejunum of heat stressed, injected with cycloheximide birds during heat stress condition in male and female of broiler chickens.

Serum glucose, cholesterol, triglyceride and total lipids were observed significantly higher under different stress condition. Total leukocyte, total erythrocyte counts, hemoglobin content and lymphocyte counts were significantly reduced whereas, heterophils and packed cell volume were increased during different stress conditions.

## **SHELTER MANAGEMENT**

### **Turkey housing and management practices**

During mild winter (Oct.-Nov.) growing turkey poults reared on river sand had about 200 g higher body weight gain (10-18 wk of age) than those reared on conventional litter (saw dust) or on combination of saw dust and rice husk. During peak winter (Dec.-Jan.) poults reared on saw dust performed comparatively better (75 g higher weight gain) than those reared on river sand (18-24 wks of age) (Fig. 11).

Turkey poults reared on saw dust and rice husk had better humoral immunity (response to SRBC expressed as log 2 titer value) than those kept on river sand or rice husk. During first six weeks of housing, moisture content of litter in river sand and combination of saw dust and rice husk was 6-9% lower than those of only rice husk or saw dust. Cost of bedding materials for entire experimental period for saw dust, rice husk, river sand and combination saw dust and rice husk were Rs. 384/-, Rs. 360/-, Rs. 240/- and Rs. 372/-, respectively.

It was concluded that river sand can be an alternate litter material during mild winter months, whereas, combination of saw dust and rice husk can be used during severe winter months for better production and immunity. Further experiment is needed during summer and rainy season.

## Introduction of Emu

Emu, one of the important poultry species of economic importance for its oil, meat, skin and feathers, is a recent introduction to the diversified poultry species maintained at this Institute. Efforts were made to provide protection against inclement winter season under semi-intensive system of rearing. This species is being maintained and regenerated for increasing its population for initiating research on shelter management, feeding, reproduction, disease pattern and reproduction particularly, optimization of artificial insemination technique, etc.



## Poultry rearing practices at high altitude

Comparative performance of Vanaraja chicks in cage and on litter system of rearing was evaluated at Mukteswar at an altitude of >2000 mmsl. In the first 4 week, body weight gain of Vanaraja chicks reared in cage was higher than those reared on litter (floor). However, the floor reared chicks had better body weight during 10-14 weeks of age. FCR was better in chicks kept in cage than on floor. No mortality was recorded in any of the housing systems. Keeping Vanaraja chicks beyond 8 weeks of age may not be economical under intensive system of rearing at high altitude.

## HEALTH MANAGEMENT

### Surveillance and monitoring of poultry diseases and bio-security measures

Different poultry species maintained at this Institute viz. chickens (layer, broiler and desi fowl), quails, turkey, guinea fowl and emu were provided health coverage both prophylactic as well as curative. Sero-surveillance, monitoring, diagnosis of disease conditions and immunity status of the different poultry species were regularly carried out and based on the prevalence

of disease condition(s) and immunity status, the health programme for different species of poultry was re-designed from time to time. Bio-security measures were further strengthened and regularly monitored.

To minimize the stress to poultry,



immunity boosters were administered from time to time and the immunity of the vaccination programme was assessed. Deworming was carried out as per the schedule. Preventive health coverage was carried out to boost the immunity of the birds. Therapeutic health programme was provided based on the disease diagnosis and immunity status of the birds. As a part of health coverage programme, hepatotonics, gut acidifiers, antibiotics, vitamins, minerals, probiotics, anti-coccidial drugs, electrolytes, immuno-modulators and water sanitizers were given to the birds as therapeutic or prophylactic agents to prevent the infection/disease.

Assessment of antibiotic sensitivity pattern was done regularly. Moreover, use of antibiotics in feed was reduced to avoid the residual effect of antibiotics in poultry egg and meat from human health point of view. Pathogen profiling was carried out regularly which included sero-surveillance of *Salmonella* and Avian Leucosis Virus. Besides, microbiological quality of poultry drinking water and poultry feed samples was also carried out regularly. Poultry wastes generated from hatchery, processing plant and dead birds were disposed off hygienically by burning in incinerator. Disinfection of all the poultry sheds was carried out regularly. Disinfection procedures were in place at the main gate of experimental complex and areas surrounding hatchery, sheds, processing unit, post-mortem unit and marketing centre and these were monitored from time to time.

## PROCESSING, VALUE ADDITION, PRODUCT SAFETY AND QUALITY PARAMETERS

### Bacterial pathogens in poultry products

Enteric pathogens, including *Salmonella* and *Campylobacter* are important from public health point of view. Chicken eggs collected from selected poultry farms located in and around Bareilly region, only 1.75% were found positive for *Salmonella* in the range of  $1 \times 10^5$  to  $1 \times 10^6$  cfu/egg. Poultry feed and drinking water were negative for *Salmonella*.

During the standardization procedure, annealing temperature of 56.2°C was found most appropriate for *hipO* gene amplification of *Campylobacter* and a PCR product of 124 bp was visualized on agarose gel electrophoresis. Subsequently, the conventional conditions standardized for annealing temperature and other reaction constituents were used in setting real-time PCR reaction. The specificity of desired product was documented using analysis of melting temperature, which is product specific and the melt curve for *Campylobacter* was found to give single peak at a temperature of 76°C.

A total of 273 chicken eggs were assessed for *Campylobacter* level which revealed that the threshold values (Ct values) during real-time PCR amplification ranged from 56 to 39. In quantitative terms, *Campylobacter* on chicken egg shell in winter months was in the range of  $1.2 \times 10^4$  to  $1.0 \times 10^5$  cfu/egg, in 5.49% positive samples (15 out of 273 eggs) with higher percentage in the month of March as compared to peak winter months (January and February). To assess the traceability of these pathogens contaminating chicken eggs in the poultry environment, samples each of poultry feed and drinking water were found negative for *Campylobacter*.

### Residues of chemical contaminants in poultry feed and products

The presence of residues of harmful chemicals in food chain has got direct bearing on the public health system. Attempt has, thus, been made to assess the poultry products for residues of common chemical contaminants like heavy metals (lead, arsenic, cadmium and molybdenum), pesticides (eldrin, dieldrin, BHC, DDT, chloropyrifos, monocrotophos,

dichlorovous) and veterinary drugs viz. tetracycline, chlortetracycline and enrofloxacin in poultry feed, eggs and tissues collected from certain locations in eastern India. Residues of metallic origin ranging from 0.15 to 0.35 ppm occurred in all samples of poultry feed, egg and tissues of poultry. Occurrence of residues of pesticides (0.01 to 0.03 ppm) was noticed in about 7% of samples with higher levels found in feed and adipose fat. Drug residues (0.01 to 0.02 ppm) were found in all the samples analysed but was relatively higher in liver samples of poultry. Among the locations of eastern region, samples collected from Kolkata and Jamshedpur contained higher levels of residues than those from other areas. The level of residues detected in samples appeared to be within the permissible limit.

### Development of poultry meat based functional foods

In view of the growing demand for functional foods, efforts were made to standardize the cost-effective and easily adoptable technology for processing functional chicken meat products. After evaluating the quality of functional chicken scroll, functional meat pellets were prepared with different levels of natural sources of Beta glucan, tocopherols and Isoflavones.

Functional chicken meat pellets containing 15% processed soya nuggets (PSN) and 5% each of processed barley flour (PBF) and sprouted green gram (SGG) was evaluated for quality characteristics during storage at refrigerated and freezing temperatures. Storage studies on physico-chemical, microbiological and sensory quality evaluation suggested that functional chicken meat pellets made with 15% PSN could be safely utilized till 2 and 6 weeks of storage under refrigeration (4 1°C) and freezing environments (-18±1 C), respectively. Functional chicken scroll made with 20% level of PSN could be safely utilized till 3 and 8 weeks of refrigeration (4 1°C) and frozen (-18±1 C) storage, respectively.

### Processing and shelf-life assessment of egg-based finished products

Developing newer egg products will expand the utilization of eggs as food ingredients and improve the egg consumption as well. Studies were thus, undertaken on development, quality evaluation and shelf-life assessment of egg *tikka*,

a nutritious and versatile snack food, ideal for the breakfast meal.

Trials were conducted to standardize the recipes and processing methodology of preparing egg *tikka*. A number of coating mixtures were tried for enrobing the boiled halved egg for preparing egg *tikka*. Based on the organoleptic evaluation results of initial trials, 3 blends were finally formulated which contained mashed potato, refined rice flour, bread crumbs, black pepper and salt at 77, 5, 15, 1.5 and 1.5% level, respectively (blend I); green gram splits paste, bread crumbs, spice mix, black pepper and salt at 76, 20, 1, 1.5 and 1.5% level, respectively (blend II); and mashed potato, green gram splits paste, refined rice flour, bread crumbs, spice mix, black pepper and salt at 60, 26.5, 5, 5, 1, 1 and 1.5% level, respectively (blend III). Coating ingredients were mixed properly. Hard cooked peeled and halved egg lengthwise were covered with the coating mixture, dipped into the beaten egg white, rolled over the bread crumbs and dip fried in refined vegetable oil at 205°C oil temperature for 3-4 min or until golden brown in colour.

Study indicated higher cooking yield in blend I than others, while no difference existed among blends II and III. Blend I had higher moisture level followed by blend III, while blend II was intermediate in moisture content. Inclusion of green gram splits paste either alone (77% in blend II) or in combination with mashed potato (26 and 60%, respectively in blend III) in coating mixture significantly increased the protein and ether extractive contents of processed egg *tikka* as compared to the group containing mashed potato alone (blend I). However, flavour of the product was adversely affected due to green gram paste inclusion. Sensory evaluation indicated that the egg *tikka* from blend I was preferred over other blends for appearance, flavour, texture and overall acceptability and was liked most overall. Incidence of Coliforms, Staphylococci and yeast and moulds were not encountered in any sample during processing. Refrigerated (4 °C) shelf-life of the most acceptable formulation i.e., blend I of egg *tikka*, based on physico-chemical (pH, TBA values, moisture, CP, EE), microbiological (APC, coliforms, staphylococci) and sensory quality evaluation was found to be 20 days under vacuum and 18 days under aerobic packaging.

Based on the market price of ingredients used, the cost of formulating one kg of processed egg *tikka* was calculated to Rs. 70.00 and for one egg *tikka* weighing about 80 g was estimated to Rs. 5.60.

## ASSESSMENT OF POULTRY PRODUCTION AS INFLUENCED BY MARKET DYNAMICS

### Economic analysis of poultry production in Kumaon hills

The eggs and majority of broilers supplied in the markets in Kumaon hill region emanated from the plains of Uttarakhand and the NCR Delhi. The family/backyard poultry rearing was quite popular and adopted by the rural masses even in the remote hill villages. The order of preference for colour chicken varieties was Kuroiler>CHABRO>CARI Nirbheek>Vanaraja reared in backyard poultry unit of 5-25 per family for 5-6 months. There was great demand for black male/female birds by the local consumers for social rituals. The feed and chicks cost accounted for 90% of total cost. The rearing cost in backyard poultry at farmers' level was Rs.168 per bird. The backyard poultry provided a gross income of Rs 5440 per family with a BC ratio 2.94 including the value of poultry products consumed by the household. Lack of finance, improper housing facilities, harsh climatic conditions and damages to standing crops caused by poultry were the major problems/constraints reported by the farmers in the backyard rearing system. They suggested that the poultry products obtained from the backyard rearing system should be marketed as organically produced products.

The NGO/KVKs introduced contract chicks rearing for promoting family/backyard poultry in Kumaon hills. The nursery operators brooded the DOCs procured from the mother hatchery under contractual arrangements for 3-4 weeks. Lack of housing facilities and technical knowledge as the main constraints caused heavy mortality during the 3-4 weeks of rearing. The average rearing cost was Rs. 43.84 per chicks for 3-4 weeks with 4% mortality (adjusted against the free chicks' allowance). The NGO and the nursery operator shared profits in 80:20 ratio along with some additional incentives to the latter for achieving lower mortality targets. The nursery operators

sold 3-4 weeks' old growers @ Rs. 50 per bird to the other members of the SHGs who were willing to adopt family poultry as an income and employment generation activity.

There was wide gap in demand of and supply of poultry products during tourists season. High transportation cost and market margin led to escalation in the prices of poultry products. Keeping in view the ever increasing demand and high prices, some farmers started the commercial broiler production in hills. They reared commercial broilers "Vencobb white" on the farms having capacity of 300-1000 per batch. The economics of commercial broilers production system was worked out (Table 1). The average DOC mortality was 13.7% on commercial broilers farms. The study concluded that the commercial broilers production had very thin profit margins with a B:C

ratio of 1.10 despite high demand and high prices of poultry products; on account of high feed cost associated with its high cost of transportation in the hilly regions. They desired government subsidy and timely support for supply of quality chicks, poultry feed and marketing infrastructural facilities for increasing profit margins.

**Poultry marketing in Kumaon hills:** The marketing channels, cost, margin, price spread and efficiency in marketing of eggs and poultry meat were studied in details.

**Marketing channels for eggs:**

- ✚ Channel I: Producer → Egg Transporter → Retailer → Consumer
- ✚ Channel II: Producer → Commission agent → Wholesaler → Distributor cum Transporter → Retailer → Consumer

**Table 1:** Economics of broiler production system in Nainital, Kumaon hills (2011-12)

<i>Particulars/parameters</i>	<i>Average per contract farm (N=6)</i>	
Broilers produced /farm/year	3417	
Variety	Vencobb (white)	
<i>Cost components (In R)</i>	<i>Total cost</i>	<i>Unit cost/broiler</i>
Cost of chicks	76,808 (23.26)	19.77
Transport cost	2,387 (0.72)	0.70
Expenses (electricity and water)	7,458 (2.26)	2.18
Vaccines and medicines	3,075 (0.93)	0.90
Labour	6,250 (1.89)	1.83
Feed cost	2,25,750 (68.39)	66.07
Depreciation	4,867 (1.47)	1.43
Maintenance of broiler shed	1,950 (0.59)	0.57
Interest on working capital	1,608 (0.49)	0.47
<b>Total cost</b>	<b>3,30,154 (100.0)</b>	<b>93.92</b>
Mortality	13.7%	
Sale of broilers	3,49,250 (96.10)	102.21
Sale of poultry manure	11,237 ( 3.22)	3.29
Sale of gunny bags	3,010 (0.68)	0.88
<b>Gross return</b>	<b>3,63,497 (100.0)</b>	<b>106.38</b>
Net profit per broiler	12.46	
<b>Benefit cost ratio (BC ratio)</b>	<b>1.10</b>	-

Note: Figures in parentheses indicate the percentage to the total cost of rearing

The total marketing cost in channel-I was Rs. 39/100 eggs, which was lower than that in channel-II (Rs. 56/100 eggs) since more market functionaries/intermediaries were involved in channel-II. Of the two channels, channel-I was considered to be more efficient as indicated by the high marketing efficiency index.

**Marketing channels for broilers:** Broilers' marketing was dominated by the unorganized wet markets and the channels involved are listed below.

- ✚ Channel I: Producer → Consumer
- ✚ Channel II: Producer → Transporter/Supplier → Retailer (fresh chicken) → Consumer
- ✚ Channel III: Producer → Commission agent → Transporter/Supplier → Retailer → Consumer

The channel-I was followed to sell coloured birds/desi reared in backyard/family poultry systems directly to the consumers. However, the product flow in this channel was meager. The most efficient and important channel for marketing of broilers was channel-II with a

transportation and poor road conditions during extreme climates. The study concluded that although the consumer's price for dressed chicken were same (Rs. 180-200/kg) in channels I and II, the producer's share in consumer's rupee was higher in channel-II (53.3%) as compared to 50.37% in channel-III.

### International poultry trade and export opportunities for Indian Poultry Sector

The Hodrick-Prescott (HP) Filter was applied to the time series for curve smoothing and filtering out the random disturbances in the series in order to obtain more robust estimates of the growth rates for studying the pattern of international trade in poultry during pre- and post- WTO periods. Having applied the HP filter on the time series data, the following results were obtained (Table 2).

It can be observed that in the post WTO period, the growth rate (CGR) figures in export of poultry products obtained from 'smoothed series' were more reasonable and statistically significant.

