Performance of back cross progeny from Hansli male and Coloured Broiler female chicken

Sagarika Behera
Adm No. 02LPM/14

DEPARTMENT OF LIVESTOCK PRODUCTION AND MANAGEMENT
COLLEGE OF VETERINARY SCIENCE AND ANIMAL HUSBANDRY
ORISSA UNIVERSITY OF AGRICULTURE AND TECHNOLOGY
BHUBANESWAR – 751003
2016
Performance of back cross progeny from Hansli male and Coloured Broiler female chicken

A THESIS SUBMITTED TO
THE ORISSA UNIVERSITY OF AGRICULTURE AND TECHNOLOGY
IN PARTIAL FULFILMENT OF THE REQUIREMENT
FOR THE DEGREE OF

MASTER OF VETERINARY SCIENCE

IN

LIVESTOCK PRODUCTION AND MANAGEMENT

By

Sagarika Behera

Adm No. 02LPM/14

DEPARTMENT OF LIVESTOCK PRODUCTION AND MANAGEMENT

COLLEGE OF VETERINARY SCIENCE AND ANIMAL HUSBANDRY

ORISSA UNIVERSITY OF AGRICULTURE AND TECHNOLOGY

BHUBANESWAR – 751003

2016
CERTIFICATE-I

This is to certify that the thesis entitled “Performance of back cross progeny from Hansli male and Coloured Broiler female chicken” submitted in partial fulfilment of the requirements for the award of the degree of Master of Veterinary Science (Livestock Production and Management) to the Orissa University of Agriculture and Technology is a faithful record of bonafide and original research work carried out by Sagarika Behera under my guidance and supervision. No part of this thesis has been submitted for any other degree or diploma.

It is further certified that the assistance and help received by her from various sources during the course of investigation has been duly acknowledged.

CHAIRMAN
ADVISORY COMMITTEE
CERTIFICATE-II

This is to certify that the thesis entitled “Performance of back cross progeny from Hansli male and Coloured Broiler female chicken” submitted by Sagarika Behera to the Orissa University of Agriculture and Technology, Bhubaneswar, in partial fulfilment of the requirements for the degree of Master of Veterinary Science (Livestock Production and Management) has been approved/disapproved by the student’s advisory committee and the external examiner.

Advisory Committee

Chairman

Dr. B. Panigrahi
Associate Professor
Department of Livestock Production and Management
C.V.Sc. and A.H., O.U.A.T., Bhubaneswar

Members

1. Dr. C.R. Pradhan
   Professor and Head (Retd.)
   Department of Livestock Production and Management
   C.V.Sc. and A.H., O.U.A.T., Bhubaneswar

2. Dr. N.C. Behura
   Associate Professor and Head
   Post Graduate Department of Poultry Science
   C.V.Sc. and A.H., O.U.A.T., Bhubaneswar

3. Dr. N. Panda
   Associate Professor
   Department of Animal Nutrition
   C.V.Sc. and A.H., O.U.A.T., Bhubaneswar

External Examiner
(Name & Designation)
ACKNOWLEDGEMENTS

I am exhilarated to acknowledge and express my profound sense of colossal gratitude and indebtedness to my beloved guide and Major Advisor of the advisory committee, Dr. B. Panigrahi, Ph.D., Associate professor, Department of Livestock Production and Management, College of Veterinary Science and Animal Husbandry, Orissa University of Agriculture and Technology, Bhubaneswar for his scholastic guidance, prudent suggestion, constant inspiration and supervision, perpetual interest, constructive criticism, incessant encouragement and conscientious efforts throughout the period of investigation. This work has been possible because of his continuous suggestions, inspiration, motivation and full freedom given to me to incorporate my ideas. It is a matter of great pride to get an opportunity to work under the dynamic guidance of an able, affectionate and highly intellectual academician of his calibre.

With profound privilege, I express my deep sense of gratitude to Dr. L.M. Mohapatra, Professor and Head, Department of Livestock Production and Management, College of Veterinary Science and Animal Husbandry, Orissa University of Agriculture and Technology, Bhubaneswar for his precious guidance, timely suggestions, inspiration, consolation, expert proposals and efforts throughout the period of thesis work and thesis preparation.

I deem it the rarest opportunity and proud privilege to express my profound sense of immeasurable gratitude and indebtedness to Dr. C.R. Pradhan, Professor and Head (Retd.), Department of Livestock Production and Management, College of Veterinary Science and Animal Husbandry, Orissa University of Agriculture and Technology, Bhubaneswar for his valuable supports, suggestions, relentless efforts, constructive counsel, inspiration, critical appreciation, contribution in teaching, timely help, interest in the subject, depth of knowledge approach to the subject and constant cooperation throughout the entire study. It is a matter of great pride to get an opportunity to work under the dynamic guidance of an able, affectionate, and erudite academician of his calibre. I can never thank him enough.
Words of acknowledgement cannot fathom the efforts put by Dr. N. Panda, Ph. D., Associate Professor, Department of Animal Nutrition, College of Veterinary Science and Animal Husbandry, Orissa University of Agriculture and Technology, Bhubaneswar and esteemed member of my advisory committee for his scholastic guidance, diligent help, continuous inspiration, critical appreciation, sustained interest, constructive criticism, ceaseless encouragement, painstaking efforts and cooperation in analysis of gargantuan experimental data during the entire course of study.

I wish to avail this opportunity moment in life to express my sincere and heartfelt gratitude to Dr. N.C. Behura, Ph.D., Associate Professor & Head, Post Graduate Department of Poultry Science, College of Veterinary Science and Animal Husbandry, Orissa University of Agriculture and Technology, Bhubaneswar, the esteemed member of my advisory committee for his adroit supervision, pertinent suggestions, erudite guidance and extending facilities during the course of experiment throughout this research. Above all and the most needed, he provided me unflinching encouragement, blend of affection, moral support and support in various ways.

The guidance and help rendered by galaxy of my teachers Dr. R. R. Rout, Dr. L. K. Babu, Dr. G. P. Mohanty, Dr. S. Kanungo, Dr. K. Behera and Dr. J. Bagh of Department of Livestock Production and Management is highly appreciated. These versatile personalities stimulate student’s thinking for the obfuscate determination.

I am especially thankful to Dr. P.K. Pati, Professor and Head, Department of Livestock Products Technology, College of Veterinary Science and Animal Husbandry, Orissa University of Agriculture and Technology, Bhubaneswar, for his timely help & proper guidance during my research work.

I am especially thankful to the Dean, College of Veterinary Science and Animal Husbandry, Bhubaneswar for providing necessary physical facilities for carrying out the present study.

I take this opportunity to express my amicability and endearment to my seniors, friends and colleagues, Chichi didi, Sujit bhai, Daya bhai, Sushree didi,
Anurag, Kuldeep, Partha, Sasmita, Amaresh bhai, Suchismita, Ranjeeta, Bijayalaxmi, Ankita, for their help and cooperation during my study.

It would be injustice not to remember my juniors, Bibhu, Pankaj, Prithviraj, Lenin, Nilamadhav for their help and cooperation during my study.

I would like to thank all the non teaching staff members of Department of Livestock Production and Management, College of Veterinary Science and Animal Husbandry, Bhubaneswar, Rout Babu, Bisoi Babu, Kishori Bhaina and Nanda Bhaina for their assistance during the period of research.

I am immensely grateful to Swain babu, Narayan, Gopal, Kalia, Madha, Sameera, of the P.G. department of Poultry Science, College of Veterinary Science and Animal Husbandry, Bhubaneswar, for their kind cooperation and help to accomplish the research work with constant encouragement.

Words are short to express my cordial regards, love, and devotion to my respected father Shri Bimbadhar Behera who laid the foundation stone of my education and has been a constant support and guide throughout my life.

My beloved mother Smt. Ashalata Behera has always acted as an endless source of love and affection with constant encouragement in each and every sphere of my life.

I deeply express my sincere regards to my elder sister Madhusmita Behera and younger brother Rajesh Behera whose continuous encouragement boosted up my moral during the period of my study.

Above all I bow my head before the almighty for giving me health, courage and a sound mind to work on this project.