**Table 2:** Growth trends in exports (quantity) of India's poultry products

Items data	Over all (S.E.) Period	Coefficient (%)	CGR	R <sup>2</sup>	Pre - 1996 (Pre-WTO)			1996 -2007 (Post-WTO)		
					Coefficient (S.E.)	CGR (%)	R <sup>2</sup>	Coefficient (S.E.)	CGR (%)	R <sup>2</sup>
Chicken	1992-07 (0.042)	<b>0.32</b>	<b>37.71'</b>	0.79	-	-	-	0.18 (0.02)	<b>19.34'</b>	0.86meat
Duck	1993-07 (0.03)	<b>0.28</b>	<b>32.65'</b>	0.89	-	-	-	0.20 (0.01)	<b>22.92'</b>	0.91meat
Chicken	1986-07	<b>0.13</b> (0.01)	<b>13.65'</b>	0.76	0.30 (0.04)	<b>35.3'</b>	0.84	0.05 (neg.)	<b>4.08*</b>	0.99Canned
Hen-eggs- in-shell	1986-07	<b>0.22</b> (0.01)	<b>24.16'</b>	0.96	0.29 (0.03)	<b>34.91'</b>	0.93	0.18 (0.004)	<b>20.22'</b>	0.99
Eggs Dried	1991-07	<b>0.30</b> (0.03)	<b>35.29'</b>	0.90	-	-	-	0.21 (0.007)	<b>23.62'</b>	0.99
Live	1984-07	<b>0.02</b> (0.01)	<b>2.49'</b>	0.24	0.05 (0.01)	<b>5.54'</b>	0.82	-0.07 (0.02)	<b>-6.37**</b>	0.59chickens

'(P<0.05); \*\*(P<0.01)

marketing efficiency of 2.14. The transporters cum chicken suppliers reported losses to the extent of 5-10% attributed to shrinkage and broilers mortality due to long distance

However, the CGR figures for pre-WTO and over all periods were still too high primarily due to erratic data series as is evident from the poor

coefficients of multiple determination ( $R^2$ ) even for 'smoothed series' obtained after applying HP filter.

## **REGIONAL CENTRE, BHUBANESWAR**

### **Nutrient requirements of ducks**

Determination of the optimum level of protein in the diet of Khaki Campbell ducks during grower stage (9-16 weeks of age) and laying period revealed that a diet containing 16% CP (crude protein) was optimum for growth and nutrient utilization of Khaki Campbell ducks during grower stage. While 18% CP was optimum for nutrient utilization and egg production for Khaki Campbell ducks during layer stage. Further, 18% CP was also found optimum for early sexual maturity in female, whereas 20% CP in male ducks, diet appeared optimum for attaining earlier sexual maturity.

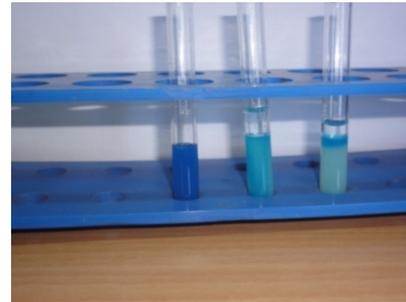
### **Disease management of ducks**

Suitable health coverage was provided in order to achieve the better survivability and productivity to 12,989 number of ducks. The overall mortality percentage was 12.54% in all the flocks, which was under stipulated mortality percentage. Breed-wise highest mortality was recorded in Khaki 5.58% followed by *Desi* (4.92%), White Pekin (1.78%) and least in Moti (0.25%) breeds. Highest mortality was due to pneumonia. In these ducks, therapeutic and prophylactic measures were undertaken for control and prevention of important duck diseases. Antibiotic sensitivity test for *Pasturella* showed maximum sensitivity to agithromycin, chloramphenicol, ciprofloxacin, enrofloxacin and ofloxacin.

### **Augmentation of fertility and hatchability in ducks**

Earlier method of semen collection in ducks by introducing a dummy female into the male's cage was modified in case of White Pekin ducks. Massaging the drake on its back and tail for 5-6 min and then squeezing the cloacal region gently helped to activate the drake for giving a thrush and to donate semen. Birds were kept inside cages and a small plastic trough full of water was provided inside the cage besides feeder and waterer fixed at the side of the cage. Collection of semen was done at one day interval. Every time

evaluation was done for semen volume, pH, motility, concentration and live percentage. Methylene Blue Reduction Test (MBRT) and Hypo-osmotic swelling tests were conducted as a means of *in vitro* fertility test.



Semen evaluation test in ducks



AI in ducks

Female laying ducks were regularly inseminated with 0.1 ml of collected neat semen (pooled) at one day interval by eversion method like chicken. Semen was deposited at anterior vagina with the help of 1 ml glass syringe. Eggs collected for seven continuous days were incubated and fertility per cent was recorded by candling the eggs on 10<sup>th</sup> day of incubation. Four such lots of eggs were incubated. Preliminary result revealed a significant increase (>5%) in fertility in White Pekin ducks over conventional floor mating.

## **NAIP SPONSORED PROJECTS**

### **Holistic approach for improving livelihood security through livestock based farming system in Barabanki and Raibareli districts of U.P.**

It is an integrated project having various components with holistic approach to improve livelihood security of identified beneficiaries of 21 villages each under two clusters viz. Trivediganj and Haidergarh of Barabanki and Raibareli districts, U.P. The salient achievements of the

poultry component part of the project are as follows:

Presently 783 farmers are engaged in the improved backyard poultry rearing under this project against the target of 500 farmers. A total of 26,843 chicks were distributed/ sold to the farmers of the project area while 21,372 chicks were distributed during the previous year. Continuous informal training was conducted on night shelter for chicks using locally available materials. Five new farmers have upgraded their poultry farm from scavenging chicken to small farm broiler production (250 to 2000 birds) during last year. Attracted by the success, more and more farmers are following its adoption.

To reduce the cost of feeding, the small flocks of scavenging chicken reared by the small poultry producers were integrated with the horticulture (fruits and vegetables). Farmers of horticulture crops were motivated for mixed farming including horticulture crops (fruits and vegetables); vermi-composting and small farm chicken production. Earthworm obtained as the by-product of the vermi-compost was also used for feeding the birds. Further, farmers were made acquainted with the importance of Azolla as natural source of poultry feed and trained for its cultivation on small scale on farmer's door and in village ponds on large scale. Both green and dried Azolla were used for feeding of the birds in addition to their scavenging and/or conventional feed.

Holistic approach for integrated farming resulted in very economical farming and helped much in improving livelihood security. Use of vermin-compost manures increased the humus of land as a result crop yield increased significantly. Birds were left in the guava, banana and other vegetable crops yard where they found plenty of land for scavenging. Availability of plenty of insects, worms and soft green forages were sufficient for their feed requirement and there was no need of additional feed supplementation. It was amazing to note that the scavenging chicken were found to control the problem of insects and pests up to nearly 80% especially in guava and banana orchard and also in some vegetable crops. Thus symbiotic relationship was observed for horticulture cropping and scavenging birds by way

of pest control for horticulture crops saving of supplementary feeding to chickens.

### **Goat husbandry based integrated approach for livelihood security in disadvantaged districts of Bundelkhand region**

A total of 325 day old guinea fowl keets were supplied to a farmer of Prem Nagar village of Mahoba district. Guinea fowl keets were grown up to eight weeks of age and were further distributed to different farmers of Bajaria village of Mahoba district. Similarly, a total of 475 eight-week old chicks of CARI Debendra variety were distributed in Sudamapuri village of Mahoba district to 21 beneficiaries for rural poultry production system. Twenty five chicks @ Rs. 5/- per chick were given to each beneficiary and 22.50 kg feed was also provided to each beneficiary for supplementary feeding (30 g feed per chick per day for 30 days).

Health care was provided through health camps and regular personal visits. The regular health camp and personal visits motivated the farmers to rear the scavenging chicken in profitable way. Provision of night shelters for chicks was made in four villages, viz. Sudamapuri, Bihuni-Khurd, Itkor and Barel.

### **Developmental potency of parthenogenetic turkey embryos**

Hormonal profile and molecular study on parthogenetic development in turkey was investigated. Black variety males had significantly higher serum testosterone level (ng/ml) than white variety males. Normal females (kept with males) and parthenogenetically derived chicks had lower testosterone level than other birds. Parthenogenetic adult males had lower testosterone levels than their counterparts (normal males) of black or white variety. Parthenogenetic females showing male behaviour had significantly lower serum progesterone (pg/ml) than those parthenogenetic females kept either on floor or cages. Among normal females (kept with males), white females had higher progesterone level than black females. Parthenogenetically developed chicks had lower progesterone level.

Expressions of PouV, Nanog and Sox2 genes were significantly lower in parthenogenetic embryos at 24 hr incubation in white variety turkey hens than that of black variety hens. Expression of these genes in embryos developed from young turkey hens was similar to that of fertile egg embryos. At 48 hr of incubation expression of all pluripotent and developmental genes in the parthenogenetically developed embryos were lower than the embryos of fertile eggs. However, among parthenogenetic embryos, those produced by black hens had higher expression of those genes than their other counterparts.

Earlier study revealed that parthenogenetic development can be induced by injection of mitogen to an extent of 12-15%. Subsequent

embryo of normal fertile eggs is concerned, Con-A treated embryos had significantly lower expressions of most of the genes in comparison to PHA-P treated or un-injected normal fertilized embryos.

### **Sustainable livelihood improvement through integrated freshwater aquaculture, horticulture and livestock development in Mayurbhanj, Keonjhar and Sambalpur districts of Odisha**

The project under NAIP (Component-3) has successfully completed two years of its operation with the main aim of improving livelihood of 3000 farm families belonging to Keonjhar, Mayurbhanj and Sambalpur district of Odisha through freshwater aquaculture, horticulture and livestock development. The operational activities of the

**Table 3:** Operational activities in three districts

<b>Activities</b>	<b>Districts</b>			<b>Total</b>
	<b>Keonjhar</b>	<b>Mayurbhanj</b>	<b>Sambalpur</b>	
No. of farmers adopted	3285	229	147	761
Units of backyard poultry initiated	247	113	26	386
Units of ducks initiated	138	116	121	375
Chicks supplied	5438	2348	536	8322
Ducklings supplied	3430	2549	2705	8684
Vaccination (R2B)	3380	2945	992	7317
Vaccination (Lassota)	5324	2109	502	7935
Farmers' trainings conducted	6	4	2	12
SHG adopted	3	2	2	7
No. of units as integrated farming	88	64	23	175

studies on *in-ovo* injection of the mitogens on the expression pattern of developmental genes shared no variation in the expression of PouV and Gata-4 between mitogen treated and un-injected (control) parthenogenetic embryos at 96 hr of incubation, but PHA-P and Con A injected parthenogenetic embryos had significantly lower expression of Nanog. Expression of Sox-2 and Sox-3 was more in Con-A injected parthenogenetic embryos in comparison to un-injected control. As far as expression of pluripotent and developmental genes in the

project during 2011-12 are summarized in Table 3.

Previous year, major emphasis was given on backyard poultry rearing and "CARI model of backyard poultry rearing" was successfully introduced. This year, the same programme was continued. However, more effort was given to popularize duck rearing in different situations of water availability which has created much interest among the farmers. A complete package of practices for duck rearing was prepared, introduced and successfully implemented in the

three districts which was named as “CARI-Model of Duck rearing in village ponds”.



Aquaculture



Maize

Integrated duck rearing

**Duck production under extensive management:** Khaki Campbell and Native cross (egg purpose) ducks were introduced under extensive management system. Proper trainings were imparted for brooding, feeding, growing and laying management. It was found that Rs. 8,000/- to 12,000/- was generated from each unit of duck per year by adopting our model. Places where no pond is available, farmers created artificial water sources by mulching the pits and putting water inside and reared the ducks successfully. This proved that ducks can be maintained with minimal water. Duck production has been integrated with aquaculture, horticulture and crop productions like rice and maize. The economic benefit is more in integrated mode than that of single cropping.

**Poultry production under free range management:** Previous year, 1007 farmers were adopted in three districts for backyard poultry production with CARI Debendra variety. This year, 375 farmers have been given support by supplying chicks and chick feed, etc. Many farmers procured the inputs from their own source generated last year and are continuing the programme. On field farmers’ trainings were organized for enlightening the farmers with disease, laying management, brooding and marketing of their products. Nearby farmers also participated on many occasions which showed the expansion of the technology horizontally.

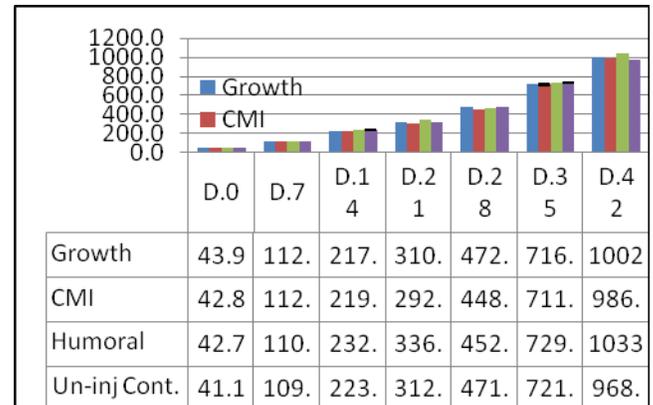


Backyard chicken rearing

## EXTERNALLY FUNDED PROJECTS

### Enhancement of post-hatch immunocompetence and growth of broiler chickens through *in-ovo* approaches (DBT sponsored)

The chicks which received *in-ovo* injection of growth and humoral nutrients and *in-ovo* ND or IBD vaccines had consistently higher body weight than un-injected control group of chicks (Fig. 12). At the marketable age (42 days) *in-ovo* treated chicks had 65-69 g higher body weight than control group.

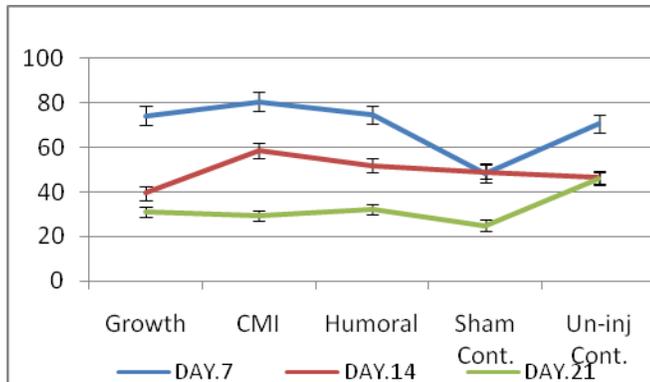


**Fig. 12:** Body weight of broiler chickens received *in-ovo* injection of different combination of nutrients and *in-ovo* ND vaccine

The antibody level to NDV vaccine expressed as PI was more than 30 during 7-21 days and only in sham control group on 21<sup>st</sup> day it was 25. The antibody level was higher in the chicks injected with CMI or Humoral group nutrients (Fig. 13). The antibody titer to IBD vaccine expressed as sample to positive ratio (S/P ratio) was significantly higher in the chicks received *in-ovo* injection of growth group of nutrients than the un-injected control group chicks on day of hatch and 7 days post-hatch. Humoral nutrient injected chicks had similar S/P ratio with that of un-injected control group chicks but better than CMI nutrient group.

Differential expression of immunity related genes viz. IL-2 ( $P < 0.09$ ) and IFN ( $P < 0.007$ ) was significantly higher in the chicks received *in-ovo* injection of growth, CMI and humoral group of nutrients and *in-ovo* IBD vaccine than the un-injected control group chicks. However, expression of IL-12 ( $P < 0.018$ ) was significantly lower in growth or CMI group chicks than humoral and un-injected control chicks. It was evident that

the humoral group of nutrients had performed better along with *in-ovo* ND or IBD vaccine.



**Fig. 13:** Per cent Inhibition (PI) to NDV antigen in *in-ovo* nutrient and *in-ovo* ND vaccinated chicks

**Post-hatch performance of *in-ovo* treated broiler stocks under small scale farming systems:**

The *in-ovo* injected chicks kept in battery brooders consistently performed better at all the periods. On 28<sup>th</sup> day around 46 g higher body weight was recorded in the chicks having *in-ovo* growth group nutrients and *in-ovo* ND and IBD vaccination and by 42 day the difference was around 100 g. FCR was better in *in-ovo* injected birds on 14<sup>th</sup> and 42 day of age. The cost of production including injection cost, feed, medication/vaccination was higher in *in-ovo* injected birds (around Rs. 3.0 more than control group). However, the net profit per bird was higher (around Rs. 4.0) in *in-ovo* injected birds. More or less similar results were obtained when such chicks were reared on floor.

Field performance of the control and *in-ovo* fed chicks reared on floor at farmer's house was not much different on 28<sup>th</sup> day in respect of body weight, however on 42<sup>nd</sup> day the *in-ovo* fed and *in-ovo* vaccinated chicks had around 45 g higher body weight than the un-injected control group.

**Application of RNAi technology for augmenting broiler production (DBT project)**

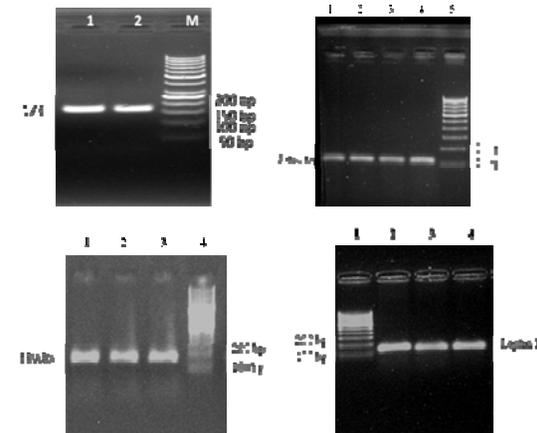
**Standardization of chicken preadipocyte cell culture:**

Abdominal adipose tissue was excised from 2-4 weeks old birds by sterile dissection following rapid decapitation and preadipocyte culture technique was standardized.

**Synthesis of shRNAs for myostatin and PPAR genes and preparation of lentiviral clones:**

shRNAs for myostatin and PPAR genes were synthesised and lentiviral clones (Sigma-Aldrich) were prepared.

**Standardization of qPCR for myostatin, -actin, PPAR and leptin R genes:** qPCR for quantification of expression of myostatin (Fig. 14a), -actin (Fig. 14b), PPAR (Fig. 14c), and leptin R (Fig. 14d) genes were standardized. The products of 173 bp, 114 bp, 199 bp and 137 bp were obtained for corresponding genes using gene specific primers (Fig. 14a to d).



**Fig. 14 (a to d):** Amplification of various genes from liver samples of broiler breeder hens

**Animal trial for standardization of dose and route of shRNA lentiviral clone of myostatin:**

The dose and route of myostatin shRNA lentiviral clone was standardized in broiler day old chicks. The dose of 4 I through i/v route was found optimum. Fluorescent microscopy of blood smear and heart tissues of representative samples from lentiviral injected and control group revealed presence of fluorescence protein in injected samples but no fluorescence in control thereby confirming the shRNA lentiviral in the tissues of injected groups.

**Expression analysis of myostatin gene in breast muscle of injected and control birds:**

The expression analysis revealed down- regulation of myostatin gene in myostatin shRNA lentiviral clone injected groups (i/v and i/m groups) than in control. However, the percent knock down in i/v route groups was higher (69.9%) than i/m group (12.04%).

**Backyard poultry and duck production as a tool to sustainable livelihood for rural women of Khurda district of Odisha (DST project)**

**Selection of farmers:** The objective of the project has been livelihood improvement through backyard poultry and duck rearing. 100 women

farmers were identified in five villages after conducting series of meetings with them. The criteria of selection were enough interest in backyard poultry rearing, the families have some members to look after the birds during her absence, she must be a landless or marginal farmer, and preference for SC and ST ladies.

For base line survey of the enlisted farmers, a questionnaire was prepared and the information collected from individual farmer regarding their family background, social status, resource, income, occupation, time utilization, previous experience about backyard poultry production, if any and accessibility to market, etc. The data so generated were analysed and summarized as below:

**Category:** S.T.: 71 nos, S.C.: 18 nos, Gen.: 11 nos

**Age group:** Below 30 yrs: 28 nos, Above 30 yrs: 82 nos

**Family income:** Less than Rs. 5000/-: 69 nos, More than Rs. 5000/-: 31 nos

**Literacy rate:** Literate: 18%, Illiterate: 82%

**Trainings:** Eight training programmes were organized at village level. Initial trainings were imparted for extending basic knowledge regarding backyard poultry and duck rearing. They were also sensitized about the benefits of such practices. Very good response was received from the selected farmers. Also five women farmers from each of the five villages were brought to the Regional Centre, CARI, Bhubaneswar for exposure visit. They were exposed to the scientific methods of poultry and duck rearing in the campus which not only enhanced their knowledge but also created more interest for this practice of their own.

**Operational activities:** Ninety five women farmers initiated backyard poultry unit with 30 day-old chicks (CARI Debendra) and five with duckary (30 day old ducklings–Khaki Campbell). Feed for brooding period, feeder and waterer were provided. The farmers had brooded the chicks and growth performances were recorded. CARI-Model of backyard poultry was fully implemented with proper health coverage. Low cost poultry houses were constructed for night shelter of the birds. All the women farmers were careful about offering

kitchen wastes regularly. It was observed that participation of women farmers were more intense in backyard poultry and duck production activity.



**Training of the farmers under DST project**

### **Augmentation of production in Naked Neck White population (*Emeritus Scientist Scheme*)**

The White Naked Neck population (NNWP) was subjected to specialized selection programme to maximize long term responses for economic traits. In present generation, this gene has shown very favourable results in pure line and cross with respect to growth rate, livability, FCR, dressing percentage, less fat content in high humid temperature. The effective population size ( $N_e$ ) was observed as 140 in NNWP, and rate of inbreeding was 0.003. The average realized response over five generations was calculated as 72.33 14.79 g in NNWP population. The heritability estimates for 3 and 5 weeks body weight ranged from moderate to high values. In another experiment, highest body temperature was exhibited by fully feathered birds and lowest by the homozygous ( $Na Na$ ) naked neck birds. Further, the result suggests significant interactions between genotype and environment on reproductive traits. This emphasizes the need for breeding programmes for improving performance under suboptimal conditions, especially exploiting Naked Neck gene with positive effects on improved productive ability.

# Technology Assessed and Transferred

## Technology Assessed

- Storage quality evaluation of functional chicken meat pellets and functional chicken scroll packed in laminated aluminum foil pouches revealed that the former product containing 15% processed soya nuggets (PSN) could be safely utilized till 2 and 6 weeks of refrigerated (4 °C) and frozen (-18 °C) storage, respectively. While the latter containing 20% PSN could be safely stored for 3 and 8 weeks under identical storage conditions.
- Technology for preparing egg *tikka* has been standardized. Egg *tikka* prepared with coatings containing mashed potato (77%), refined rice flour (5%), bread crumbs (15%), black pepper (1.5%) and salt (1.5%) was organoleptically most acceptable and had refrigerated shelf-life of 20 days in vacuum and 18 days in aerobic packaging with satisfactory microbiological and organoleptic quality. The cost of formulating egg *tikka*, at laboratory scale, was calculated as Rs. 5.60/80 g.
- Cost-effective feed formulation for quails, turkey and chicken.
- Amelioration of heat stress by certain herbs and nutritional agents.
- Nutritional package for production of designer eggs (cholesterol reduction and enrichment with fatty acids) has been assessed.
- Dietary supplementation of phytoestrogen to enhance egg production and egg weight.
- Commercial broiler farming at high altitude (<2000 mmsl) was assessed and transferred to the farmers of Kumaon region.
- Small scale backyard poultry farming with very little input and scavenging chickens integrated with the horticulture (fruits and vegetables) was assessed and transferred to the farmers of the villages of Barabanki and Raebareli districts of U.P.
- Popularization of backyard poultry and duck rearing among rural landless and marginal

farmers including integrated farming with aquaculture and horticulture as a sustainable livelihood in selected districts of Odisha.

## Extension Activities

**Farm School on Akashwani:** During the period under report, 12<sup>th</sup> Farm School on “*Kukkut Utpadan mein Ahar ka Mahatva*” was organized through Prasar Bharati, Akashwani Rampur during September 07 to October 19, 2011. A large number of farmers belonging to 7 districts of U.P. and one district of Uttarakhand had been registered for the programme. More than 70% registered farmers took active participation in the Farm School.

**Commercial Poultry Farms Established:** A total of 52 farmers started poultry farming by adopting CARI germplasm and other technologies after getting proper training provided by this Section.

**Farmer Awareness Programme:** An awareness programme on poultry farming was organized on March 23, 2012 with the active participation of CARI Scientists and the specialists of KVK, Amriya at Gajrola Farm of Pilibhit district. In this awareness meet, 29 farmers participated. Discussions/lectures between poultry scientists and farmers on scientific poultry production were held during this programme.

**Field Trials:** One field validation trial was carried out on the performance of coloured broiler developed through *in-ovo* approaches at adopted village Nawadia Harkishan, Bareilly. Besides, three on-going trials were also laid out on coloured Dhanraja broiler under AICRP at village Bujia, Daulatpur Karaina and C.B. Ganj, Bareilly.

**Farmer-Scientist Meet:** One Farmer-Scientist meet was organized on November 02, 2011 on the occasion of Foundation Day of the Institute. During the meet, lectures on commercial broiler farming, preparation of balanced broiler feed, disease management of poultry, quail farming and backyard poultry rearing were delivered by the scientists. A total number of 147 poultry farmers

**Short Term Trainings:**

<i>Name of training, date</i>	<i>No. of beneficiaries</i>	<i>Sponsoring agency/Self and venue</i>
<i>At Izatnagar Campus</i>		
<b>Short term training on poultry production management</b>		
April 25-30, 2011	20 farmers/unemployed youth	Self
August 24-29, 2011	99 army soldiers	GRTU, C/O 56 APO
	22 farmers/unemployed youth	Self
September 19-24, 2011	15 farmers/unemployed youth	ATMA, Katihar, Bihar
	6 farmers/unemployed youth	Self
October 28-November 01, 2011	14 farmers/unemployed youth	A.H. Dept., Govt. of Bihar
	19 farmers/unemployed youth	Self
January 02-07, 2012	11 farmers/unemployed youth	ATMA, Poornea, Bihar
January 16-21, 2012	15 farmers/unemployed youth	A.H. Dept., Govt. of Bihar
	2 farmers/unemployed youth	Self
February 20-25, 2012	60 army soldiers	GRTU, C/O 56 APO
	15 farmers/unemployed youth	A.H. Dept., Govt. of Bihar
	4 farmers/unemployed youth	Self
<i>At Regional Centre, Bhubaneswar</i>		
<b>Backyard poultry and duck production</b>		
April 28, 2011	40 women farmers	Jamujhari, Khurda
April 29, 2011	20 women farmers	Kukudamundi, Khurda
June 28, 2011	62 farmers	Maneswar, Sambalpur
June 29, 2011	51 farmers	Rengali, Sambalpur
August 13, 2011	20 women farmers	Dalua, Khurda
August 25, 2011	40 women farmers	Guptapada, Khurda
September 08-09, 2011	25 farmers (10 women)	Foundation for Ecological Security, Dhenkanal
October 17, 2011	20 women farmers	Mundasahi, Khurda
October 20, 2011	40 women farmers	Guptapada and Jamujhari, Khurda
October 24, 2011	20 women farmers	Kukudamundi, Khurda
October 29, 2011	40 women farmers	Dalua and Mundasahi, Khurda
December 15, 2011 (Morning)	68 adopted farmers	Udula, Mayurbhanj
December 15, 2011 (Afternoon)	59 adopted farmers	Baisinga, Mayurbhanj
December 16, 2011	74 adopted farmers	Sindurgoura, Mayurbhanj
December 19, 2011	42 farmers	A.H. Dept., Govt. of Odisha

from different district of U.P., Bihar and U.K. participated in this farmer-scientist meet.

Besides, a scientist-farmer interface meeting was also conducted at village MudiKhurd, Bareilly to motivate farmers and farm women to

take up poultry farming as source of income and employment generation.

**Press Meet on Self-Employment:** A Press Meet was organized on "Scope of Self-Employment for Youth in Poultry" on August 23, 2011 by courtesy

of Sr. Associate PR, India News Communication Ltd., Noida. A large number of national/local print and electronic media representatives attended the Meet and exchanged the views with the scientists of the Institute.

#### **Participation in Exhibitions:**

- ✚ Kisan Mela held on October 18-20, 2011 at Indian Veterinary Research Institute, Izatnagar.
- ✚ Eastern Regional Farmers Fair held on February 21, 2012 at CRRI, Cuttack.
- ✚ Krishi Vigyan Mela held on March 01-03, 2012 at IARI, Pusa, New Delhi.
- ✚ Exhibition held on March 13-15, 2011 at NASC Complex, New Delhi.

**Foundation Day Celebrations:** The 33<sup>rd</sup> Foundation Day of the Institute was celebrated on November 02, 2011 with great zeal and enthusiasm. The valedictory function of XII Farm School on AIR aired through AIR Rampur and the plenary session of short term training on poultry production management was organized on the occasion. The Chief Guest of the function distributed the cash prizes, mementoes and certificates to 15 winning farmers of Farm School programme. The cash prizes worth Rs. 25,000/- were sponsored by the courtesy of National Egg Coordination Committee (NECC), Pune. The Director along with the Guest of Honour distributed the certificates to 33 trainees, who have successfully completed the short term training on poultry production management.

**Communication through Mass media:** Several news features and press releases on the activities of the Institute were released to local and national dailies and journals, besides Doordarshan Bareilly and Akashwani Bareilly and Rampur. A number of advertisements to popularize latest commercial stocks developed by the Institute were also released to various magazines, souvenirs and newspapers.

**MoUs Signed:** Following MoUs were prepared and finalized for transfer of technologies between the Institute and various clients.

1. MoU signed for transfer of Broiler Production Technology along with supply of parent stock of CARIBRO Dhanraja on 11.05.2011

with the Deputy Director, Animal Husbandry, Intensive Poultry Development Project, Lal Bangalow, Athwa Lines, Surat, Gujarat.

2. MoU signed for transfer of Quail Production Technology along with the germplasm on 26.09.2011 with Shri Rakesh Kumar Malik, Village Sikri, Post Kumhera, Distt. Bijnor, U.P.
3. MoU signed for transfer of Broiler Production Technology along with supply of parent stock of CARIBRO Dhanraja on 05.03.2012 with the Deputy Director, Animal Husbandry, Intensive Poultry Development Block, Makarba, Ahmadabad, Gujarat.

#### **Radio Talks under XII Farm School on AIR, Akashwani Rampur:**

- Deo, C. (2011). *Ahar rupantaran chamta ko prabhavit karne wale karak*. October 19.
- Deo, C. (2011). *Kukkut ahar ki paushnik nyuntayen evam sudhar ke upay*. September 30.
- Deo, C. (2011). *Kukkut ahar mein paye jane wale poshanrodhi tatva evam unse bachao*. October 05.
- Majumdar, S. (2011). *Kukkut ahar mein milaye jane wale samanya kukkut khadya padarth evam sampurak*. September 14.
- Mandal, A.B. (2011). *Broiler murgi hetu ahar prabandhan*. September 23.
- Mandal, A.B. (2011). *Layer murgi hetu ahar prabandhan*. October 12.
- Shrivastav, A.K. (2011). *Kukkut ahar mein paye jane wale vibhinn poshak tatva evam unki mahatta*. September 09.
- Shrivastav, A.K. (2011). *Murgiyon ke liye santulit ahar sutrikaran*. October 14.
- Singh, R.P. (2011). *Kukkut utpadan mein ahar evam poshan ki mahatta*. September 07.
- Tyagi, Pramod K. (2011). *Kukkut ahar ka gunvatta niyantran*. October 07.
- Tyagi, Pramod K. (2011). *Kukkut ahar mishran evam khadya padarth tatha taiyyar ahar ka bhandaran*. September 21.

Tyagi, Praveen K. (2011). *Desi murgi hetu ahar prabandhan*. September 28.

Tyagi, Praveen K. (2011). *Kukkut ahar mein khadya yogajon ki bhoomika*. September 16.

**Other Radio Talks:**

Gangwar, L.S. (2011). *Barsat ke mausam mein murgiyon ki dekhrekh*. AIR Rampur, June 09.

Gangwar, L.S. (2012). *Murgi palan karen vaigyanik dhang se*. AIR Bareilly, February 15.

Narayan, R. (2011). *Bater palan kitana labhkar*. AIR Rampur, May 29.

Narayan, R. (2011). *Bater palan kar rozgar payen*. AIR Bareilly, September 29.

Narayan, R. (2011). *Kukkut palan ki samasyayen va samadhan*. AIR Bareilly, May 21.

Narayan, R. (2012). *Bater palan kuchh nai sambhawnayen*. AIR Bareilly, January 27.

Narayan, R. (2012). *Bater palan mein vaigyanik shodh*. AIR Rampur, February 26.

**Supply of Germ Plasm:** In order to promote diversified poultry production in the country, high yielding germplasms as parent stocks and commercial crosses were supplied to various agencies in different pockets of the country (Table 4).