Place :

Date : (Sagarika Behera)
## CONTENTS

| CHAPTER NO. | PARTICULARS                      | PAGE NO. |
|-------------|----------------------------------|----------|
| 1           | INTRODUCTION                     | 1-3      |
| 2           | REVIEW OF LITERATURES            | 4-25     |
| 3           | MATERIALS AND METHODS            | 26-34    |
| 4           | RESULTS                          | 35-44    |
| 5           | DISCUSSION                       | 45-47    |
| 6           | SUMMARY AND CONCLUSION           | 48-49    |
|             | REFERENCES                       | i-viii   |
|             | APPENDIX                         | 1        |
## LIST OF FIGURES

| FIGURE NO. | PARTICULARS                                | AFTER PAGE NO. |
|------------|-------------------------------------------|----------------|
| 3.1        | Eggs in incubator tray                    | 27             |
| 3.2        | Candling of eggs                          | 27             |
| 3.3        | Chicks in hatcher                         | 27             |
| 3.4        | Recording of body weight at day old       | 27             |
| 3.5        | Brooding of chicks                        | 27             |
| 3.6        | ND vaccination on 6th day                 | 27             |
| 3.7        | Birds in deep litter system of housing    | 27             |
| 3.8        | Recording of body weight at 8 weeks of age| 27             |
| 3.9        | Weighing of residual feed                 | 27             |
| 3.10       | Measurement of breast angle               | 30             |
| 3.11       | Measurement of keel length                | 30             |
| 3.12       | Measurement of shank length               | 30             |
| 3.13       | Measurement of body length                | 30             |
| 3.14       | Measurement of beak length                | 30             |
| 3.15       | Measurement of body girth                 | 30             |
| 3.16       | Dressed bird                              | 31             |
| 3.17       | Weighing of wings                         | 31             |
| 3.18       | Weighing of drumstick                     | 31             |
| 3.19       | Weighing of gizzard                       | 31             |
| 3.20       | Weighing of liver                         | 31             |
| 3.21       | Weighing of thigh                         | 31             |
| 4.1        | Weekly body weight (g) of chicks          | 35             |
| 4.2        | Weekly cumulative weight gain (g) of chicks| 35             |
| 4.3        | Weekly cumulative feed intake of chicks   | 38             |
| 4.4        | Weekly cumulative FCR of chicks           | 38             |
| TABLE NO. | PARTICULARS                                                                 | PAGE NO. |
|----------|-----------------------------------------------------------------------------|----------|
| 4.1      | Weekly body weight (g) of chicks                                           | 35       |
| 4.2      | Weekly cumulative weight gain (g) of chicks                                | 37       |
| 4.3      | Weekly cumulative feed intake (g) of chicks                                | 38       |
| 4.4      | Weekly cumulative FCR of chicks                                            | 40       |
| 4.5      | Weekly mortality of chicks                                                 | 40       |
| 4.6      | Body linear measurements of chicks                                          | 41       |
| 4.7      | Carcass traits of chicks                                                   | 43       |
| 4.7a     | Cut up parts as percentage of eviscerated weight and dressed weight        | 43       |
| 4.8      | Proximate composition of thigh and breast muscle                           | 44       |
# LIST OF ABBREVIATIONS

| Abbreviation | Definition                  |
|--------------|-----------------------------|
| AIA          | Acid Insoluble Ash          |
| B.A.         | Breast Angle                |
| Cm           | Centimeter                  |
| g            | Gram                        |
| CP           | Crude Protein               |
| CSML         | Colour Synthetic Male Line  |
| CSFL         | Colour Synthetic Female Line|
| DM           | Dry Matter                  |
| H$_2$SO$_4$  | Sulphuric Acid              |
| HCl          | Hydrochloric Acid           |
| I/M          | Intra Muscular              |
| I/N          | Intra Nasal                 |
| IBD          | Infectious Bursal Disease   |
| K.L.         | Keel Length                 |
| NaOH         | Sodium Hydroxide            |
| NFE          | Nitrogen Free Extract       |
| RD           | Ranikhet Disease            |
| S.L.         | Shank Length                |
| S/C          | Subcutaneous                |
| ME           | Metabolised energy          |
| Wk           | Week                        |
ABSTRACT

Performance of two genotypes of broiler chicken were evaluated under intensive system of management for different growth and carcass traits. The genotypes were (i) Group-I: Colored synthetic broiler (CSML ♂ x CSFL ♀) crosses; (ii) Group-II: (Hansli x CSML) ♂ x CSML ♀ crosses. Significantly (p ≤ 0.05 or 0.01) higher body weight and weight gain was recorded in group-I at every stage from 1st to 8 week. Chicks in group-II showed significantly higher values for FCR at 2nd, 3rd, 4th and 5th week. Chicks in group-I showed higher feed intake in every week compared to those in group-II and differences were found significant (P≤0.05 or 0.01) at 1st, 5th, 6th, 7th and 8th week of age. Group-I showed mortality of 1.66% where as in group-II mortality percent was 0. Chicks in group-II showed significantly (p≤0.01 or p≤0.05)) greater breast angle and beak length, while the chicks in group-I showed significantly (p≤0.01) greater body length, body girth, shank length, shank width and keel length at 6th week. At 8th week, chicks in group-II showed significantly (p≤0.05 or 0.01) lower values compared to those in group-I in respect of all parameters except for beak length and breast angle which was not differ significantly (p≥0.05). Chicks in group-I showed significantly (p≤0.05 or 0.01) higher live weight, dressed weight, eviscerated weight, liver weight, drumstick weight, wings weight, back weight and giblet%. Numerically the dressing% was higher in group-II than group-I (p>0.05). Birds in group-II showed higher (P≥0.05) moisture and crude protein, and lower ether extract for both thigh and breast muscle.
CHAPTER-1

INTRODUCTION
INTRODUCTION

Commercial poultry production has gained popularity since last two decades in India. Unlike other livestock enterprises, poultry production enjoys advantages like ease of management, higher turnover, quicker returns to capital investment, wide acceptance and little discrimination against its production. Poultry has adapted to most areas of the world and has a high economic value as well as rapid generation time (Smith, 1990). It is a means of bridging the ever widening gap of protein insufficiency (Ughene et al., 2005). The rapid growth of the human population in India has led to a relatively high demand for protein. Meat and eggs are among the most important forms of animal protein in economically developed and developing areas of the world. Poultry meat is the cheapest source of protein compared to other animal protein forms and, probably, the most consumed. Medical research also indicates that poultry meat has lower cholesterol content in contrast to red meat (Khatun, 2012).

Unemployment and malnutrition are the major problems associated with national development. About 45% people live in acute poverty level. Poultry farming plays an important role to create employment and improve the nutritional status of the people. Appearance is a very important quality attribute of a food product and for live birds demand. Consumers pay more attention to colour of plumage, skin and shanks as well as redness and size of comb (Chen and Sun, 1997). However, local chickens are insufficient to provide sufficient meat to the people in a highly populated country. So there is a growing demand from the farmers for the exotic hybrids suitable to family production system. Hence, efforts have been diverted in to production of dual purpose breeds and hybrids with improved production profiles. Utilization of native chicken breeds for the development of suitable scavenging chicken has resulted in great success in our country. These hybrids are readily accepted by the rural farmers owing to their similarity to the typical appearance of the local birds and low operational cost with significant returns under the existing methods of rearing in the rural areas. Hence, the commercial hybrid cross between a native breed and an exotic breed would be a good proposition for the ideal replacement of native scavenging chicken in the backyard poultry keeping.
India’s poultry sector represents one of the biggest success stories of the country over the past decade. Poultry are the most commonly kept livestock species and have been reared as an integral part of the mixed agricultural system throughout India. On the basis of their contribution to total farm income, chickens rank the highest followed by goats and cattle (Muchenje and Sibanda, 1997). The Indian poultry industry has come a long way from a backyard enterprise to an organized commercial industry. The Indian poultry industry is growing at the rate of 8 to 10% for eggs and 15 to 20% for broiler chicken with production estimates of 65,000 million eggs and 3 million tones of broiler meat per year (Srivastava, 2011). Today, India is the third largest in egg and fifth largest in chicken production in the world (BAHS-2012, Department of Animal Husbandry, Dairying and Fisheries, M/O Agriculture). In India, per capita availability of egg and meat are 53 and 2.2 kg, respectively against the recommended level of 180 eggs and 9.00 kg of meat by Indian council of medical research (BAHS-2012, Department of Animal Husbandry, Dairying and Fisheries, M/O Agriculture). The vast increase in egg production during last five decades is mainly due to the use of specialized layer strains of high genetic potency and its crosses. Among the various aspects in poultry science, improvement in genetic makeup by various breeding methods is an important aspect to improve feed efficiency, egg production and egg quality. Cross bred poultry have higher feed efficiency and lower mortality as compared to purebreds and these two factors play a very important role in increasing profits in poultry production (Dwivedi et al., 1986).