**Table 4:** Supply of germplasm

Germ plasm supplied	Fertile eggs		Day-old chicks		Growers	Adults	
	Parent line	Commercial	Parent line	Commercial		Parent line	Commercial
Layer	-	215	-	6,250	-	-	-
Broiler	21,589	14,393	13,165	34,166	1,852	381	-
Desi fowl	200	-	-	15,018	-	-	46
Guinea fowl	100	-	-	-	-	-	-
Quail	-	4,200	-	-	-	5,767	1,000
Turkey	-	476	-	4,568	-	616	-
Vanaraja	-	-	-	3,377	-	104	-
Duckling	-	-	-	6,340	-	-	-

## Education and Training

Post-Graduate Education and Training (PGE&T) programme leading to Master's (MVSc) and Doctoral (PhD) degrees in Poultry Science (PSC) and National Diploma in Poultry Husbandry (NDPH) under IVRI DU, Izatnagar has been coordinated and monitored through the PGE&T Section.

### ***Poultry Science (PSC) students on roll:***

- MVSc-28, PhD-17
- NDPH-Nil

### ***Poultry Science courses offered:***

- MVSc/PhD-97 Courses of 186 Credits (55 Credits for Theory and 131 Credits for Practical)
- NDPH-24 Courses of 24 Credits (12 Credits for Theory and 12 Credits for Practical)

### ***Poultry Science (PSC) degree awarded:***

- MVSc-7 students (Post Harvest Technology-1, Avian Genetics and Breeding-3, Avian Physiology and Reproduction-2, Avian Nutrition and Feed Technology-1)
- PhD-4 students (Avian Nutrition and Feed Technology-1, Avian Physiology and Reproduction-1, Avian Genetics and Breeding-2)

***Seminars organized:*** Faculty Seminar-01, Major-14, Minor-11, ORW-08 and Pre-thesis submission-11.

### ***Specialized trainings organized:***

<b>Ser. No.</b>	<b>Name of the training course</b>	<b>Duration of training</b>	<b>Number of Participants</b>
1.	Quail Production	April 05-25, 2011	3
2.	Poultry Hatchery Operation	April 05-25, 2011	2
3.	Broiler Production	June 04-24, 2011	2
4.	Broiler Production	June 11 to July 01, 2011	2
5.	Poultry Production at High Altitude	July 25, 2011 to August 15, 2011	1
6.	Layer Production	August 02-22, 2011	6
7.	Poultry Diseases and Bio-Security Measures	September 01-21, 2011	2
8.	Quail Production	September 06-26, 2011	1
9.	Poultry Entrepreneurial Development and Project Formulation	October 04-24, 2011	1

# Awards and Recognitions

## Awards

- Based on last 10 years research contribution in the area of Animal Physiology, Dr. Jag Mohan, Principal Scientist was bestowed with Dr. D.N. Mullick Memorial award by Society of Animal Physiologists of India.
- Prof. P.K. Pani Research Award was awarded for best research article entitled "Mitochondrial genome diversity among red jungle fowl and domestic chicken" authored by S.U. Ahmed and Deepak Sharma for the year 2010 by IPSA.
- Prof. P.K. Pani Award was awarded for best Poultry Genetics Research Paper entitled "Genetic variation in hyperpigmentation of an F2 chicken population involving Kadakanath and White Rock chickens" authored by Arora, G., Mishra, S.K., Nautiyal, B., Pratap, S.O., Gupta, A., Singh, D.P., Beura, C.K. and Kataria, M.C. in IJPS.
- IPSA, Kerala Chapter Award 2011 was awarded on best research article entitled "Effect of feeding low and high tannin sorghum on carcass quality, skeletal status and histopathology in broiler chicken" authored by Prakash Sannamani, Pramod K. Tyagi, Praveen K. Tyagi, V.R.B. Sastry, A.V. Elangovan and A.B. Mandal.
- Dr. Simmi Tomar, Senior Scientist selected for Norman E. Borlaug International Agricultural Science and Technology Fellowship Programme by FAS, USDA, USA.
- The scientists of CARI Regional Centre, Bhubaneswar received Krushakabandhu Team Award for distinct contribution in NAIP-SRLs project for livelihood improvement of farm families in Keonjhar, Sambalpur and Mayurbhanja districts of Odisha.
- Drs. A.K. Mishra, M.C. Kataria, S. Kumar, N. Lal, R.K.S Bais, R.D. Sharma, Raj Narayan, Shri Ram Gopal and Shri S.K. Johari received First prize for research paper in Hindi "Uttam vyavshayik anda utpadak vibhed-CARI Priya ka grameen prashetra mein prashikshan evan mulyankan" during Hindi Pakhwara-2011 at CARI, Izatnagar.

- Drs. Chandra Deo, Praveen K. Tyagi and A.B. Mandal received Second prize for research paper in Hindi " " during Hindi Pakhwara-2011 at CARI, Izatnagar.
- Drs. V.K. Saxena, A.K. Sachdev, S. Tomar and Shri Ram Gopal received Third prize for research paper in Hindi " " during Hindi Pakhwara-2011 at CARI, Izatnagar.

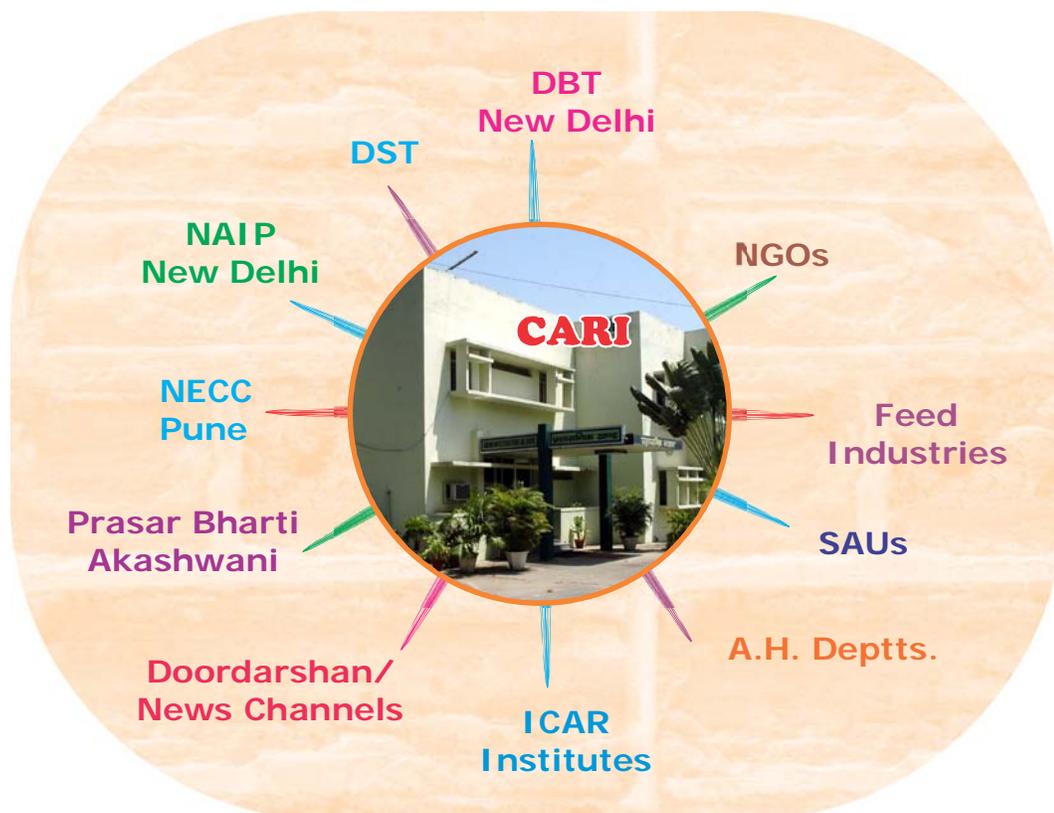
## Recognition

- Dr. V.K. Saxena – Member, Niche Area Committee of DBT, New Delhi on "Biotechnology for animal health and production quality" for the year 2011.
- Dr. V.K. Saxena - Indian Delegate in BBSRC-DBT (Indo-UK) Livestock Health and Disease Workshop held at NII, New Delhi during February 06-08, 2012 (D.E. 32-33).
- Dr. V.K. Saxena - Member, Expert Committee, "NER R&D Twinning Program", DBT, New Delhi (2011).
- Dr. D.P. Singh, Principal Scientist co-chaired the Session-7 on "Poultry science education, employment generation and nutritional security" during IPSACON 2011 held at Bihar Veterinary College, Patna from December 22-24, 2011.
- Dr. Sandeep Saran, Principal Scientist nominated as Alternate Representative on Agricultural Systems and Management Sectional Committee (FAD-22) of Bureau of Indian Standards (BIS).
- Dr. A.S. Yadav, Senior Scientist invited as member of technical expert committee in a National Workshop on "Strategies for modernizing/upgrading service abattoirs in India" under NAIP on "Value chain for clean meat production from sheep" organized on

March 16-17, 2012 by NRC on Meat, Hyderabad.

- Dr. A.S. Yadav, Senior Scientist was invited as National Resource Person on Bio-security (Animal Science) in a NAIP sponsored National Training on "Bio-security in livestock and poultry health" from December 19 to 31, 2011 organized by Centre of Animal Health Studies, TANVASU, Chennai.
- Dr. A.S. Yadav, Senior Scientist - Member, Technical Expert Committee to review the research project of Indovax, Gurgaon under SBIRI (DBT) scheme.

## Linkages and Collaborations



# List of Publications

## Research Papers

- Arora, G., Mishra, S.K., Nautiyal, B., Pratap, S.O., Gupta, A., Beura, C.K. and Singh, D.P. (2011). Genetics of hyperpigmentation associated with the Fibromelanosis gene (*Fm*) and analysis of growth and meat quality traits in crosses of native Indian Kadakanath chickens and non-indigenous breeds. *British Poult. Sci.*, 52(6): 675-85.
- Awachat, V.B., Majumdar, S., Mandal, A.B. and Bhanja, S.K. (2011). Chemical composition and microbiological quality of rendered poultry slaughter byproduct meal prepared from different types of chicken. *Indian J. Poult. Sci.*, 46: 411-14.
- Awachat, V.B., Majumdar, S., Mandal, A.B. and Bhanja, S.K. (2011). Effect of feeding rendered poultry slaughter byproduct meal on growth and immunocompetence of growing turkey poults. *Indian J. Anim. Sci.*, 82(3): 312-17.
- Awachat, V.B., Majumdar, S., Mandal, A.B. and Bhanja, S.K. (2011). Slaughter byproduct yields of poultry, their rendering into poultry byproduct meal and evaluation of its nutrient composition and aflatoxin content. *Anim. Sci. Reporter*, 5 (4): 135-40.
- Bakayaraj, S., Bhanja, S.K., Majumdar, S. and Dash, B.B. (2012). Post-hatch immunomodulation through *in ovo* supplemented nutrients in broiler chickens. *J. Sci. Food and Agric.*, 92(2): 313-20.
- Churchil, R.R., Gupta, J., Singh, A. and Sharma, D. (2011). Exogenous DNA internalization through direct uptake by sperm cells and improving the efficiency of internalization through REMI in chicken. *British Poult. Sci.*, 52(3): 287-91.
- Deo C., Shrivastava, H.P., Tyagi, Praveen K., Mandal, A.B. and Singh, D.P. (2011). Response of feeding different levels of dietary phosphorus and manganese on growth performance of CARI Red chicks. *Indian J. Poult. Sci.*, 46: 75-78.
- Deo, C., Shrivastava, H.P. Mandal, A.B., Tyagi, Praveen K. and Singh, D.P. (2011). Effect of feeding different levels dietary copper on production, performance, egg quality traits and egg cholesterol content in CARI Red layers. *Indian J. Poult. Sci.*, 46: 79-82.
- Elangovan, A.V., Mandal, A.B., Shrivastav, A.K. and Yadav, A.S. (2011). Supplementing probiotics (Gallipro) to broiler chicken on growth performance, immunity and gut microbial population. *Animal Nutr. Feed Technol.*, 11: 169-76.
- Elangovan, A.V., Mandal, A.B., Yadav, A.S. Tyagi, Praveen K., Tyagi, Pramod K. and Deo, C. (2011). Response of CARI Sonali hens to different nutritional methods of moulting. *Indian J. Poult. Sci.*, 46: 346-49.
- Elangovan, A.V., Tyagi, Praveen K., Mandal, A.B., Tyagi, Pramod K. and Deo, C. (2011). Effect of dietary supplementation of certain herbal agents and cholesterol lowering drug on egg production performance and egg quality of Japanese quail layers. *Indian J. Poult. Sci.*, 46: 316-19.
- Giri, S.C. and Sahoo, S.K. (2012). Performance of Grama Priya chickens under extensive system of management. *Indian Vet. J.* 89(12): 52-55.
- Juneja, V.K., Yadav, A.S., Hwang, C.A., Sheen, S., Mukhopadhyay, S. and Mendel Friedman, M. (2012). Kinetics of thermal destruction of *Salmonella* in ground chicken containing trans-cinnamaldehyde and carvacrol. *J. Food Protect.*, 75(2): 289-96.
- Kulkarni, R.C., Mandal, A.B., Munj, C.P., Dan Ananaya, Saxena, A. and Tyagi, Pramod K. (2011). Response of coloured broilers to dietary addition of geloi (*Tinospora cordifolia*) during extreme summer. *Indian J. Poult. Sci.*, 46: 70-74.
- Kulkarni, R.C., Shrivastava, H.P., Mandal, A.B., Deo, C., Deshpande, K.Y., Singh, R. and Bhanja, S.K. (2011). Assessment of growth performance, immune response and mineral retention in colour broilers as influenced by dietary iron. *Anim. Nutr. Feed Technol.*, 11(1): 81-90.

- Kumar, R. and Kumar, S. (2011). Immunocompetence profile of Aseel breed of native chicken. *Indian Vet. J.*, 88(8): 23-25.
- Kumar, S., Alyethodi, R.R., Sankhyan, V. and Sharma, S.K. (2011). Genetic comparison between Indian Runner and Moti native duck breeds. *Indian Vet. J.*, 88(5): 36-38.
- Kumar, S., Gaur, P. and Sharma, S.K. (2011). Genetic characterization of Kadakanath breed of Indian native chicken. *Indian Vet. J.*, 88(6): 41-42.
- Kumar, S., Anjaneyulu, A.S.R., Majumdar, S., Godekar, Y.P., Patel, A. and Singh, R.P. (2011). Physiochemical and functional parameters of black turkey, Beltsville white turkey and broiler spent hen meat. *Indian J. Poult. Sci.*, 46: 365-69.
- Kumar, S., Ciraci, C., Redmond, S.B., Chuammitri, P., Andreasen, C.B., Palic, D. and Lamont, S.J. (2011). Immune response gene expression in spleens of diverse chicken lines fed dietary immunomodulators. *Poult. Sci.* 90: 1009-13.
- Kumar, V., Elangovan, A.V., Mandal, A.B., Tyagi, Praveen K., Bhanja, S.K. and Dash, B.B. (2011). Effect of DL-methionine supplementation and high tannin red sorghum feeding on nutrient utilization and blood biochemical profile of broilers. *Indian J. Anim. Nutr.*, 28(2): 185-90.
- Maheshwari, M.S. and Gangwar, L.S. (2011). Impact of rural development scheme on availability of agricultural labour - A study of dairy farmers in Thanjavur district of Tamil Nadu. *Agril. Econ. Res. Rev.*, 24(Conf.): 409-14.
- Majumdar, S., Awachat, V.B., Tyagi, Praveen K., Mandal, A.B. and Bhanja, S.K. (2011). Hematology and serum biochemistry of growing turkey poults on feeding rendered poultry slaughter byproduct meal. *Indian J. Poult. Sci.*, 46: 194-97.
- Mishra, S.K., Khan, A.A., Narayan, R., Singh, S.P., Pratap, S.O., Saxena, D. and Chaudhuri, D. (2011). Inheritance of plumage colour variations in a large flock of Japanese quails. *British Poult. Sci.*, 52: 686-93.
- Padhi, M.K. and Sahoo, S.K. (2011). Evaluation of Native and Khaki Campbell ducks and their crosses. *Indian Vet. J.* 88(12): 54-56.
- Pandey, N.K. and Yadav, A.S. (2011). Development, quality evaluation and shelf-life of egg strips under vacuum and aerobic packaging. *Fleischwirtschaft International*, 26(2): 72-74.
- Renu, Yadav, A.S., Tripathi, V. and Singh, R.P. (2011). *Salmonella* occurrence in chicken eggs and environmental samples and their sero-prevalence in laying hens. *Indian J. Anim. Sci.*, 81(11): 1087-88.
- Renu, Yadav, A.S. and Tripathi, V. (2011). Seasonal effect on the shedding pattern of *Salmonella*, *E. coli* and *Campylobacter* in poultry. *J. Vet. Publ. Hlth.*, 9(1): 13-17.
- Satisha, K.G., Majumdar, S. and Awachat, V.B. (2011). Nutritional evaluation of goat waste as feedstuff for poultry. *Indian J. Poult. Sci.*, 46: 350-55.
- Saxena, M., Saxena, V.K., Singh, K.B., Sharma, D., Ahmed, K.A. and Kumar, S. (2011). Cloning and sequence analysis of complete interleukin-2 mRNA sequences of Indian broiler parent line chicken. *Indian J. Poult. Sci.*, 46: 148-53.
- Shariq, I., Deo, C., Mandal, A.B., Tyagi, Praveen K. and Awachat, V.B. (2011). Response of feeding different sources and concentrations of zinc and copper on performance of broiler chicken. *Indian J. Poult. Sci.*, 46: 330-36.
- Sharma, A., Kumar, S., Sharma, N. and Sharma, D. (2011). 16S rRNA PCR-RFLP for speciation of meat of porcine origin in processed and admixed meats. *Pig J.*, 65. ([www.thepigsite.com/pigjournal/volume/65/index](http://www.thepigsite.com/pigjournal/volume/65/index)).
- Shivakumar, B.M., Kumar, S., Kataria, M.C. and Singh, N.S. (2011). Selection for antibody response to sheep erythrocytes in layer birds. *Indian Vet. J.*, 88(7): 44-45.
- Singh, R. and Shrivastav, A.K. (2011). Occurrence of aflatoxins in maize feed in Bihar. *Indian J. Poult. Sci.*, 46: 341-45.
- Singh, R., Shrivastava, H.P. and Shrivastav, A.K. (2011). Effect of dietary aflatoxin on the

- performance of turkey poult. Indian J. Poult. Sci., 46: 185-88.
- Singh, R.P., Mohan, J. Sastry, K.V.H., Khanday, J.M., Sharma, D., Agarwal, R., Moudgal R.P. and Tyagi, J.S. (2011). Some production traits and egg quality characteristics of different varieties of guinea fowl hens. Indian J. Poult. Sci., 46: 374-78.
- Singh, R.P., Sastry, K.V.H., Agarwal, R. and Mohan, J. (2011). Cloacal gland foam enhances sperm transport in Japanese quail (*Coturnix coturnix japonica*). Indian J. Poult. Sci., 46: 370-73.
- Singh, R.P., Sastry, K.V.H., Agarwal, R., Pandey, N.K., Saxena, V.K. and Mohan, J. (2012). Molecular and kinetic characterization of lactate dehydrogenase enzyme in heart and breast muscle of Japanese quail (*Coturnix coturnix japonica*). Turkish J. Vet. Anim. Sci., VET-1104-27.
- Singh, R.P., Sastry, K.V.H., Pandey, N.K., Shit, N., Agarwal, R., Singh, K.B., Mohan, J., Saxena, V.K. and Moudgal, R.P. (2011). Characterization of lactate dehydrogenase enzyme in seminal plasma of Japanese quail (*Coturnix coturnix japonica*). Theriogenology, 75: 555-62.
- Singh, R.P., Sastry, K.V.H., Pandey, N.K., Shit, N., Singh, R. and Mohan, J. (2011). Sperm competition in Japanese quail (*Coturnix coturnix japonica*): Last male precedence is declined in two successive matting with two different male. Indian J. Poult. Sci., 46: 130-31.
- Singh, R.P., Sastry, K.V.H., Pandey, N.K., Shit, N.G., Agarwal, R., Singh, R., Sharma, S.K., Saxena, V.K. and Mohan, J. (2011). Molecular characterization and expression of LDHA and LDHB mRNA in testes of Japanese quail (*Coturnix coturnix japonica*). Asian-Aust. J. Anim. Sci., 24(8): 1060-68.
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- Singh, R.P., Sastry, K.V.H., Shit, N., Pandey, N.K., Singh, K.B., Mohan, J. and Moudgal, R.P. (2011). Cloacal gland foam enhances motility and disaggregation of spermatozoa in Japanese quail (*Coturnix coturnix japonica*). Theriogenology, 75: 563-69.
- Singh, R.P., Shit, N., Sastry, K.V.H., Pandey, N.K., Agarwal, R., Singh, R., Sharma, S.K., Saxena, V.K. and Mohan, J. (2011). Molecular characterization and expression of lactate dehydrogenase A and B mRNA in testes of Japanese quail (*Coturnix coturnix japonica*). Asian-Aust. J. Anim. Sci., 24: 1060-68.
- Tomar, S., Saxena, V.K. and Dhama, K. (2011). Effect of symbiotic on the performance of broilers. Indian J. Vet. Sci., 88: 27.
- Tomar, S., Saxena, V.K., Sachdev, A.K. and Gopal, R. (2011). *Vyavsayik broiler CARIBRO Dhanraja kaa vibhinn parivesh mein upaadakta moolyankan* (Hindi Shodh Patra). Bhartiya Krishi Anusandhan Patrika, 26(34).
- Tyagi, Pramod, K., Mandal, A.B. and Tyagi, Praveen K. (2011). Utilization of roasted guar (*Cyamopsis tetragonoloba*) korma in diet of broiler chicken. Indian J. Poult. Sci., 46: 326-29.
- Vasan, P., Amutha, R. and Mandal, A.B. (2011). Apparent and true digestibility of amino acids in high tannin sorghum and low tannin sorghum cultivars. Indian J. Poult. Sci., 46: 295-98.
- Yadav, A.S., Mukadam, N.V. and Mandal, A.B. (2011). Effect of Chickton on performance of broilers. Indian Vet. J., 88: 50-50.

### Research Papers presented in Conferences/Symposia/Seminars

#### 5<sup>th</sup> National Seminar on "Multi sectoral innovations for rural prosperity" held on May 19-21, 2011 at NDRI, Karnal

- Lal, N., Gupta, R. and Arya, H.P.S. Profitability of tick control technology: A perception. p. 92.
- Lal, N., Sagar, M.P., Majumdar, S. and Saran, S. Combating organic poultry husbandry: A vision. p. 165.

***Institute of Food Technologists (IFT) Annual Meeting held on June 11-14, 2011 at New Orleans, Louisiana, USA***

Juneja, V.K., Yadav, A.S., Hwang, C.A. and Sheen, S. Predictive thermal inactivation for effects of cinnamaldehyde and carvacrol. p. 86.

***International Association for Food Protection Annual Meeting-2011 held on July 31 to August 03, 2011 at Milwaukee, WI, USA***

Juneja, V.K., Yadav, A.S., Hwang, C.A. and Sheen, S. Influence of carvacrol and cinnamaldehyde on the thermal inactivation of multiple salmonella serotypes in ground chicken. p. 132.

***XVII World Congress of the World Veterinary Poultry Association held on August 14-18, 2011 at Cancun, Quintana Roo, Mexico***

Awachat, V., Majumdar, S., Mandal, A.B., Bhanja, S.K. and Tyagi, Praveen K. Effect of feeding rendered poultry slaughter byproduct meal on growth and immunocompetence of growing turkey poults. Abstr. No. WVPC/2011/Vit, p. 58.

Awachat, V., Majumdar, S., Mandal, A.B., Bhanja, S.K. and Tyagi, Praveen K. Chemical composition and microbiological quality of rendered poultry slaughter byproduct meal prepared from different types of chickens. Abstr. No. WVPC/2011/Vit, p. 59.

***16<sup>th</sup> International Workshop on Campylobacter, Helicobacter and Related Organisms (CHRO- 2011) held on August 28 to September 01, 2011 at Fairmount Hotel ,Vancouver, Canada***

Rajkumar, R.S., Yadav, A.S. and Kizhakayyil, S. *Campylobacter* contamination in small scale poultry dressing units of northern India: PCR amplification of 16s RNA gene for rapid detection. p. A73.

***XX Annual Conference of SAPI and International Symposium held on November 02-04, 2011 at Department of Veterinary Physiology, WBUAFS, Kolkata***

Agarwal, R., Sastry, K.V.H., Singh, R.P., Mohan, J., Saxena, V.K. and Moudgal, R.P. Expression profile of HSP-70 and survivin in

ovary and oviduct of WLH hens during molting induced by high zinc diet. p. 98.

Biswas, A., Mohan, J. and Sastry, K.V.H. Effect of dietary vitamin E on some biochemical characteristics of cloacal foam in male Japanese quail. p. 70.

Madhurkar, A.D., Moudgal, R.P., Mohan, J., Singh, R.P., Sastry, K.V.H., Sirajudeen, M. and Tyagi, J.S. Impact of phytoestrogens and feed restrictions at endocrine and molecular levels in regulating the reproductive functioning of broiler pullets. p. 230.

Mohan, J., Singh, R.P., Sastry, K.V.H., Moudgal, R.P., Tyagi, J.S. and Agarwal, R. Fertile period in WLH using stored and freshly ejaculated semen. p. 228.

Shit, N., Sastry, K.V.H., Agarwal, R., Singh, R., Singh, R.P., Pandey, N. and Mohan, J. Effect of stress on body weight, ovary and oviductal regression and serum biochemical profiles in Japanese quail (*Coturnix coturnix japonica*). p. 145.

Singh, R.P., Sastry, K.V.H., Agarwal, R., Mohan, J., Saxena, V.K. and Moudgal, R.P. Male cloacal gland in reproductive success in Japanese quail (*Coturnix coturnix japonica*). p. 229.

***6<sup>th</sup> NECC-2011 on "Emerging models of technology application for agri-rural development" held on December 17-19, 2011 at ICAR Research Complex, Goa***

Lal, N., Sagar, M.P., Majumdar, S., Mishra, A.K. and Narayan, R. Improvement in research quality for sustainable poultry technology development: An opinion of farmers. p. 62.

Meena, S.R., Meena, H.R., Lal, N. and Meena, K.L. Socio-economic profile of agriculture students. p. 382.

***XXVIII Annual Conference and International Symposium of Indian Poultry Science Association held on December 22-24, 2011 at Bihar Veterinary College, Patna***

Ali, H., Singh, D.P. and Rai, R.B. Integration of traditional backyard poultry with horticulture for symbiotic effects. p. 34.

Bais, R.K.S., Kataria, M.C., Mishra, A.K., Mishra, S.K. and Sharma, R.D. Genetic gains from

- family index selection for part period egg production in Rhode Island Red. Abstr. No. 1.4, p. 24.
- Bhanja, S.K., Mandal, A.B., Mishra, S.K., Majumdar, S., Goel, A., Mehra, M. and Gupta, S. Development of *in ovo* nutritional packages for post-hatch growth on immunity in broiler chickens. Abstr. No. 2.60, p. 86.
- Bhanja, S.K., Mandal, A.B., Mishra, S.K., Majumdar, S., Goel, A., Mehra, M. and Gupta, S. Feasibility of *in ovo* feeding and *in ovo* Newcastle disease or infectious bursal disease vaccination in broiler chickens. Abstr. No. 2.61, p. 87.
- Gangwar, L.S., Saran, S. and Kumar, S. Egg supply value chains in national capital region (NCR) Delhi. Abstr. No. 7.2, p. 242.
- Giri, S.C., Sahoo, S.K. and Karna, S.K. Performance of Khaki Campbell ducks under extensive system of management in Keonjhar District of Odisha in NAIP (Component-3). Abstr. No. 7.12, p. 247.
- Kulkarni, R.C., Mandal, A.B., Bhanja, S.K., Akhtar, S., Goel, A., Mehra, M. and Gupta, S. Comparative efficacy of certain herbs in diet on welfare and expression of Hsp70 during extreme summer in coloured broiler chickens. Abstr. No. 1.33, p. 37.
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## Gene Sequenced Accession Numbers Obtained

<i>Sl. No.</i>	<i>Name of the gene (bp)</i>	<i>Amplicon length obtained</i>	<i>Accession number</i>	<i>Agency role</i>	<i>Putitative biological</i>	<i>Authors</i>
<b>Chicken (Gallus gallus)</b>						
1	Gallus gallus growth hormone (CGH gene)	201	HE608816	EMBL, UK	Growth	Bhanja, S.K., Majumdar S., Mandal, A.B., Mishra, S., Goel, A. Mehra, M. and Pandey, N.
2	Insulin Like Growth Factor-1 (IGF-1) gene of Gallus gallus	203	JN942578	NCBI, USA	Growth	Bhanja, S.K., Mandal, A. B., Majumdar, S., Pandey, N., Mehra, M., Goel, A. and Sudhagar, M.
3	Insulin Like Growth Factor-2 (IGF-2) gene of Gallus gallus	215	JN942579	NCBI, USA	Growth	Bhanja, S.K., Mandal, A.B., Mishra, S., Pandey, N., Goel, A., Mehra, M. and Sudhagar, M.
4	Somatotropin gene of Gallus gallus	204	JN639853	NCBI, USA	Growth	Bhanja, S.K., Majumdar, S., Pandey, N., Goel, A., Mehra, M. and Mandal, A.B.
5	Intestinal mucin (Mucin) gene of Gallus gallus	241	JN639849	NCBI, USA	Intestinal	Bhanja, S.K., Mandal, A.B., Mehra, M., Goel, A. and Pandey, N.
6	28S rRNA, House keeping gene of Gallus gallus	273	JN639848	NCBI, USA	House keeping gene	Bhanja, S.K., Mandal, A.B., Majumdar, S., Goel, A., Mehra, M., Pandey, N., Gupta, S. and Mishra, S.
7	Beta Actin, House keeping gene of Gallus gallus	273	JN639846	NCBI, USA	House keeping gene	Bhanja, S.K., Majumdar, S., Goel, A., Mehra, M., Pandey, N. and Gupta, S.

<b>Sl. No.</b>	<b>Name of the gene (bp)</b>	<b>Amplicon length obtained</b>	<b>Accession number</b>	<b>Agency role</b>	<b>Putative biological</b>	<b>Authors</b>
8	Gallus gallus Interleukin-2, (IL-2 gene)	287	HE608819 (3'UTR region)	EMBL, UK	Cell mediated immunity	Bhanja, S.K., Pandey, N., Goel, A. and Mehra, M.
9	Interleukin-6 (IL-6) gene of Gallus gallus	219	JN639847	NCBI, USA	Humoral immunity	Bhanja, S.K., Mishra, S., Pandey, N., Mehra, M., Goel, A. and Gupta, S.
10	Interleukin-12 (IL-12) gene of Gallus gallus	227	JN942590	NCBI, USA	Cell mediated immunity	Bhanja, S.K., Mishra, S., Pandey, N., Goel, A. Mehra, M. and Sudhagar, M.
11	Interferon Gamma (IFN-Gamma) gene of gallus gallus	260	JN942588	NCBI, USA	Cell mediated immunity	Bhanja, S.K., Pandey, N., Gupta, S., Goel, A. and Mehra, M.
12	Tumor necrosis factor-alpha (TNF-Alpha) gene of gallus gallus	219	JN942589	NCBI, USA	Humoral immunity	Bhanja, S.K., Pandey, N., Gupta, S., Goel, A. and Mehra, M.
13	Interleukin-8 (IL-8) gene of Gallus gallus	280	JN942580	NCBI, USA	Humoral immunity	Bhanja, S.K., Goel, A. and Mehra, M.
14	Gallus gallus TGFB gene 3' UTR	180	HE646744	EMBL, UK	Cellular immunity	Bhanja, S.K., Goel, A. and Mehra, M.
15	Gallus gallus inducible nitric oxide synthase (inos)	203	JQ280464	NCBI, USA	Cellular immunity	Bhanja, S.K., Goel, A., Mehra, M. and Pande, V.
16	Gallus gallus toll-like receptor 2 (TLR2)	202	JQ280465	NCBI, USA	Innate immunity	Bhanja, S.K., Goel, A. and Mehra, M.
17	Gallus gallus toll-like receptor 4 (TLR4)	217	JQ280467	NCBI, USA	Innate immunity	Bhanja, S.K., Goel, A. and Mehra, M.