Genetic progress can be attained either by selection or crossbreeding (Adebambo et al., 2011). Crossbreeding of the indigenous stock with exotic commercial birds will take advantage of artificial selection for productivity in the exotic birds and natural selection for hardiness in the indigenous birds. (Adebambo et al., 2011). Crossbreeding could lead to production of birds that will be better in growth rate, efficiency of feed conversion and reproductive traits without sacrificing adaptation to the local environment, thereby resulting in reduced cost of production (Adebambo et al., 2011). The outcome of crossbreeding is due to the phenomenon of heterosis which is expressed in the performance of the hybrids. Since, heterosis is almost exclusively the aggregate of all single *locus* dominance effects, and as these are usually positive or beneficial, heterosis can be expected mostly in the favourable direction (Kitalyi, 1998). To utilize the good adaptive characteristics of the
Introduction

indigenous chickens and possibly exploit the phenomenon of heterosis, Oluyemi et al., (1979) proposed that crossbreeding programmes including upgrading local chickens with suitable exotic stocks would be more appreciable. Genetic improvement of important economic traits would increase the production efficiency and profitability of native fowl.

The knowledge of performance of economic traits in chicken is important for the formulation of breeding plans for further improvement in production traits. Growth and production traits of a bird indicate its genetic constitution and adaptation with respect to the specific environment (Ahmed et al., 2007).

The breeding objectives should focus on the development of a chicken crossbred that would be adaptable to the local climatic conditions and be suitable for backyard as well as commercial rearing, while retaining the characters of the indigenous chicken such as plumage colour and meat quality.

In view of the afore said, the present study has been undertaken to study the broiler traits of crosses of native and coloured parent line in respect of their growth performance, carcass quality and mortality rate.
CHAPTER-2

REVIEW OF LITERATURES
REVIEW OF LITERATURES

Body weight and weight gain

Barua et al. (1998) reared Fayoumi (F₀), Rhode Island Red and their crosses up to 512 days of their age and studied comparative performances of the three genetic groups with or without extra feeding to scavenging system of rearing and also studied the suitability of these breeds under the rural condition. They observed that Fayoumi attained earlier sexual maturity and laid more eggs than other breeds/ types. Rhode Island Red produced the largest eggs, but mortality rates were highest. Fayoumi showed greatest resistance to diseases. Cross breds were heaviest and highest hatchability than parental breeds. It was found that extra feeding was more beneficial to the chickens irrespective of breeds and types and cross bred F₀X RIR chickens were more suitable under rural scavenging system than the exotic breeds.

An experiment was conducted by Stringhini et al. (2003) to evaluate the performance of Ross, Cobb, Avian Farms and Arbor Acres broiler strains. The performances were measured until 41, 44 and 48 days of age. It was shown that males had better productive parameters and heavier body than females. Ross birds showed heavier body weights and higher cumulative live weight gains at 44 days of age.

Bharadwaj et al. (2005) conducted a study on Kadaknath, Aseel, Rhode Island Red, Brown Cornish, Kadaknath X Brown Cornish, Brown Cornish X Kadaknath, Rhode Island Red X Aseel and Aseel X Rhode Island Red, crosses for the comparison of their growth. The corresponding body weights at day old, 2, 4, 6, 8 and 10 weeks were 41.23 ± 0.69, 98.34 ± 2.58, 349.6± 33.45, 510.4 ± 12.97, 639.1 ± 12.34 and 1091 ± 18.11 g, respectively in Brown Cornish which was significantly higher(p<0.5) as compared to others.

Mondal et al. (2007) conducted an experiment to study the growth, using 6 different genetic groups i.e. Kadaknath × Rhode Island Red, Aseel × Rhode Island Red, Aseel × Brown Cornish, Kadaknath × Brown Cornish, Rhode Island Red × Aseel and Brown Cornish × Kadaknath. Among the six genetic groups Kadaknath × Brown Cornish attained maximum body weight (1023 g) at 10th week, followed marginally by Aseel × Brown Cornish and minimum (762g) in Kadaknath × Rhode
Island Red. In all the crosses, there was an average weekly body weight gain of about 100–125g/week after 4th week onwards.

Krishna et al. (2007) compared the production potential of desi birds and coloured layer birds up to 40 weeks of age under backyard farming and recorded the average body weight (g) at 6, 8, 12, 16, 20 and 40 weeks of age which were significantly (P≤0.01) higher in coloured layer than desi birds. The corresponding body weights(g) were 408.00 ± 4.79 vs. 339.00 ± 9.66, 575.00 ± 14.43 vs. 450.00 ± 15.14, 1165 ± 25.00 vs. 734 ± 6.25, 1560 ± 34.88 vs. 870 ± 13.54, 1648.00 ± 18.87 vs. 1058.00 ± 14.93 and 1940.00 ± 25.98, respectively for coloured layer and desi birds, indicating higher weight gain in coloured layer birds in comparison to desi birds.

Niranjan et al. (2008) studied the growth and production performance of Vanaraja (c3), Gramapriya (c4), c1 cross (Broiler pure line x tinted egg layer) and c2 cross (Broiler pure line2 x tinted egg layer). The body weight at 72 weeks varied between 2866.31±22.31 (c3) and 2469.29± 29.58 g(c4). The body weight between c1 and c3 were not significant but significantly higher (p<0.05) from other two crosses. However the body weight of c2 cross at 72wks of age was significantly (p<0.05) higher than c4.

Sarkar et al. (2008) conducted an experiment with commercial broiler (Cobb 500), cockerel (Shaver 579) and cross-bred (F1 RIR ♂ × Fayoumi ♀) chicks up to target body weights of 850, 1000 and 1250g. Commercial broilers attained the target weights of 850, 1000 and 1250g at the age of 21, 24 and 28 days, respectively whereas cockerels attained weights close to those targets at 56, 63 and 74 days, respectively and in the case of cross-breds, the days were 63, 77 and 90 for those target weights, respectively.

Saddy et al. (2008) carried out an experiment on diallel crossing analysis for body weight and egg production traits of two native egyptian and two exotic chicken breeds. Two local breeds namely Fayoumi (F) and Sinai (S) and two exotic ones named Rhode Island Red (RIR) and White Leghorn(WL) were used in 4x4 diallel mating system. They reported that, within pure breed, RIR breed had heaviest body weight at 0, 2 and 3 month of age (43.04, 958.08, 1155.35) compared to remaining
breeds. However, the Sinai breed had heaviest body weight at 1 and 4 month of age compared to other ones. With respect to crosses FxS and SxWL crosses were heaviest at all ages compared to other crosses and, within reciprocal crosses, SxF and WLxS crosses were heaviest compared to other reciprocal crosses. Results of heterosis estimates indicated that crossing between Sinai (S) males and White Leghorn (WL) females as well as between Fayoumi (F) males and Sinai (S) females gave the highest heterotic effect for body weight.

Bekele et al. (2010) conducted a crossbreeding experiment with the objective of producing dual purpose synthetic chicken for village poultry production in Ethiopia. The two exotic chicken breeds used were the Fayoumi (F) and Rhode Island Red (R) as dam line, whereas the two indigenous chicken breeds used were the Naked neck (N) and local Netch (W) (a white feathered chicken). The indigenous breeds were used as sire line to produce the hybrids FN and RW. Growth and egg production performance of the crosses were compared with each other and with the exotic pure line performance. Body of FN was improved while that of RW was reduced. Although FN cross chicks weighed more and grew faster than RW chicks during the brooding period, the difference became insignificant as they grew older. However, the higher overall average body weight gain of RW crosses that was observed was mainly due to higher weight gain for the RW cocks. Mortality in the FN cross was lower than in the RW cross.