<b>Sl. No.</b>	<b>Name of the gene (bp)</b>	<b>Amplicon length obtained</b>	<b>Accession number</b>	<b>Agency</b>	<b>Putitative biological role</b>	<b>Authors</b>
18	Gallus gallus glyceraldehy de-3-phosphate dehydrogenase (GAPDH)	266	JQ280469	NCBI, USA	House keeping gene	Bhanja, S.K., Goel, A. and Mehra, M.
19	Gallus gallus partial mRNA for doublesex and mab-3 related transcription factor (DMRT1 gene)	187	HE608818	EMBL, UK	Sex related (Male specific)	Bhanja, S.K., Goel, A. and Mehra, M.
20	Gallus gallus anti-mullerian hormone (AMH gene)	182	HE608815	EMBL, UK	Sex related (Male specific)	Bhanja, S.K., Majumdar, S., Goel, A. and Mehra, M.
21	Transcription factor sox-9 (SOX-9) gene of Gallus gallus	234	JN639852	NCBI, USA	Sex related (Male specific)	Bhanja, S.K., Majumdar, S., Goel, A. and Mehra, M.
22	ASW gene of Gallus gallus	201	JN639850	NCBI, USA	Sex related (Female specific)	Bhanja, S.K., Majumdar, S., Mehra, M., Goel, A. and Mishra, S.
<b>Turkey (Meleagris gallopavo)</b>						
23	Insulin Like Growth Factor-1 (IGF-1) gene of Meleagris gallopavo	203	JN942587	NCBI, USA	Growth	Bhanja, S.K., Goel, A. and Mehra, M.
24	mRNA Insulin Like Growth Factor-2 (IGF-2) gene of Meleagris	215	JN942585	NCBI, USA	Growth	Bhanja, S.K., Majumdar, S., Goel, A., Mehra, M., Bag, S. and Das, B.C.
25	Intestinal mucin (Mucin) gene of Turkey	242	JN942583	NCBI, USA	GI tract develop- mnet	Bhanja, S.K., Majumdar, S., Mehra, M. and Goel, A.

<b>Sl. No.</b>	<b>Name of the gene (bp)</b>	<b>Amplicon length obtained</b>	<b>Accession number</b>	<b>Agency role</b>	<b>Putitative biological</b>	<b>Authors</b>
26	28s rRNA House Keeping Gene of Turkey	274	JN942581	NCBI, USA	House keeping	Bhanja, S.K., Majumdar, S., Mehra, M., Goel, A., Bag, S. and Das, B.C.
27	Beta Actin House Keeping Gene of Turkey	273	JN942582	NCBI, USA	House keeping	Bhanja, S.K., Majumdar, S., Mehra, M., Goel, A., Bag, S. and Das, B.C.
28	Meleagris gallopavo GATA-binding protein 4 (GATA-4)	262	JN639851	NCBI, USA	Develop-mental	Bhanja, S.K., Majumdar, S., Bag, S., Das, B.C., Goel, A. and Mehra, M.
29	Meleagris gallopavo POU domain class 5 transcription factor (POU-V)	189	HE608817	EMBL, UK	Develop-mental	Bhanja, S.K., Majumdar, S., Mehra, M., Goel, A., Bag, S. and Das, B.C.
30	Meleagris gallopavo SOX-3 transcriptional factor (Sox 3)	231	JN942586	NCBI, USA	Develop-mental	Bhanja, S.K., Mishra, S., Goel, A. and Mehra, M.
31	mRNA ASW (ASW) gene of Meleagris gallopavo	201	JN942586	NCBI, USA	Sex specific	Bhanja, S.K., Mishra, S., Goel, A. and Mehra, M.
32	Interleukin-2 (IL-2) gene of Meleagris gallopavo	288	JN942584	NCBI, USA	Cell mediated immunity	Bhanja, S.K., Goel, A. and Mehra, M.
33	Meleagris gallopavo interferon-gamma (IFN-gamma)	260	JQ280471	NCBI, USA	Cell mediated immunity	Bhanja, S.K., Goel, A. and Mehra, M.

<b>Sl. No.</b>	<b>Name of the gene (bp)</b>	<b>Amplicon length obtained</b>	<b>Accession number</b>	<b>Agency role</b>	<b>Putative biological</b>	<b>Authors</b>
34	Meleagris gallopavo glyceraldehyde -3-phosphate dehydrogenase (GAPDH)	266	JQ280470	NCBI, USA	House keeping gene	Bhanja, S.K., Goel, A. and Mehra, M.
35	Meleagris gallopavo interleukin 12 (IL-12)	227	JQ280472	NCBI, USA	Cell mediated immunity	Bhanja, S.K., Goel, A. and Mehra, M.
36	Inducible nitric oxide synthase (iNOS) of Meleagris gallopavo	203	JN942591	NCBI, USA	Immunity	Bhanja, S.K., Goel, A. and Mehra, M.
37	Meleagris gallopavo toll-like receptor 2 (TLR2)	202	JQ280468	NCBI, USA	Innate Immunity	Bhanja, S.K., Goel, A. and Mehra, M.

## Participation in Workshops, Conferences, Symposia and Meetings

<i>Date</i>	<i>Event</i>	<i>Venue</i>	<i>Participant (s)</i>
May 18-19, 2011	4 <sup>th</sup> Common Research Advisory Committee of CARI and PDP	PDP, Hyderabad	Team of Scientists
May 19-21, 2011	5 <sup>th</sup> National Seminar on "Multi sectoral innovations for rural prosperity"	NDRI, Karnal	Dr. Niranjan Lal
July 08, 2011	Workshop on "Gender dimension for manpower planning in agriculture"	Bhubaneswar	DRWA, Dr. S.C. Giri
August 01-03, 2011	MDP on "Creativity and innovation"	IIM, Lucknow	Dr. S.C. Giri
August 25, 2011	Business Opportunities Workshop organized by ZTM-BPD unit	IVRI, Izatnagar	Dr. A.B. Mandal Dr. D.P. Singh Dr. V.K. Saxena Dr. Sandeep Saran
September 02, 2011	Brainstorming Workshop on "Identifying biotechnological priorities in poultry" organized by DBT, New Delhi	CARI, Izatnagar	All the Scientists of CARI
September 19-20, 2011	National Stakeholder Consultation on climate change platform	CRIDA, Hyderabad	Dr. J.S. Tyagi
September 24, 2011	Mid-term Review-workshop on the action points of XX meeting of ICAR regional committee-II	Barrakpore, Kolkata	Dr. S.K. Mishra
September 31, 2011	Interactive Meeting on "Genomics for livestock and poultry improvement"	NBAGR, Karnal	Dr. D.P. Singh Dr. Anil K. Mishra
October 03, 2011	Interactive Meet on "Mission on backyard poultry"	CARI, Izatnagar	Dr. R.P. Moudgal Dr. D.P. Singh Dr. Jag Mohan Dr. J.S. Tyagi Dr. Sandeep Saran Dr. Raj Narayan Dr. Anil K. Mishra Dr. M. Sirajudeen
October 10-14, 2011	USDA Seminar on "Challenges of natural resource management for small-holder farmers on marginal lands" and the World Food Prize Symposium events and 2011 Laureate Award Ceremony	Des Moines, IA, USA	Dr. Simmi Tomar

<i>Date</i>	<i>Event</i>	<i>Venue</i>	<i>Participant (s)</i>
October 18, 2011	Meeting and presentation at 12 <sup>th</sup> Plan EFC formulation under Platform "Water"	NBFGR, Lucknow	Dr. S.C. Giri
November 02-04, 2011	XX Annual Conference and International Conference of SAPI	WBUA&FS, Kolkata	Dr. R.P. Moudgal Dr. Jag Mohan Dr. J.S. Tyagi
November 03-05, 2011	14 <sup>th</sup> Biennial Conference of Animal Nutrition Society of India	GBPUA&T, Pantnagar	Dr. A.B. Mandal
November 09-12, 2011	International Conference on "Innovation approaches for agricultural knowledge management"	Vigyan Bhawan and NASC Complex, New Delhi	Dr. Niranjana Lal
November 23, 2011	Annual Review meeting of DST	NIN, Hyderabad	Dr. S.C. Giri
November 28-30, 2011	XIX Annual Conference of Agricultural Economics Research Association on "Dynamics of supply and demand for labour in Indian agriculture"	AAU, Jorhat	Dr. L.S. Gangwar
December 17-19, 2011	6 <sup>th</sup> NECC-2011 on "Emerging models of technology application for agri-rural development"	ICAR Research Complex, Goa	Dr. Niranjana Lal
December 22-24, 2011	XXVIII Annual Conference of IPSACON and International National Symposium on "Rural employment generation and nutritional security through poultry production"	BVC, Patna	Dr. A.B. Mandal Dr. D.P. Singh Dr. V.K. Saxena Dr. R.K.S. Bais Dr. Chandra Deo Dr. L.S. Gangwar Dr. Simmi Tomar
January 03-07, 2012	99 <sup>th</sup> Indian Science Congress	KIIT, Bhubaneswar	Dr. S.K. Mishra Dr. R.K.S. Bais Dr. D. Mondal Dr. S.K. Sahoo Dr. S.C. Giri
January 09-10, 2011	Workshop on "Cross-farming in livestock" jointly organized by IVRI an AAU, Anand	AAU, Anand	Dr. A.B. Mandal
February 01-03, 2012	National Symposium on "Animal health vis-vis animal welfare with application of biotechnology with special reference to north east region"	CAU, Selesih, Aizwal	Dr. D. Mondal

<b><i>Date</i></b>	<b><i>Event</i></b>	<b><i>Venue</i></b>	<b><i>Participant (s)</i></b>
February 03-04, 2012	First Annual Conference of Association of Avian Health Professionals	PDP, Hyderabad	Dr. R.P. Moudgal
February 20-23, 2012	Workshop on "Project proposal development"	NAARM, Hyderabad	Dr. S.K. Mishra
February 28- Mishra	State Level Workshop on "Backyard poultry and duck production for sustainable livelihood and food security"	Centre, Bhubaneswar	CARI Regional Dr. S.K.
March 01, 2012			Dr. R.K.S. Bais Dr. D. Mondal Dr. S.K. Sahoo Dr. K.V.H. Sastry Dr. S.C. Giri
March 02, 2012	Slaughter House and Meat Industry Sectional Committee FAD 18	Bureau of Indian Standards, New Delhi	Dr. A.K. Sachdev
March 13-15, 2012	Global Conference on "Women in agriculture"	NASC Complex, New Delhi	Dr. S.K. Mishra Dr. M.P. Sagar Dr. S.K. Sahoo Dr. S.C. Giri Dr. Niranjana Lal
March 15-16, 2012	Annual Workshop of NAIP (Component-3)	Kalyani, West Bengal	Dr. S.C. Giri
March 16-17, 2011	National Workshop on "Strategies for modernizing/upgrading service abattoirs in India" under National Agricultural Innovation Project on "Value chain for clean meat production from sheep"	NRCM, Hyderabad	Dr. A.S. Yadav
March 18, 2012	Industry-Farmers-Scientist Meet on "Improving farm performances" organized by American Soybean Association and United Poultry Group	Boat Club, Nainital	Dr. A.B. Mandal
March 19-20, 2012	Annual Workshop 2012 of NAIP- Comp-4 (Basic and Strategic Research in Frontier Areas of Agricultural Science)	NASC Complex, New Delhi	Dr. S.K. Bhanja
March 26, 2012	Cost Committee of NAIP (Component-3)	KAB-II, New Delhi	Dr. S.C. Giri

## Consultancy, Patents and Commercialization of Technology

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Consultancy services were provided to the farmers and other poultry entrepreneurs from all over the country. More than 120 postal/E-mail and 1000 consultancies in person or on phone/Kisan Call Centre (Toll free number 1551) on various aspects of poultry farming were provided. Institute free publications in a large number were issued to the visiting farmers, students and other poultry entrepreneurs.

Following bankable projects were also provided for establishing poultry units to the farmers of Bareilly and Budaun districts of U.P.

- Shri Kaushal Kumar, Vill. and Post Mongar, Budaun, U.P. for preparing a bankable project for production of about 37,000 broilers per year in batches of 1,000 broilers per batch in deep litter system.
- Shri Harish Kumar Gangwar, Vill. Sanjarpur, Mirganj, Bareilly, U.P. for preparing a bankable project for production of about 48,000 broilers per year in 6 batches of 8,000 broilers per batch in deep litter system.
- Shri Rupesh Kumar, Vill. Nawadia Harkishan and Post Balipur, Bareilly, U.P. for preparing a bankable project for production of about 29,000 broilers per year in batches of 1,000 broilers every fortnight in deep litter system.
- Shri Kasim Ali, Vill. Samua, P.O. Ratna, Tehsil Nawabganj, Bareilly, U.P. for preparing a bankable project for production of about 63,800 broilers per year in a cycle of 2,200 every fortnight in deep litter system.
- Shri Nipendra K. Maurya, Vill. Jatau Patti, P.O. Bhojipura, Bareilly, U.P. for preparing a bankable project for production of about 23,200 broilers per year in a cycle of 800 broilers every fortnight in deep litter system.

## Workshops, Seminars and Farmers' Day Organized

<i>Date</i>	<i>Event</i>	<i>No. of farmer/beneficiaries</i>
<b><i>At Izatnagar Campus</i></b>		
September 02, 2011	Brainstorming Workshop on "Identifying biotechnological research priorities in poultry"	Scientists, academicians and industry people
October 10-14, 2011	Exposure visit	16 farmers nominated by ATMA, Vaishali, Bihar
November 02, 2011	33 <sup>rd</sup> Foundation day of CARI	Participants of XII Farm School, farmers and unemployed youth from Bihar, U.K. and U.P.
November 02, 2011	Farmer-scientist meet	147 poultry farmers from Bihar, U.K. and U.P.
December 28, 2011	Seminar on "Present scenario of biodiversity in domesticated poultry species and strategies for its conservation"	Scientists
February 06-08, 2012	BBSRS-DBT Livestock Health and Disease Scoping Workshop	UK delegation consisting of nine scientists and scientists from CARI
March 23, 2012	Awareness programme on poultry husbandry	29 farmers of Amariya Block, Pilibhit district, U.P.
<b><i>At Regional Centre, Bhubaneswar</i></b>		
February 28 to March 01, 2012	State level workshop on "Rural poultry and duck production for sustainable livelihood and food security"	65 farmers (NAIP, DST and NGO)

## Distinguished Visitors

<i>Date</i>	<i>Name</i>	<i>Address</i>
April 02, 2011	69 students on educational tour	G.B. Pant University of Agriculture and Technology, Pantnagar
August 19, 2011	Dr. S. Ayyappan	Secretary, DARE and DG, ICAR, New Delhi
	Prof. K.M.L. Pathak	DDG (AS), ICAR, New Delhi
September 21,	Hon'ble MLAs	Bihar Legislative Assembly, Patna, 2011 Bihar
October 13, 2011	12 farmers	ATMA, Vaishali, Bihar
November 02,	Prof. M.C. Sharma	Director and Vice Chancellor 2011 IVRI, Izatnagar
November 05, 2011	Students of Kendriya Vidyalaya	IVRI, Izatnagar
December 16, 2011	Dr. Smita Jain	Assoc. Prof. Zoology Govt. Degree College, Bareilly
February 10, 2012	Dr. Lesley Heppell and a team of 9 scientists from U.K.	Chairperson, BBSRC-DBT Livestock Health and Disease Scoping Workshop, U.K.
March 10, 2012	Prof. M.J. Modayil	Member, A.S.R.B., New Delhi
March 15, 2012	Shri Raj Kumar, IPS	DIG, Bareilly range, Bareilly

### SOME VIEWS OF DIGNITARIES

This is my second visit to CARI in the last 4 years. I have observed visible and remarkable improvement in its outputs and inputs. There is great scope for CARI research outputs reach the villages and small scale entrepreneurs. The varieties developed by CARI are extremely interesting and potential. My best wishes to the team and the Director.

**Prof. M.J. Modayil**  
Member, A.S.R.B., New Delhi

Visited CARI for the first time. Visit was quite enlightening and knowledgeable. Institute is doing good work in developing avians for human consumption. Technology transfer scheme is also working to ensure that the common man (consumer) get benefitted by technological advances. Wish very best of luck to all the scientists and officers of the Institute and their team.