Adebambo et al. (2011) carried out an experiment with chicks. Those were obtained from a diallel combination of four breeds of chickens; (Anak Titan (A), Alpha (B), Giriraja (G) and Normal indigenous (N) chickens) in a broiler improvement programme. The chicks were reared up to 12 weeks of age. Anak Titan cocks and hens performed best in body weight with values ranging between 38.45 ± 0.74 g and 40.21 ± 0.66 g at day old to 1135.93 ± 35.67 g and 953.38 ± 35.38 g at week 12, respectively.

Ullengala et al. (2011) evaluated that the juvenile growth and carcass traits in a 4x4 full diallel crossing involving four coloured broiler chicken lines viz., Naked neck (NN), Dwarf, Punjab Broiler-1 (PB-1), and Punjab Broiler-2. The data on 2,280 chicks were analyzed using least squares techniques to assess the effect of genetic group, and the significant traits were further analyzed for crossbreeding parameters.
The cross of PB-1 x NN recorded significantly (p≤0.05) higher body weight at 6 weeks of age.

Kalita et al. (2011) studied performance of the crossbred (PB-2 × indigenous) chicken under intensive system of rearing and reported the average body weight at day old, 1 month, 2 months, 3 months and 6 months of age as 29.65 g, 210.58 g, 670.83 g, 900.45 g and 1900.48 g, respectively.

Ojo et al. (2011) studied on progenies of Dominant black strain (DB) crossed with Fulani ecotype (FE) chickens for their reproductive performance and egg quality traits by taking 4 mating groups: DBXDB, DBXFE, FE X DB and FEX FE with a mating ratio of 1 male: 8 female. The results obtained for body weight at first egg (BWF) showed that FEX DB had the highest BWF (1408 g) followed by FEX FE(1405 g), DBXFE( 1388 g), DBX DB( 1350g). This showed significant (P<0.05) differences in the weight at the onset of laying. It also indicated that FEXFE matured late (23 weeks) and required higher body weight threshold for egg laying. The FEXDB achieved required body weight at first egg at an early age (21 weeks) compared with the FEXFE.

Jha et al. (2012) recorded the mean body weight of Vanaraja birds at day-old, 4, 6, 8, 12, 16, age at first egg and at 40 weeks of age as 39.91 ± 0.26, 316.47 ± 2.47, 629.23 ± 4.02, 832.51 ± 4.53, 1072.63 ± 5.59, 1567.85 ± 6.38, 2103.39 ± 7.39 and 2467.831 ± 1.36 g, respectively under intensive system of rearing. The corresponding mean body weight of desi birds were also recorded as 28.52 ± 0.20, 124.83 ± 1.18, 183.61 ± 2.54, 258.75 ± 3.57, 408.25 ± 4.72, 617.36 ± 5.35, 982.75 ± 6.38 and 1126.41 ± 8.79 g, respectively.

The body weight of reciprocal crosses of Dwarf × PB-2 and PB-2 × Dwarf chicken at 20, 40 and 52 weeks of age were 2245.21 ± 52.45 and 2612.84 ± 38.27, 2990.94 ± 66.55 and 3072.13 ± 59.24 and 3257.37 ± 88.64 and 3345.86 ± 68.85 g, respectively. (Rajkumar et al., 2012).

Dutta et al. (2012) assessed the production performance and economic efficiencies of four meat purpose chickens viz., Cobb 500, ISA Brown, Fayoumi and Sonali and evaluated the parameters as initial body weight (IBW), 5-wk rearing
period (RP), achieved body weight (ABW), feed intake (FI), body weight gain (BWG) and feed conversion ratio (FCR). Performance of three egg purpose chickens \textit{viz.} Fayoumi, RIR and Sonali included weight of day-old chick (WDOC), growth rate (GR), death rate (DR), fertility (FR), hatchability (HT), first laying age (FLA) and monthly egg production (MEP). Economic efficiency parameters \textit{viz.}, total cost (TC), gross return (GRR), net return (NR) and cost-benefit ratio (CBR) were calculated for both types. In terms of FI, FCR and BWG values, broilers of Cobb 500 were the best preferred and cockerel of ISA Brown the least preferred chicken. In terms of the CBR values for meat producers, the cockerels of ISA White were (1.58) found the best and the broilers of Cobb 500 (1.15) were the worst. Taking the FLA and MEP into account, RIR topped the list (19.1 wks and 23 eggs per month) where as Cobb 500 ranked at the bottom (25.2 wks and 16 eggs per month). CBR for egg productivity, on the other hand, were highest in \textit{Sonali} (1.11) followed by RIR and Fayoumi (1.10 each) and Cobb 500 (1.09). As regards the meat productivity, significant correlations existed between TC and NR for all chickens except Sonali, which exhibited a negative correlation between the traits. Negative and non-significant associations prevailed for egg productivity in all the chickens. Although broilers of Cobb 500 were found to be the most popular for meat and RIR for egg, the cockerels of ISA Brown were the chickens that earned the maximum CBR.

Khwaja \textit{et al.} (2012) conducted an experiment with Fayoumi, Rhode Island Red (RIR), RIR $\times$ Fayoumi and Fayoumi $\times$ RIR for a period of 20 weeks. The results revealed that the average day old weights (g) were highest (31.30) in RIR and Fayoumi $\times$ RIR (30.00), intermediate in RIR $\times$ Fayoumi (25.24) and lowest in Fayoumi chickens (20.90). The higher weight of new born chick of RIR could probably due to larger egg weight and size than Fayoumi and crossbred chickens. The RIR breed consumed more feed (7620g) and gained maximum (P<0.05) weight gain (1608 g) during 0-20 weeks of age than those of Fayoumi and crossbred chickens, which could be explained by the variation of genotype.

Podchalwar \textit{et al.} (2013) studied on the performance of three crossbred chickens for rural farming and recorded the body weights of crossbred A $\times$ IWP at 0 day, 4\textsuperscript{th} week, 8\textsuperscript{th} week were 32.31±0.20, 196.44±2.77, 572.60±4.60, Na $\times$ IWP were 33.01±0.20, 184.76±2.74, 509.74±5.39, and RIR $\times$ IWP were 33.87±0.20,
Review of Literatures

The RIR x IWP crossbred had significantly (P<0.05) higher body weight at 0 day as compared to Na x IWP and RIR x IWP crossbreds. The A x IWP and RIR x IWP crossbreds had significantly (P<0.05) higher body weight as compared to Na x IWP crossbred but there was no significant difference in 4th week between A x IWP and RIR x IWP crossbreds. The body weight at 8th week was found to be significantly (P<0.05) higher in A x IWP as compared to other crossbreds.

Jha et al. (2013) studied on the performance of Dahlem Red, local Desi & their crosses for a period of 72 weeks. There was significant variation in growth rate and mortality pattern of crosses compare to their parent birds. The crosses showed significantly (P<0.05) higher body weight, higher feed intake, than local Desi birds under same system of management. The bodyweights of Dahlem Red (g), Dahlem Red X Desi (g), Desi (g) at 0 day, 4 week, 6 week, and 8 weeks of age were (33.24±0.31, 32.67±0.25, 29.56±0.20 ), (145.82±2.13, 138.34±2.25, 114.83±1.28), (369.48±1.17, 346.38±1.53, 185.61±2.54) and (495.46±1.86, 478.23±2.32, 263.75±3.57), respectively.

Kgwatalala and Segokgo (2013) studied on the growth performance of Australorp x indigenous Tswana chickens F1 crossbred progeny relative to purebred indigenous Tswana chickens under an intensive management system. The body weights of males of Australorp x Tswana F1 crosses at 4th week, 6th week and 8th week were 235.14±17.05, 461.82±24.14, 727.61±31.89, respectively and females were 225.63±11.16, 411.15±15.80, and 634.03±20.88, respectively. The body weights at 4th week, 6th week and 8th week of Tswana males were 259.24±12.59, 438.50±17.83, 647.50±23.56, respectively and Tswana females were 251.60±12.59, 416.91±17.83, 610.04±23.56, respectively. There were no significant differences in body weight between Australorp x Tswana crossbred males and indigenous Tswana chicken males from 4-8 weeks of age. In females, there were no significant differences in bodyweights between Australorp x Tswana F1 crosses and purebred indigenous Tswana chickens from 4-14 weeks of age.

A study was conducted to evaluate the performance of Hazra, Aseel and Kadaknath chicken by Jha et al. (2013) revealed the mean body weight at 0, 4, 6, 8, weeks of age were 31.48 ± 0.28, 162.45 ± 2.48, 276.73 ± 3.12, 384.54 ± 4.23 g for
Hazra birds and 29.72 ± 0.21, 127.43 ± 1.28, 186.78 ± 2.55 g for Aseel birds and 28.54 ± 0.33, 114.86 ± 1.63, 152.42 ± 2.87, 238.86 ± 3.76 g in Kadaknath birds which differed significantly (P ≤ 0.05) from each other.

Padhi et al. (2014) studied on the performance of a crossbred chicken developed using both exotic and indigenous breeds under backyard system of rearing. Body weight and weight gain (g) of PD1 x PD4 at 0 day, 2 week, 4 week, 6 week of age were 32.11±0.24, 86.99±1.27, 177.25±3.11 and 380.63±6.85, respectively. Body weights of male and female chickens in field in the free range were 627g and 528g respectively. Performance of PD1 x PD4 during brooding period was better than indigenous birds. The better body weight of this cross compared to indigenous birds indicates presence of heterosis. The average weight gain during different period differs significantly (p<0.05).

Padhi et al. (2014) evaluated four different crossbreds PD1× PD4 (A), PD1 × PB2 (B), PD1x PD3 (C) and PD1 × IWI (D) developed for backyard poultry farming under intensive system, evaluated the body weights, conformation traits during starter and growing period and production performance were measured up to 72 weeks of age. It was found that, body weights at day 0, 2, 4, 6, 7 and 8 weeks of age in the starter period and at 10, 12, 14, 16, 18 and 20 weeks of age during growing period differed significantly(p<0.05) between crosses in both male and female. Irrespective of age, cross B recorded higher body weight compared to other crosses. Shank length and keel length measured at 6, 8, 18 and 20 weeks of age in both the sexes differed significantly (p<0.05) between the crosses. The maximum shank and keel lengths were achieved by 20 weeks of age. Feed conversion ratios (FCRs) from 0–8 weeks of age were best in B followed by A, C and D. The age at sexual maturity (ASM), weight at sexual maturity, body weight and shank length at 40 weeks of age, egg production up to 72 weeks of age differed significantly (p<0.05) between different crosses. Egg weights measured at different weeks of age also differed significantly (p<0.05) between the crosses. The egg production up to 72 weeks of age was the highest in C followed by D, A and B. Mortality % was lowest in D at different period.

Pathak et al. (2015) conducted an experiment on productive and reproductive performances of indigenous and broiler parent line crossed with indigenous chickens. The indigenous chickens were grouped on the basis of plumage colour pattern as
group I (black), group II (black with brown hackle), group III (brown) and group IV (barred). Another group V (PB-2 X indigenous chicken) was included in the study for comparison. Recorded mean body weight (g) of indigenous chicken at day old, 8th, 14th, 20th and 40th weeks of age ranged from 25.87 to 26.83, 373.64 to 389.04, 807.10 to 821.25, 1044.58 to 1071.41, and 1342.50 to 1371.81 g, respectively and the corresponding body weights for crossbred (PB2 × Indigenous) chicken were 29.56, 670.68, 1712.27, 2272.00 and 3530.00 g, respectively. Significantly (P<0.05) higher body weights were observed in crossbred than that of indigenous chicken, which is due to the fact that the indigenous chickens are known to be lighter and have compact body to escape from predators in free range system of rearing. Also, their lower body weight might be due to lower response to improved feeding management. The higher body weight in the group V may be attributed to the broiler inheritance of PB-2 which is a synthetic broiler line.

Munisi et al. (2015) conducted an experiment to compare the growth performance and livability of two exotic stocks namely Broiler (B) and Black Australorp (A), and two indigenous chickens sourced from warm (W) and cool(C) ecological zones and their crossbreds. The four parental stocks were used in 4x4 diallel crossing to produce 16 genetic stocks totalling 1256 experimental chicks. The results revealed that the cross between the indigenous chickens from the warm ecological zone and Black Australorp (WA) in both sexes were significantly (P<0.001) heavier than the indigenous chickens from the warm ecological zone (WW) at eight weeks of age. The observed higher body weights of the crossbreds (WA) than those of indigenous birds (WW) were probably due to breed complementarily and the fact that heritability for body weight is moderately high.

Padhi et al. (2015) conducted an experiment on a three-way cross chicken developed for backyard poultry in respect to growth, production and carcass quality traits under intensive system of rearing. To improve the egg production further and to get colour plumage pattern, the two-way cross PD1 X IWI males were crossed with PD3 females to produce three-way cross (PD1 X IWI X PD3). The crossbred was evaluated for different traits up to 72 weeks of age. Body weights showed sexual dimorphisms from two weeks on wards and the males recorded significantly (P <
0.05) higher body weights (1670 g) than females (1096 g) during 0-16 weeks of age. Only day-old body weights did not differ significantly between males and females.

An experiment was conducted by Rahman (2016) to know the growth and meat production performances of chickens of four different crosses of MLW (♂) × FLW (♀), MLW (♂) × FLC (♀), MLC (♂) × FLW (♀) and MLC (♂) × FLC (♀). During the experimental period from day old to 42 days of age, adlibitum feeds were supplied to birds. The body weight at 1, 2, 3, 4, 5 and 6 weeks of age was significantly (P<0.001) different in four crosses of chickens. Significantly (P<0.05) higher body weight was found in MLW × FLW followed by MLW × FLC, MLC × FLW and MLC × FLC. The weight gain obtained had the similar trend as the body weight. The highest weight gain from 0-6 weeks of rearing was found in MLW × FLW. The 0-6 week weight gain for four line crossed chicken were 693.73, 701.21, 1138.56 and 1179.00g, respectively. The body weight and weight gain rate were always higher in male rather in female. The results of the present study implied that the MLW × FLW might be appropriate for producing white feathered broiler, while the MLC × FLC as coloured broiler.

**Feed conversion ratio**

Souza et al. (1996) stated that feed conversion ratio of Arber Acres, Cobb, Hubbard and Ross broilers were 1.82, 1.92, 1.84, and 1.85 for males and 1.78, 1.93, 1.87, and 1.86 for females, respectively up to 32 weeks.

Smith and Pesti (1998) conducted an experiment with high-yield broiler strain cross (Ross × Ross 208) and fast growing broiler strain cross (Peterson × Arber Acres). The Ross × Ross 208 males had lower FCR (2.10) than Peterson × Arber Acres (2.16) male. Peterson × Arber Acres females had lower FCR (1.97) than The Ross × Ross 208 females (2.04).

Haque (2001) reported FCR of 5.5, 4.9, 5.1, 4.7, 5.0, 5.0 and 4.6 at 0-5 weeks and 5.3, 4.9, 5.3, 5.7, 5.6 and 5.6 at 6-17 weeks of age in Local naked-neck, Rhode Island Red, White Leghorn, Fayoumi, Local naked-neck × Rhode Island Red, Local naked-neck × Fayoumi, respectively.
Howlider (2001) stated that feed intake in Redbro × Redbro (RbRb), Redbro × Local naked-neck (RbNa), Local naked-neck × Redbro (NaRb) and Local naked-neck × Local naked-neck (NaNa) were 5585.77, 3713.83, 2860.53 and 1642.11 g at 56 days of age and the FCR was 2.98, 3.18, 3.74 and 4.00 for RbRb, RbNa, NaRb and NaNa, respectively.

Castelini et al. (2001) studied on day old chicks of both sexes of Leghorn and cross breed of Leghorn x French female line for a period of 120 days. They found the best productive performance in cross-bred males (Feed conversion index – 3.4, slaughter wt- 2.4 kg; p<0.01)) and worst was found in pure-bred females (Feed conversion index-4.8, slaughter wt-1.48).