**Shri Raj Kumar, IPS**  
DIG, Bareilly range, Bareilly

## Personnel (Managerial Positions)

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### Director

**Dr. A.K. Shrivastav** (Offg.)  
(upto 12.04.2011)  
**Dr. R.P. Singh** (w.e.f. 13.04.2011)

### Heads of Divisions/Sections

Division of Avian Genetics and Breeding	Dr. M.C. Kataria
Division of Avian Nutrition and Feed Technology	Dr. A.K. Shrivastav (upto 30.11.2011) Dr. A.B. Mandal (w.e.f. 01.12.2011)
Division of Avian Physiology and Reproduction	Dr. R.P. Moudgal
Division of Post-Harvest Technology	Dr. A.K. Sachdev
Poultry Housing and Management Section	Dr. S. Majumdar
Technology Transfer Section	Dr. S. Majumdar
Prioritization, Monitoring and Evaluation Section	Dr. Sandeep Saran
Poultry Economics and Agribusiness	Dr. Sandeep Saran Research Section
Post-Graduate Education and Training Section	Dr. A.B. Mandal (upto 22.01.2012) Dr. Praveen K. Tyagi (w.e.f. 23.01.2012)

### Administration

Administrative Officer	Shri H.M. Azad
Assistant Administrative Officer	Shri Shiv K. Saxena (upto 31.03.2012 F.N.)
Assistant Administrative Officer	Shri B.S. Bisht
Assistant Finance and Accounts Officer	Shri P.K. Singh

### Incharge, Regional Centre, Bhubaneswar

Dr. S.K. Mishra (w.e.f. 04.04.2011)

**LIST OF SCIENTISTS (as on 31.03.2012)****IZATNAGAR CAMPUS**

<i>Ser. Name</i>	<i>Designation</i>	<i>Ser. Name</i>	<i>Designation</i>
<i>No.</i>		<i>No.</i>	
1. Dr. R.P. Singh	Director	15. Dr. C.K. Beura	Senior Scientist
2. Dr. A.K. Sachdev	Principal Scientist	16. Dr. Raj Narayan	Senior Scientist
3. Dr. N.K. Pandey	Principal Scientist	17. Dr. L. S. Gangwar	Senior Scientist
4. Dr. R.P. Moudgal	Principal Scientist	18. Dr. Pramod K. Tyagi	Senior Scientist
5. Dr. M.C. Kataria	Principal Scientist	19. Dr. Anil K. Mishra	Senior Scientist
6. Dr. A.B. Mandal	Principal Scientist	20. Dr. A.S. Yadav	Senior Scientist
7. Dr. S. Majumdar	Principal Scientist	21. Dr. Chandra Deo	Senior Scientist
8. Dr. D.P. Singh	Principal Scientist	22. Dr. S.K. Bhanja	Senior Scientist
9. Dr. Jag Mohan	Principal Scientist	23. Dr. M.P. Sagar	Senior Scientist
10. Dr. Praveen K. Tyagi	Principal Scientist	24. Dr. Simmi Tomar	Senior Scientist
11. Dr. Jagbir S. Tyagi	Principal Scientist	25. Dr. Ram Singh	Senior Scientist
12. Dr. Sanjeev Kumar	Principal Scientist	26. Shri Ram Gopal	Scientist (SG)
13. Dr. V.K. Saxena	Principal Scientist	27. Dr. Niranjana Lal	Scientist
14. Dr. Sandeep Saran	Principal Scientist	28. Dr. M. Sirajudeen	Scientist

**REGIONAL CENTRE, BHUBANESWAR**

<i>Ser. Name</i>	<i>Designation</i>
<i>No.</i>	
1. Dr. S.K. Mishra	Principal Scientist
2. Dr. R.K.S. Bais	Principal Scientist
3. Dr. D. Mondal	Senior Scientist
4. Dr. S.K. Sahoo	Senior Scientist
5. Dr. K.V.H. Sastry	Senior Scientist
6. Dr. S.C. Giri	Senior Scientist

## Other Relevant Information

### ***Institute Research Committee (IRC) Meeting:***

The annual IRC meeting of the Institute was held on May 30-31, 2011 under the chairmanship of Dr. R.P. Singh, Director, CARI, Izatnagar. Dr. Sandeep Saran, Head, PME and Secretary IRC, conducted the meeting which was attended by all scientists of the Institute. Dr. Sandeep Saran presented brief overview of the Institute research programmes/projects which was followed by presentations by the respective divisions/sections of the Institute. The Action Taken Report (ATR) on the last year's IRC general recommendations was presented by the respective HDs and that of the project wise recommendations, by the respective PIs. During the plenary session, Chairman applauded the overall performance of the scientists which was evident from the excellent research output. He also exhorted the scientific community to work still harder to solve the problems faced by the poultry producers and Indian poultry sector. He also emphasized that project on food safety aspects of poultry products should be proposed in collaboration with SAUs/SVUs/MOFPI/ICAR Institutes etc. The project may be submitted to the Ministry of Food Processing, Govt. of India for funding.

### ***Research Advisory Committee (RAC)***

***Meeting:*** The 5<sup>th</sup> meeting of the Common RAC of CARI, Izatnagar and PDP, Hyderabad was held at PDP during May 04-05, 2011 under the chairmanship of Dr. Lalji Singh, Ex-Director, CCMB, Hyderabad. Dr. D. Thyagarajan, CAPS, TANUVAS, Chennai; Dr. A.S. Ranade, Prof. and Head, Dept. of Poultry Science, BVC, Mumbai; Dr. A.G. Khan, Ex-Professor and Head, Dept. of Poultry Science, JNKVV, Jabalpur; Dr. S.C. Gupta, ADG (AP&B), ICAR, New Delhi; Dr. R.P. Singh, Director, CARI, Izatnagar; Dr. R.N. Chatterjee, Acting Project Director, PDP, Hyderabad; Shri A. Gopal Reddy, Director, Sneha Farm (P) Ltd., Hyderabad and Dr. M.V.L.N. Raju, PS and I/C PME Cell, PDP, Hyderabad as Member Secretary attended the meeting.

Dr. R.P. Moudgal, PS and Head, P&R Division; Dr. M.C. Kataria, PS and Head, AGB

Division; Dr. A.K. Sachdev, PS and Head, PHT Division; Dr. A.B. Mandal, PS and Nodal Officer; Dr. V.K. Saxena, PS; Dr. S. Saran, PS and Head, PME Cell; Dr. S.K. Mishra, PS and I/c CARI Regional Centre, Bhubaneswar and Dr. S.K. Bhanja, Sr. Scientist from CARI presented the work done in their respective Divisions. During the session, the whole proceedings of the meeting were reviewed and several specific recommendations were made for the Institute.

### ***Institute Management Committee (IMC) Meetings:***

The 37<sup>th</sup> and 38<sup>th</sup> Institute Management Committee Meetings were held on December 28, 2011 and February 08, 2012 under the Chairmanship of Dr. R.P. Singh, Director, CARI, Izatnagar. Dr. Satish Kumar Garg, Dr. S.D. Singh, Dr. Sandeep Bhatia and Shri Ravindra Kumar as outside experts besides Dr. A.B. Mandal, Dr. Sandeep Saran, Shri P.K. Singh and Shri H.M. Azad, Member Secretary attended the meeting. The Committee was satisfied with the research activities and achievements made by this Institute. Research projects for the year 2011-12 were brought to the notice of all the members and were approved by IMC. The IMC appreciated the administration to maintain homely atmosphere, as there has been no grievance of the employees at this Institute.

***Hatchery Operations:*** With incubation/hatching capacity of about 80,000 eggs at a time, the major responsibilities of the hatchery are to hatch out the required number of replacement chicks of different pure line/pedigreed flocks pertaining to different strains of various germplasms e.g. chicken, quails, turkey, guinea fowl, etc. being maintained at the Institute and also for supply to public/private sector.

The average hatchability in various germplasms on fertile egg set (FES) basis was recorded 82.39% during 2011-12. At occasion, the highest hatchability (FES) upto 100% was also obtained in broiler chicken (Table 5).

**Table 5:** Hatching performance of various germplasms

<i>Type of birds</i>	<i>Total eggs (%)</i>	<i>Fertile eggs set (%)</i>	<i>Hatchability on total egg set (%)</i>	<i>Hatchability on fertile egg</i>	<i>Number of good chicks hatched</i>	<i>set</i>
Layer	29,971	63.14 (31.27-85.83)	55.13 (30.33-82.35)	87.31 (75.55-97.00)	16,522	
Broiler	70,913	70.50 (40.69-84.40)	60.47 (36.83-77.14)	90.02 (84.41-100.00)	45,005	
Quail	35,896	73.34 (64.37-84.33)	47.32 (34.93-58.86)	64.53 (47.35-89.28)	16,987	
Guinea Fowl	14,476	40.14 (27.25-57.06)	29.08 (9.89-47.69)	72.43 (36.28-83.95)	4,209	
Turkey	11,603	69.70 (56.71-77.40)	56.65 (39.99-65.79)	85.33 (70.51-91.32)	6,573	
Desi Fowl	35,486	67.93 (42.94-77.60)	59.62 (36.04-73.32)	87.78 (74.41-95.77)	21,158	
Commercial (TT section)	37,384	78.20 (68.84-87.72)	69.87 (58.12-81.14)	89.35 (81.88-94.37)	26,121	

Figures in parenthesis denote range

**Table 6:** Quantity of poultry products marketed

<i>Month</i>	<i>Eggs (No.)</i>			<i>Dressed poultry (kg)</i>			
	<i>Chicken</i>	<i>Quail</i>		<i>Chicken</i>	<i>Guinea fowl</i>	<i>Kadakanath</i>	
			<i>Quail</i>	<i>Turkey</i>			
April 2011	1,86,567	19,179	1152.25	86.50	17.75	72.60	5.75
May 2011	1,72,969	18,120	1468.00	128.25	-	57.00	32.75
June 2011	1,51,429	13,821	1461.75	8.75	-	56.50	-
July 2011	1,41,492	12,825	418.40	131.00	52.00	45.00	24.00
Aug. 2011	1,40,945	13,047	605.75	48.75	14.75	22.50	38.00
Sept. 2011	1,24,974	11,535	937.25	69.75	18.00	39.50	37.00
Oct. 2011	1,07,946	8,366	1011.25	115.50	3.25	23.50	13.75
Nov. 2011	1,19,271	17,105	817.20	12.00	-	26.00	12.75
Dec. 2011	1,19,565	24,205	1020.50	38.50	76.50	74.50	21.50
Jan. 2012	89,647	32,905	803.30	2.00	120.50	36.50	15.25
Feb. 2012	93,395	29,060	2568.00	-	53.00	14.50	9.00
March 2012	1,08,354	24,565	1701.50	6.50	-	29.00	23.00
<b>Total</b>	<b>15,56,554</b>	<b>2,24,733</b>	<b>13,965.15</b>	<b>647.50</b>	<b>355.75</b>	<b>497.10</b>	<b>232.75</b>

### **Agriculture Knowledge Management Unit**

**(AKMU):** The erstwhile Agricultural Research Information System (ARIS) established in 1997 in the Institute has now been named as "Agricultural Knowledge Management Unit (AKMU)". It has been instrumental in establishment and management of Local Area Network (LAN) connecting about 80 nodes for providing internet, intranet and e-mail connectivity to the scientists, officers/staff and students in the Institute. It has recently established two 4 mbps each broad band line of BSNL for internet usage in the Institute. Also, Internet connectivity was provided in the Training-cum-Guest house of the Institute.

**Library and Information Services:** During the period 2011-2012, a total of 71 new publications were added in the Library. This brings the total number of books, bound volumes of scientific journals and Poultry Science theses etc. in the library from 5517 to 5587. The library subscribed 30 journals out of which 14 were reputed foreign journals, besides, a number of scientific national and international serial publications, Annual Reports and Newsletters were received on gratis.

CARI Library, being a member of Consortium for e-resources in Agriculture (CeRA), is getting access to about more than 2000 online full text journals. In addition, document delivery request services are being exchanged with the member libraries under CeRA.

Institute Library purchased and installed Library Automation and Management software (LIBSYS 7 with Web OPAC) and preparation of library database is under process. The library provides Internet and E-Mail, CD-ROM services to the scientists/students and trainees. Meeting day-to-day requirement, Xerox facility is available in the library for staff of this Institute.

**Marketing of Poultry Products:** The detailed break-up of eggs and poultry meat sold and the net revenue generated through Marketing Centre of the Institute during the period April 2011 to March 2012 is given in Table 6-7.

**Table 7:** Net revenue generated from sale of eggs and poultry meat

<b>Commodity</b>	<b>Revenue (Rs.)</b>
Chicken eggs	37,73,042
Quail eggs	2,24,733
Chicken meat	11,51,713

Guinea fowl meat	50,097
Kadakanath meat	26,703
Quail meat	2,31,020
Turkey meat	20,764

**Total 54,78,072**

**Feed Storage and Processing:** During the period, the Feed Processing Unit of the Institute has manufactured and supplied 13,205.02 qtls. of poultry feed. Detailed break up of feed supplied to different farms/divisions/sections/units and others are shown below.

### **Project/Division Total quantity (Qtls.)**

Broiler farm	3848.4
Layer farm	4085.39
Desi fowl farm	1657.2
Quail farm	944.1
Guinea fowl farm	576.7
Turkey farm	575
AN&FT Division	56.8
P&R Division	136.5
PHM Section	257.3
TT Section	940
IVRI	41.55
NAIP	42.5
SAUs	41.58

**Total 13,205.02**

**Hindi Cell:** The meetings of Official Language Implementation Committee were held time to time for review of progressive use of Hindi in the Institute. Quarterly Reports of Official Language were sent to ICAR as well as Department of Official Language, Govt. of India. Data regarding working knowledge of Hindi and Proficiency in Hindi of the officials were updated and individual orders/instructions were issued for doing official work in Hindi for acquainted proficiency in Hindi.

Hindi workshops were organized in the Institute during the year for the administrative staff to increase the use of Hindi and acquainted the staff with Official Language Act and Rules and trained 48 administrative officials in two terms. Besides this, circulars and instructions were issued for compliance of Official Language Act and Rules in the Institute. Scientific, technical and

administrative materials were translated and typed.

Hindi Pakhwara was organized during September 14-28, 2011 in the Institute. Dr. R.P. Singh, Director, CARI addressed the staff and said that use of Hindi is not only increasing in administrative work, but also technological achievements of the Institute are spreading to the end users through research papers, lectures and other publications in Hindi. Various competitions such as essay writing, debate, typing on computer, noting/drafting, general knowledge, translation and shabdawali parichaya were conducted in the Hindi Pakhwara. Research paper writing in Hindi competition was also organized, a total of seven research papers were received and three of them were awarded as First, Second and Third and remaining four consolation prizes. Prizes were distributed in cash to competitors. A Kavi Gosthi was also organized on this occasion.

**Publication Services:** Following Institute publications were undertaken during the period under report.

- CARI Annual Report (2010-2011)
- The CARI News (2 issues)
- Kukkut Utpadan mein Ahar ka Mahatva (Book)
- Sexing of Day-old Chicks (Tech. Bulletin)

A total of 256 Saghan Kukkut Palan, 15 Adhunik Kukkut Palan, 18 Clinical Information System for Poultry, 11 Layer Cage Management, 19 Management of Commercial Layers, 15 Incubation and Hatching, 38 Poultry Housing and Management, one set of Poultry Research Priorities to 2020 and 176 Extension Leaflets were sold to the farmers, students and other interested persons. Besides, 70 Saghan Kukkut Palan and 1168 Extension Leaflets were issued to the participants of regular and sponsored training programmes as complimentary.

**Instrumentation Services:** This includes repair, service and maintenance of scientific and laboratory equipments, refrigerators, air-conditioners and other cooling appliances etc. of the Institute. In addition, maintenance of cooling unit of hatchery and layer farm, testing and verification work of newly purchased

equipments/machines and unserviceable equipments/machines of different Divisions and Sections of the Institute were also made.

#### **Human Resource Development:**

- ✚ Dr. Simmi Tomar, Sr. Scientist received 70 days foreign training on "Metagenomic analysis of GIT in broiler chicken" from September 15, 2011 to November 24, 2011 at A and M University, College Station, Texas, USA as a visiting scientist.
- ✚ Dr. D. Mondal, Sr. Scientist attended 12 days training on "Public private partnership for science and technology sector" from September 19-30, 2011 sponsored by Department of Biotechnology, GOI at Administrative Staff College of India, Hyderabad.
- ✚ Dr. Sandeep Saran, Principal Scientist attended training programme on "Half yearly progress monitoring of scientists in the ICAR" on March 03, 2012 organized by the IASRI, New Delhi.

#### **Staff Personalia:**

##### **Appointments**

- Dr. R.K.S. Bais, Senior Scientist appointed as Principal Scientist w.e.f. 08.08.2011 at CARI Regional Centre, Bhubaneswar (Odisha).
- Shri Pradeep Kumar appointed as T-1 (Lab Technician) w.e.f. 09.01.2012 at CARI Regional Centre, Bhubaneswar (Odisha).
- Shri Rakesh Jaiswara appointed as T-3 (Lab Technician) w.e.f. 20.01.2012 at CARI Regional Centre, Bhubaneswar (Odisha).

##### **Promotions**

- Shri Ram Manorath, T-7-8 (Technical Officer) promoted to the post of T-9 (Technical Officer) w.e.f. 14.10.2010.
- Shri Prem Chandra, T-5 (Technical Officer) promoted to the post of T-6 (Technical Officer) w.e.f. 06.01.2011.
- Shri Paras Nath Yadav, T-5 (Technical Officer) promoted to the post of T-6 (Technical Officer) w.e.f. 29.06.2009.
- Shri Tasnim Ahmed Khan, T-5 (Technical Officer) promoted to the post of T-6 (Technical Officer) w.e.f. 13.10.2011.