Das (2003) conducted an experiment with fast (Arber Acres) and slow (ISA I757) growing broiler strains to compare the productive performance of two strains in rainy season under Bangladesh condition up to 6 weeks of age. It was stated that the feed conversion ratios were 1.8 and 2.00 for Arber Acres and ISA I757, respectively.

Nwachukwu et al. (2006) studied on day old f1 chicks generated by main and reciprocal cross breeding of normal local(NL), Naked neck(Na), Frizzle(F) chicken with Arbor acre broiler. It was found that, feed intakes were significantly (P<0.05) higher for the reciprocal cross breds (FXE) than the main cross individuals at wks 6, 12, 18 because heavier birds consume more feed than lighter ones. FCR was more efficient for reciprocal cross breds (FXE) than in their main cross counter parts. Their outstanding performance seems to suggest that this genetic group was better adapted to its humid tropical condition environment than other genetic groups.

Sarkar et al. (2008) conducted an experiment with commercial broiler, cockerel and cross-bred (F1 RIR ♂ × Fayoumi ♀) chicks up to target body weights of 850, 1000 and 1250g. They reported that feed conversion ratio (FCR) was best in broilers 1.62, followed by cockerels and cross-bred birds 2.3 and 2.9, respectively.

An experiment was conducted by Khawaja et al. (2012) on day-old chicks of each Fayoumi, Rhode Island Red (RIR), RIR × Fayoumi(RIFI) and Fayoumi × RIR(FIRI) for a period of 20 weeks. The poor (P<0.05) feed conversion was observed in Fayoumi (5.76) while better feed conversion was recorded in RIR (4.64) and both
crossbred chickens (RIFI-4.40, FIRI-4.55) at 20 weeks of age. Moreover, the performance of FIRI was better than RIFI. The reason was the higher weight of newborn chick of FIRI due to larger egg weight and size than RIFI chickens.

Bharambe and Garud (2012) conducted an experiment to see the comparative performance of some improved poultry crossbreds in Konkan region of India by allocating seven treatment groups viz. T1- Giriraja × Dahlem Red, T2- Dahlem Red × White Leghorn, T3- Giriraja × Asselkala, T4- Dahlem Red × Giriraja, T5- Asselkala × Giriraja, T6- Dahlem Red pure and T7- Vanaraja pure under intensive system of management and reported that the feed conversion efficiency per dozen of eggs were significantly (P≤0.05) different between crossbred and purebreds during early and peak laying period. The result showed that feed consumption in early and peak laying period was highest at 829.78 and 855.68 g/day/bird in crossbreds than in the purebreds i.e. 787.00 and 840.80 g/day/bird but pure breeds utilized their feed more efficiently along with more gross returns as compared to crossbreds.

Ojo et al. (2012) Carried out an experiment comprising local chicken (Fulani Ecotype or FExFE), exotic chicken (Dominant Black or DBxDB), and their reciprocal crosses (DBxFE and FExDB) from day old to 21 weeks. They found that, FExFE had significantly (p<0.05) lower feed efficiency than all other groups (FExDB 69.18±0.03, DBxDB 68.78±0.03, DBxFE 68.50±0.02 > FExFE 67.50±0.02) over the same period.

Debata et al. (2012) reported that the feed conversion ratio at 4, 8, 12, 16, 20 and 24 weeks as 1.76, 1.76, and 1.83; 2.22, 2.08 and 2.16; 2.80, 2.68 and 2.76; 3.50, 3.22 and 3.40; 4.20, 3.77 and 4.07 and 5.09, 4.57 and 4.99, respectively, in Black Rock, Red Cornish and Vanaraja birds reared under intensive system of management in the coastal climatic condition of Odisha.

Jha et al. (2013) reported the feed conversion ratio as 4.82, 5.24 and 5.47 respectively in Hazra, Kadaknath and Aseel birds under intensive farming system at 40 weeks of age.

Dubey et al. (2013) conducted an experiment to study the juvenile growth rate and feed conversion efficiency in Kadaknath breed of fowl up to 20 weeks of age.
under intensive system of housing. The weekly feed conversion ratio were 2.82 ± 0.35, 2.75 ± 0.09, 2.56 ± 0.05, 2.46 ± 0.05, 2.26 ± 0.03, 2.09 ± 0.08, 2.32 ± 0.13 and 2.84 ± 0.12 for 1, 2, 3, 4, 5, 6, 7 and 8 weeks of age and 6.46 ± 0.06, 9.97 ± 0.37 and 12.56 ± 1.98 for 3, 4 and 5 months of age. The FCR was poor in Kadaknath birds as compared to fast growing birds.

Jha and Prasad (2013) reported that the feed conversion ratios of Vanaraja, Gramapriya and Aseel birds were 4.28, 3.85 and 5.47 respectively, up to 40 weeks of age under deep litter system of rearing.

Faruque et al. (2013) observed that FCR of non-descript desi (ND), hilly (H) and nakec neck (NN) genotypes were 3.58 ± 0.06, 3.45 ± 0.06, 3.34 ± 0.06, respectively. There was a non-significant (p > 0.05) variation in FCR among the native chicken genotypes. Growth rate affected feed conversion.

Ogbu et al. (2015) found the Feed conversion ratio of Light body weight and Heavy body weight of Nigerian indigenous chicken at 4th week were 9.07 ± 0.16 and 10.72 ± 0.07, respectively. Feed conversion ratios at 8th week were 8.11 ± 0.11 and 5.11 ± 0.86, respectively.

**Mortality**

A study was conducted to compare the performances of three genetic groups (Fayoumi( Fo), RIR, Fayoumi x RIR) with or without extra feeding to scavenging system of rearing up to 512 days of their age. It was observed that, mortalities of birds were highest in RIR i.e. 20%, intermediate in Fo x RIR (15%) and lowest in Fayoumi (10%). Extra feeding decreased mortality rate by approximately 35.5%. Genotype and feed supplementation were independent in effect on mortality. (Barua et al., 1998).

Castelini et al. (2001) studied on day old chicks of both sexes of Leghorn and cross bred of Leghorn x French female line for a period of 120 days. It was found that, the mortality rates (7%) of all the birds were very low and were not affected by genotype.
Howlider (2001) reported the mortality of Redbro × Redbro (RbRb), Redbro ×
Local naked-neck (RbNa), Local naked-neck × Redbro (NaRb) and Local naked-neck ×
Local naked-neck (NaNa) were 9.53, 3.53, 10.83 and 6.7%, respectively up to 56
days of age.

Haque (2005) stated that synthetic broiler perform better than commercial
broilers. In synthetic broiler, mortality was 0% as against 1.5 % for commercial
broilers and the difference was non-significant.

Parvin (2005) found 0% mortality in both synthetic and commercial broiler
during 1-5 weeks of age and the differences was non-significant (p>0.05).

Sarkar et al. (2008) conducted an experiment with commercial broiler,
cockerel and cross-bred (F1 RIR ♂ × Fayoumi ♀) chicks up to target body weights of
850, 1000 and 1250g. The highest mortality (8.3%) was found in cross-bred group
when reared up to target weight of 1250g. The mortality of broiler was 1.4% and no
bird was died in cockerel.

A study was carried out on four genotypes i.e. (DBXDB, DBXFE, FEXDB,
and FEXFE) to evaluate reproductive performance, mortality and egg quality traits
among them. Mortality was significantly (P<0.05) higher in the pure bred exotic
strain DBXDB (0.14) than other genotypes. Zero mortality in FExFE and DBxFE, and
low mortality in FExDB showed that pure bred FE and the cross bred adapted
favourably to the environmental condition. (Ojo et al., 2011).

A study was conducted on day-old chicks of each Fayoumi, Rhode Island Red
(RIR), RIR × Fayoumi and Fayoumi × RIR for a period of 20 weeks to compare the
growth performance, mortality pattern among them. The results showed that crossbred
chickens had lowest (P<0.05) mortality than pure bred chickens. The highest
mortality was recorded in RIR followed by Fayoumi chickens. In this study, the
mortality during the rearing period was higher than growing period in all types of
chickens; thus further managerial practice improvement was necessary to reduce the
mortality among the chicks regarding the fact that no particular infectious disease was
reported during the experimental period. Livability is a composite character which
concerns the question of the adaptive value for the organism. Furthermore, it related
to all physiological steps leading from genotype to the resultant phenotype. (Khawaja et al., 2012).