## Transfers

- ✚ Dr. S.K. Mishra, Principal Scientist transferred to CARI Regional Centre, Bhubaneswar (Odisha) on 04.04.2011.
- ✚ Dr. K.V.H. Sastry, Senior Scientist transferred to CARI Regional Centre, Bhubaneswar (Odisha) on 13.05.2011.
- ✚ Dr. Deepak Sharma, Principal Scientist relieved on 25.01.2012 (F.N.) to join his new assignment as Head, Division of Animal Genetics, IVRI, Izatnagar.

- ✚ Shri Ram Gopal, S.S.S. retired on 31.07.2011.
- ✚ Shri Vijay Dev Sharma, S.S.S. retired on 31.12.2011.
- ✚ Shri Anokhey Lal, S.S.S. retired on 31.01.2012.

## Resignations

- ✚ Resignation accepted in r/o Dr. Mintu Nath, Scientist (SS) w.e.f. 11.06.2008 (F.N.).
- ✚ Resignation accepted in r/o Dr. P.V.K. Sasidhar, Scientist (SS) w.e.f. 31.03.2009 (F.N.).

## Retirements

- ✚ Dr. A.K. Shrivastav, Principal Scientist and Head, AN&FT Division retired on 30.11.2011.
- ✚ Shri Divesh C. Garg, T-5 (Technical Officer) retired on 30.09.2011.
- ✚ Shri V.P. Yadav, T-2 retired on 30.11.2011.
- ✚ Shri Shiv Kumar Saxena, Asstt. Admn. Officer retired on 31.03.2012 (F.N.).
- ✚ Shri Ram Dayal, S.S.S. retired on 30.04.2011.

## DEMISE

Dr. D. Chaudhuri, Principal Scientist expired on 13.08.2011.

## Empowerment of Women and the Mainstreaming Gender Issues

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- Some of the simple and cost-effective technologies standardized for preparing value added egg and poultry meat products can be adopted by the unskilled and uneducated women/housewives enabling them to augment their family income and nutritional security at relatively moderate cost.
- Imparted training to the farm women under NAIP and DBT projects in the districts of Keonjhar, Mayurbhanj, Sambalpur and Khurda districts of Odisha.
- Empowering women farmers through backyard poultry and duck rearing under DST project.
- Empowering women SHGs through training, capacity building and demonstration in eight clusters of three districts of Odisha under NAIP.

## Usable Transferable Technologies

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- Technologies of processing of functional chicken roll and functional meat pellets are capable of responding to the need of health conscious society, launching of novel health foods and providing avenues of self-employment.
- Protocol for setting up of standard curve to quantify *Campylobacter* by real-time PCR technique was standardized which can be used for *Campylobacter* quantification from chicken egg surface.
- The farmers were educated about the various central/state Government poultry development schemes under which they could get loan from banks to raise capital for establishing poultry production/processing units/breeding farms/feed mills/hatchery etc.
- Backyard poultry and duck farming as a sustainable tool for landless and marginal farmers.
- Artificial insemination in ducks.
- Formulation of low cost feed for backyard poultry.

## Approved On-Going Research Projects (2011-2012)

Sl. No.	Project Code No.	Project Title	Principal Investigator	Co-Investigator
<b>PROGRAMME-1: PRODUCTIVITY INCREASE IN SELECTED AVIAN SPECIES</b>				
<b>Sub Programme - (i) Conventional and MAS for important economic traits</b>				
1.	P-1/2007/2-IAV/L10/6510 DOS: 01.09.2007 DOC: 01.09.2012	Development and improvement of specialized quail lines using alternate feather colour genes	Dr. Raj Narayan	Dr. D.P. Singh Dr. S.K. Mishra (till 24.09.2011) Dr. Anil Kumar
2	P-1/2009/1-IAV/L10/L30/6100 DOS: 01.06.2009 DOC: 31.05.2013	Analysis of gene expression, growth and immunity traits in broilers under pro and pre-biotics feeding	Dr. (Mrs) Simmi Tomar	Dr. V.K. Saxena
3.	P-1/2010/1-IAV/L10/6100 DOS: 01.06.2010 DOC: 31.05.2013	Expression profiling of genes related to immunity in Aseel, Kadakanath and WL chickens	Dr. Sanjeev Kumar	Dr. V.K. Saxena Dr. K.V.H. Sastry (till 24.09.2011) Dr. M.C. Kataria (w.e.f. 01.06.2011)
4.	P-1/2006/1-IAV/L10/6100/9610/ WL (Component-AICRP-PB, Hyderabad) DOS: 01.04.2006 DOC: 31.03.9999	Improvement of poultry for egg production	Dr. M.C. Kataria	Shri Ram Gopal Dr. Sanjeev Kumar Dr. R.K.S. Bais (till 06.08.2011) Dr. Anil Kumar Dr. Niranjan Lal
5.	P-1/85/95/1-IAV/L10/6100/9705 (Component-AICRP-PB, Hyderabad) DOS: 01.04.1985 DOC: 31.03.9999	Development and evaluation of synthetic broiler sire line	Dr. (Mrs) Simmi Tomar	Dr. V.K. Saxena Shri Ram Gopal Dr. A.K. Sachdev
6.	P-1/85/95/2-IAV/L10/6100/9705 (Component-AICRP-PB, Hyderabad) DOS: 01.04.1985 DOC: 31.03.9999	Development and evaluation of synthetic broiler dam line	Dr. V.K. Saxena	Dr. (Mrs) Simmi Tomar Dr. A.K. Sachdev
7.	P-1/2011/1-IAV/L10/6100/9705/ RIR DOS: 01.06.2011 DOC: 31.05.2016	Improvement of Rhode Island Red for development of multicoloured strains for rural poultry production	Dr. Anil K. Mishra	Dr. M.C. Kataria Dr. Sanjeev Kumar Dr. Raj Narayan
8.	P-1/2007/1-IAV/L10/6400 DOS: 01.08.2007 DOC: 30.08.2011	Differential expression studies for some important genes influencing disease resistance in guinea fowl	Dr. Deepak Sharma	-
<b>Sub Programme - (ii) Nutrient balancing using conventional and alternate feed resources</b>				
1.	P-1/2008/1-IAV/L30/6100 DOS: 01.06.2008 DOC: 30.06.2012	Studies on nutritional and pharmacological levels of copper for poultry	Dr. Chandra Deo	Dr. Praveen K. Tyagi
2.	P-1/2008/1-IAV/L30/6200 DOS: 01.12.2008 DOC: 30.11.2013	Nutrient requirements of ducks	Dr. S.K. Sahoo	Dr. S.C. Giri Dr. D. Mondal

3.	P-1/2007/1-IAV/L30/8959 DOS: 01.06.2007 DOC: 30.06.2012	Augmenting nutrient utilization of alternate feed resources in poultry	Dr. Pramod K. Tyagi	Dr. A.K. Shrivastav (till 30.11.2011) Dr. Praveen K. Tyagi (till 03.10.2011)
4.	P-1/2007/1-IAV/L30/9642-9644 DOS: 01.04.2007 DOC: 31.03.2012	Dietary manipulation of external and internal egg quality	Dr. Praveen K. Tyagi	Dr. A.K. Shrivastav (till 30.11.2011) Dr. Pramod K. Tyagi Dr. Chandra Deo
5.	P-1/2009/2-IAV/L30/6000-3790 DOS: 01.04.2009 DOC: 31.03.2015	Maximizing nutrient utilization and welfare of poultry through precise nutrient supply and application of biotechnology	Dr. A.B. Mandal	Dr. Pramod K. Tyagi Dr. A.S. Yadav Dr. Chandra Deo Dr. S.K. Bhanja Dr. Ram Singh
6.	P-1/2010/1-IAV/L34/3745/6000 DOS: 01.06.2010 DOC: 31.05.2013	Management of mycotoxicosis in poultry	Dr. Ram Singh	Dr. A.K. Shrivastav (till 30.11.2011)
<b>Sub Programme - (iii) Physiological interventions to enhance and sustain productivity under normal and stressed conditions</b>				
1.	P-1/2008/1-IAV/L50/6100 DOS: 01.04.2008 DOC: 31.03.2012	Molecular mechanism of ova capturing and interventions to improve egg size and number during early laying phase in broilers	Dr. R.P. Moudgal	Dr. Jagbir Singh Tyagi Dr. Jag Mohan Dr. M. Sirajudeen
2.	P-1/2010/1-IAV/L50/6400/6100 DOS: 01.06.2010 DOC: 31.05.2015	Evaluation and improvement of reproductive efficiency in guinea fowl and chicken	Dr. Jag Mohan	Dr. R.P. Moudgal Dr. Jagbir Singh Tyagi
3.	P-1/2010/1-IAV/L50/6000/3730 DOS: 01.07.2010 DOC: 30.06.2015	Role of heat shock protein on the efficiency of digestive system under normal and stressed conditions in poultry	Dr. Jagbir Singh Tyagi	Dr. R.P. Moudgal Dr. Jag Mohan Dr. M. Sirajudeen
4.	P-1/2008/1-IAV/L50/6200 DOS: 01.02.2008 DOC: 31.01.2013	Investigation into the reproductive physiology and semen characteristics of ducks to augment fertility and hatchability	Dr. S.C. Giri	-
<b>Sub Programme - (iv) Development of health, shelter and other management packages</b>				
1.	P-1/2008/2-IAV/L05/6100 DOS: 03.01.2008 DOC: 02.01.2013	Poultry rearing practices at high altitude	Dr. S. Majumdar (till 23.09.2011) Dr. S.K. Bhanja (w.e.f. 24.09.2011)	Dr. A.B. Mandal Dr. A.K. Sharma Dr. V. Chandra Dr. S. Majumdar Dr. Praveen K. Tyagi(w.e.f. 04.10.2011)
2.	<i>Service Project</i>	Surveillance and monitoring of poultry diseases and implementation of bio-security measures including vaccination for achieving better survivability and productivity in CARI birds	Dr. A.S. Yadav	-

3.	<i>Service Project, CARI Regional Centre</i>	Surveillance and monitoring of duck diseases and their bio-security measures	Dr. Dayamoy Mondal	-
<b>Sub Programme - (v) Development of poultry germplasm and package of practices for rural poultry</b>				
1.	P-1/2009/2-IAV/L10/6400 DOS: 01.06.2009 DOC: 31.05.2014	Improving Guinea fowl for low input poultry production system	Dr. Deepak Sharma (till 24.01.2012) Dr. (Mrs) Simmi Tomar (w.e.f. 12.03.2012)	-
2.	P-1/2010/1-IAV/L10/6100 DOS: 01.06.2010 DOC: 31.03.2015	Evaluation and maintenance of native chicken genetic resources and their utilization	Dr. D.P. Singh	Dr. Raj Narayan
<b>PROGRAMME 2: PROCESSING, VALUE ADDITION, PRODUCT SAFETY AND QUALITY PARAMETERS</b>				
<b>Sub Programme - (i) Standardization of protocols of products/by-products handling and processing in unorganized sector</b>				
1.	P-1/2009/1-IAV/L73/6000-4200 DOS: 01.10.2009 DOC: 30.09.2014	Detection of quantification of bacterial pathogens in poultry products and poultry environment	Dr. A.S. Yadav	-
2.	P-1/2009/1-IAV/L34/8954 DOS: 01.04.2009 DOC: 31.03.2014	Assessment of residues of chemical contaminants in poultry feed and poultry products in different regions of India	Dr. C.K. Beura	-
3.	P-1/2006/1-IAV/Q10/9690 DOS: 01.04.2006 DOC: 30.09.2013	Processing and shelf-life assessment of egg-based finished products	Dr. N.K. Pandey	Dr. A.S. Yadav
4.	P-1/2011/1-IAV/C00/6000 DOS: 01.09.2011 DOC: 31.08.2014	Transfer of proven poultry production technologies and their impact assessment	Dr. M.P. Sagar	Dr. Niranjana Lal
<b>Sub Programme - (ii) Value addition to different poultry products and by-products</b>				
1.	P-1/2007/1-IAV/Q10/9705 DOS: 01.09.2007 DOC: 31.08.2012	Development of poultry products based functional foods	Dr. A.K. Sachdev	Shri Ram Gopal
<b>PROGRAMME 3: ASSESSMENT OF POULTRY PRODUCTION AS INFLUENCED BY MARKET DYNAMICS</b>				
<b>Sub Programme - (i) Market intelligence gathering and contingency planning</b>				
1.	P-1/2008/1-IAV/E00/9600-9705 DOS: April, 2008 DOC: April, 2011	International trade and export opportunities for Indian poultry sector	Dr. Sandeep Saran	Dr. L.S. Gangwar
2.	P-1/2010/1-IAV/E10/6000 DOS: 01.6.2010 DOC: 31.05.2013	Economic analysis of poultry production in Kumaon hills	Dr. L.S. Gangwar	Dr. Sandeep Saran

### NAIP RESEARCH PROJECTS

Sl. No.	Project Code No.	Project Title	Name of CCPI/ Consortium Partner
1.	Sanction order No. NAIP (SRLS-III) 3 <sup>rd</sup> Call-6/2008 dated 13.4.08 DOS: 13.04.2008 DOC: 30.06.2012	Holistic approach for improving livelihood security through livestock based farming system in Barabanki and Raibareili districts of U.P.	Dr. D.P. Singh
2.	Sanction order No. NAIP (SRLS-C)III-(2)7/2008 dated 07.06.2008 DOS: 01.04.2008 DOC: 31.03.2012	Goat husbandry based integrated approach for livelihood security in disadvantaged districts of Bundelkhand region	Dr. Deepak Sharma (till 24.01.2012) Dr. Sanjeev Kumar (w.e.f.16.03.2012)
3.	Sanction order No.NAIP/Comp-4/C-4/C30016/2008 dated 06.01.2009 DOS: 06.01.2009 DOC: 31.03.2012	Development potency of parthenogenetic goat embryos	Dr. S.K. Bhanja Dr. S. Majumdar
4.	Sanction order No. NAIP(SRLS-III) 3 <sup>rd</sup> Call-9/2008 dated 06.04.2009 DOS: 06.04.2009 DOC: 30.06.2012	Sustainable livelihood improvement through integrated fresh water aquaculture, horticulture and livestock development in Mayurbhanj, Keonjhar and Sambalpur district of Odisha	Dr. S.C. Giri Dr. K.V.H. Sastry (w.e.f. 24.09.2011) Dr. S.K. Sahoo Dr. R.K.S. Bais (w.e.f. 13.12.2011)

### EXTERNALLY FUNDED PROJECTS

Sl. No.	Sanction order No.	Title of the project	Name of PI	Name of Co-PI
1.	BT/PR9519/AAQ/01/345/2007 dated 13.06.2008 (DBT Project) DOS: 13.06.2008 DOC: 12.06.2011 (completed)	Enhancement of post-hatch immune-competence and growth of broiler chickens through <i>in ovo</i> approaches	Dr. S.K. Bhanja	Dr. A.B. Mandal Dr. S.K. Mishra Dr. S. Majumdar
2.	BT/PR12887/AGR/36/622/2009 dated 21.05.2010 (DBT Project) DOS: 21.05.2010 DOC: 20.05.2014	Application of RNAi technology for augmenting broiler production	Dr. V.K. Saxena	Dr. K.V.H. Sastry
3.	No. SSD/WS/089/2009 dated 10.01.2011 ((DST project) DOS: 10.01.11 DOC: 10.01.14	Backyard poultry and duck production as a tool to sustainable livelihood for rural women of Khurda district of Odisha	Dr. S.C. Giri	Dr. S.K.Sahoo Dr. Sandeep Saran Dr. S.K. Mishra (w.e.f 18.08.2011) Dr. K.V.H. Sastry (w.e.f 18.08.2011)
4.	F.No. 9(1)/2010-HRD dated 26 <sup>th</sup> August, 2010 (Emeritus Scientist Scheme) DOS: 26.08.2010 DOC: 25.07.2012	Augmentation of production in naked neck white population using conventional breeding and nano-biotechnological approaches	Dr. B.P. Singh	-

### INTER- INSTITUTIONAL PROJECTS

Sl. No.	Sanction order No.	Title of the project	Name of PI	Name of Co-PI
1.	<p>CARI, Izatnagar - IVRI, Izatnagar - IARI, New Delhi - IIT, Roorkee  <i>Inter Institutional Collaborative Research Proj. C-2/2007/1-IAV/E00/6100-4200</i>            DOS: 01.09.2007            DOC: 31.08.2011 (completed)</p>	<p>Recycling of animal and farm waste and application of their value added products in sustainable crop production and animal husbandry</p> <p><i>Hazard analysis of poultry waste and Techno-economic evaluation of its alternative uses - Component-B</i></p>	Dr. Sandeep Saran	Dr. L.S. Gangwar