An experiment was conducted by Ojo et al. (2012) on local chicken (Fulani Ecotype or FExFE), exotic chicken (Dominant Black or DBxDB), and their reciprocal crosses (DBxFE and FExDB) from day old to 21 weeks of age. Mortality was Low mortality (≤ 2%) occurred across genotypes with FExFE had the least mortality.

Bharambe and Garud (2012) reported that the mortality pattern of improved crossbred and pure bred poultry were 5.71 and 4.76 per cent, respectively under intensive system of rearing in Konkan region of India.

Jha et al. (2013) conducted an experiment to see the production performance and mortality pattern of crosses of Dahlem Red and local Desi birds under intensive system of management. They reported that, mortality percentage in crosses were more than their parents but within the permissible limit. Mortality rate was higher in winter, lower in rainy and least during summer season. Mortality in the present study was mainly due to yolk sac infection, coryza, colibacillosis and coccidiosis. There was no outbreak or death due to specific diseases was observed during the course of study.

Jha et al. (2013) reported that the mortality percentage in three indigenous breeds viz. Hazra, Aseel and Kadaknath under intensive farming system were 7.28, 9.85 and 3.72 per cent, respectively.

An experiment was conducted on Fayoumi, RIR, RIR X Fayoumi (RIFI) and Fayoumi X RIR (FIRI) for a period of 72 weeks to compare the performance among them. The results showed that, the crossbred chickens had lower (P<0.05) mortality than purebred chickens. The highest mortality was recorded in RIR followed by Fayoumi chickens. In this study, no particular infectious disease was reported during the experimental period. Livability was a composite character concerning the question of the adaptive value for the organism. Furthermore, it related to all physiological steps leading from genotype to the resultant phenotype. (Khwaja et al., 2013)

Padhi et al. (2014) studied on the performance of PD1 x PD4 cross in farmer’s field under backyard system of rearing. They reported that, the mortality was 4.41 %
Review of Literatures

during brooding period. The mortality observed showed that out of the five farmers; in three farmers all the birds were killed by the predators like dogs and jungle cat during initial period before 8 wks of age in the field. This might be due to the birds were not able to protect themselves during the initial period as they were reared under confinement up to 6 wks of age. This indicated that the birds had to be taken care for initial period for protection from predators.

Kalita et al. (2014) recorded mortality (%) from 0 to 5th week in vanaraja and indigenous chicks were 11.23±1.62a and 7.04±0.86b, respectively.

**Linear body measurements**

Bharadwaj et al. (2005) studied on crossbred chickens such as Kadaknath, Aseel, Rhode Island Red, Brown Cornish, Kadaknath X Brown Cornish, Brown Cornish X Kadaknath, Rhode Island Red X Aseel and Aseel X Rhode Island Red, crosses. It was recorded that Keel bone length, Shank length and Breast angle were found significantly higher (p<0.05) in Rhode Island Red as compare to other purebred and crossbred chicken.

Chatterjee et al. (2007) reported the shank length, keel length and breast angle of Kadaknath and Aseel were 7.75 cm, 6.89 cm and 70.45° and 9.52 cm, 8.40 cm and 81.65°, respectively. The body conformation traits (shank length, keel length and breast angle) were significantly (P<0.05) higher in Aseel than Kadaknath. This discrepancy might be due to breed differences.

Ojo et al. (2009) found the body length was 28.56 ± 3.74 cm, keel length was 18.85 ± 1.93 cm, Shank Diameter was 6.68 ± 0.86 cm, shank length was 0.85 ± 0.07 cm in Fulani Ecotype chicken at 8th weeks of age.

Faruque et al. (2010) found the Shank Length (cm), Wattle length (cm), Body length (cm) of Non-descript Desi (ND), Hilly (H) and Naked Neck (NN) at 80 weeks of age were (10.35, 11.09, 11.09), (4.98, 4.09, 5.12) and (43.64, 45.74, 43.21), respectively. There was significantly positive relationship between body weight and shank length observed in all genotypes.
Semakula et al. (2011) recorded the body measurements (cm) of indigenous chicken of the Lake Victoria from 2-4 months and found the breast angle (degree) of females were 14.80, body girths were 18.0, shank lengths were 5.40, keel lengths were 7.40 and the body measurements in male chickens were; breast angle-12.90, body girth-16.09, shank length-4.57, keel length-6.30. The effect of age and sex was significant (P < 0.01) for all measurements. Males showed higher live body weights and other body measurements than their female counterparts (P < 0.01) while all body measurements, increased with age stagnated above eight months of age. Linear measurements reflect structure growth, thus were not expected to change much after maturity was attained. However, body weight and other non-linear measurements such as girth depended on changes in muscular and fat deposition.

Adebambo et al. (2011) obtained a diallel combination of four breeds of chickens; (Anak Titan (A), Alpha (B), Giriraja (G) and Normal indigenous (N) chickens) in a broiler improvement program. The chicks were reared up to 12 weeks in which data on weekly body weight (BW), breast girth (BG) and tibia length (TL) were recorded. Sire and dam genotype significantly (p<0.05) affected all traits. Anak Titan cocks and hens performed best in body weight (BW) with values ranged from 38.45 ± 0.74 g and 40.21 ± 0.66 g at day old to 1135.93 ± 35.67 g and 953.38 ± 35.38 g at week 12, respectively. Normal and Alpha improved indigenous performed better in linear body parameters. Results of diallel analysis to test for general and specific combining abilities of breeds on traits showed that additive genetic effects were important in determining BW and dominance effects were important for BG, while both effects were important in determining TL. This indicates that selection, crossbreeding and combination of both are tools needed to improve BW, BG and TL, respectively. Anak Titan had the best general combining ability (GCA) of 19.49 ±0.42, 288.54 ± 7.52, 458.78 ± 12.15 and 769.30 ±4.80 for BW at weeks 1, 4, 8 and 12, respectively and therefore recommended as a good breed for BW in the improvement program. GB crosses had the best SCA for BG and TL of 7.43 ± 0.11, 8.21± 0.16, 11.82 ± 0.22, 5.90 ± 0.29; 8.50 ± 0.10, 9.68± 0.10, 7.92 ± 0.34, 0.86 ± 0.30 at weeks 1, 4, 8 and 12 respectively. It was recommended that an improvement process that involves all the breeds should be adapted using reciprocal recurrent selection or modifications of it.
Ojedapo (2013) designed a study on Marshall broilers and revealed that the body lengths (BL) were 21.41 cm, shank lengths (SL) were 13.54 cm, breast girths (BG) were 11.9 cm while values of 18.14 cm were obtained for keel length (KL) at 8 weeks of rearing period.

**Carcass characteristics**

Castelini et al. (2001) studied with day old chicks of both sexes of Leghorn and cross breed of Leghorn x French female line (Sasso SA51) for a period of 120 days to compare the productive performance and carcass traits between them. The results showed the cross-bred male chickens had the higher carcass weight (1.82 kg; \(P<0.01\)), while the dressing percentage was not affected by gender and genotype. Leghorn chickens showed significantly (\(P<0.01\)) lowest fat depot (0.9 %) of ready-to-cook carcass. The carcass characteristics were not greatly affected by gender, the drumstick and breast yield percentage was significantly (\(P<0.01\)) higher in cross-bred (14.2 vs. 11.6 % of ready-to-cook carcass).

A study was designed to determine the meat yield traits of different fast growing broiler strains (Arbor Acres, ISA-Vedette and Hybro) at 6 weeks of age in winter. It had been found that ISA-Vedette gain the significantly (\(p<0.05\)) highest body weight (1521 g) followed by Hybro (1427g) and Arber Acres (1295g) Blood weight of male or female and their mean value were differed significantly (\(p<0.05\)) among the strains, where Hybro had the highest blood weight (6.35), intermediate on ISA-Vedette (5.60g) and the lowest in Arbor Acres (5.47g). Feather and shank weight within male and female, and their average value among the strains did not differ significantly (\(p>0.05\)). However, these were found highest in Hybro (4.78), intermediate in Arbor Acres (4.58) and the lowest in ISA-Vedette(4.52). Giblet weight was found to be highest on Arbor Acres (4.66) followed by ISA-Vedette and Hybro broiler (\(p<0.05\)). The significant difference were not found among the strains for head weight and dressing yield. However, ISA-Vedette produced the highest percentage of dressing yield (73.63%). Hybro and Arbor Acres produced dressing yield by 72.53 and 72.50% respectively. (Sarker et al., 2002).

Chatterjee et al. (2007) conducted an experiment on cross of Brown Nicobari male with ILI-80(White Leghorn) female and cross of ILI-80 male with Brown
Nicobari female under intensive and extensive management system for different growth and carcass traits. The results showed the average live weights of male progeny of the cross of Brown Nicobari (M) X ILI-80 (F) were significantly (p<0.05) higher than the male progeny of its reciprocal cross at 24 weeks of age. There was no significant difference for evisceration percentages between the two genetic groups. Significant (P<0.05) differences between the two genetic groups for feather, back, gizzard and testis were observed. The cut-up parts for back, neck and breast differed significantly (P<0.05) between the two genetic groups. However, the weight of blood, head, neck, wings, breast, shank, thigh, liver and heart did not differ significantly among these genetic groups. Different particulars of carcass traits differed which might be due to genetic group differences.

A study was carried out to compare the growth performance and meat quality parameters of three-way crossbred chickens (White Leghorn male x F1 female) (Fayoumi male x Rhode Island Red(RIR) female with reciprocal F1 crossbred chickens (RIR X Fayoumi). Results revealed the non-significant difference (p>0.05) in dressing percentage among all crossbred chickens. Numerically, the highest dressing percentage was found in FIRI (62.60%) followed by RIFI (62.40%) and RLH (62.10%) chickens. (Khwaja et al., 2013).

Bosco et al. (2014) performed a trial to examine the performance and meat quality of pure Ancona and Cornish × Ancona chicken reared organically. The results revealed that all performance traits of Cornish × Ancona birds were better (P < 0.05) than Ancona birds, except for mortality rate which was 10% in both the groups. Crossbreds showed higher slaughter weight (2369g) respect to pure Ancona (1874g) chickens with a contrary trend in feed intake that obviously affected feed efficiency. Daily weight gain followed the same trend of body weight. Birds of Ancona group were (P < 0.01) leaner (1.30 %) in respect to the Cornish × Ancona ones (2.14%). The proportion of breast meat yield, breast width, thigh and the meat to bone ratio were greater in Cornish × Ancona chickens.

The aim of the study was to determine the effect of genotype and sex at 48 weeks of age on carcass traits of four breeds of chicken. A total of 48 chickens from four genotypes were used with 24 males and 24 females. Two chicken (1 male and 1 female) weighing average of flock weight from each replication of 4 genotypes were
selected and slaughtered for processing individually. Meat yield characteristics of slaughtered chickens were recorded. The results revealed that the live weight of male chickens were higher than females counterpart. Deshi chicken had the highest value in dressing percentage (66.80), thigh meat, breast meat, dark meat and drumstick meat followed by Fayoumi, Rhode Island Red (RIR) and Sonali chickens (58.50). All genotypes, males had higher meat yield than female counterparts. The sex differences in all genotypes, Deshi and RIR male chickens were higher than female. On the other hand, Deshi and RIR female chickens were higher value in dressing and breast meat produced than their male counterparts. The results of giblet, gizzard, heart, liver and spleen were found higher in Deshi chicken except in liver weight which was higher in Sonali chicken. Giblet, gizzard and spleen yield were higher in females than males except in liver and heart which were higher in males than females. The above findings revealed that males had higher meat yield than Female counterparts. (Jahan et al., 2015).

Padhi et al. (2015) performed a study to evaluate the growth and carcass quality traits of a three-way cross chicken developed for backyard poultry. The two-way cross PD1 X IWI males were crossed with PD3 females to produce three-way cross (PD1 X IWI X PD3). The crossbred was evaluated for different traits up to 72 weeks of age. The results showed the pre-slaughter body weight of the male was 1723 g, which seems to be appropriate for the backyard poultry. Carcass quality measured at 16 week of age recorded 66.12% eviscerated carcass yield, 4.84% giblet and 0.30% abdominal fat. Abdominal fat % was low in the present study. Low abdominal fat indicates the leanness of the male birds and may be very useful for the consumers who prefer lean meat of the local birds.

**Proximate composition of meat**

Fujimura et al. (1996) also recorded in case of different broiler strains. It was suggested that water contents differed significantly with breed.

Zollitish et al. (1997) found that there was no significant difference of dry matter between thigh and organoleptic traits of breast meat and also demonstrated no difference of fat between both.
Sogunie et al. (2010) conducted an experiment to compare chemical composition and quality of carcass parts of Arbor Acre and Marshal MY strains broiler chicken. It was found the mean values of breast muscle of Arbor Acre and Marshal MY were Dry matter - 27.78±0.055 and 29.88±0.035, respectively, Crude protein-26.60±0.101a and 25.49±0.210b, respectively. Fat- 29.72±0.021, 9.92±0.078, Crude fibre -20.00±0.000 and 0.00±0.00 Ash 11.21±0.020 and 11.73±0.620, respectively. In thigh muscle the findings were Dry matter 26.25±0.067b, 28.73±0.019a Crude protein 29.92±0.101a, 28.99±0.156b Fat 7.95±0.061, 8.08±0.075 Crude fibre 0.00±0.00, 0.00±0.00. Ash 13.40±0.032, 12.42±0.682, respectively. The results on the proximate composition(p<0.05) of the muscles showed that values obtained for the thigh gross energy (2.11 kcal/g), thigh dry matter (28.73%), thigh fibre diameter (5.24 mm), thigh fat (8.08%), breast dry matter (29.88%) and breast fibre diameter (5.54 mm) were higher in Marshal MY strain. Hence meat quality is a function of genotype and environmental factors.

An experiment was conducted to determine the effect of genotype (slower-growing vs. fast-growing) and production system (access to outdoors vs. indoor) on the growth performance, carcass yield and meat quality chickens. Day-old hybrid male chickens of two genotypes, slower-growing chickens (Hubbard JA957, certified) and fast-growing chickens (Hubbard F15) were taken and fed identical diets until 65 days of age. Compared with fast-growing, slower-growing chickens were significantly lighter (by 17%), had a lower breast and thigh muscle yield and a higher abdominal fat content, but they were characterized by higher survival rates at 65 days, a higher protein content and a lower fat content of breast meat. The dry matter, fat%, protein % of slow growing genotype and fast growing genotype were (25.86, 0.76, and 24.53) and (25.57, 1.17, 24.04), respectively. Outdoor access had no negative effects on the growth performance, muscle yield, the fatty acid profile and oxidative status of meat lipids. The meat of free-range chickens were darker in colour, it had a higher protein content and a better water-holding capacity, but it was less juicy than the meat of birds raised indoors. (Mikulski et al., 2011).

An experiment was conducted to study the proximate composition and meat quality of broilers reared under different production system. Males and females of two free-range broiler strains (Super Pesadão and Paraíso Pedrês) and one conventional
broiler strain (Cobb®). Free-range chickens were slaughtered at 85 days of age, and the conventional broilers were slaughtered at 45 days. The moisture content, protein content, ether extract, ashes content (%) of thigh muscle of Super pesadao, Paraiso Pedres, Cobb were (77.15, 77.23, 76.14), (19.41, 19.79, 19.86), (2.85, 2.65, 2.88) and (0.95, 0.91, 0.90) %, respectively. The moisture content, protein content, ether extract, ashes content (%) of breast muscle of super Pesado and Paraiso Pedres, cobb were (75.26, 75.62, 75.5), (22.61, 22.48, 22.49), (0.73, 0.68, 0.67), (0.95, 1.00, and 0.96), respectively. As to proximate composition, there was an interaction between strain and sex, with higher breast ether extract values and highest ash content values in the meat of Super Pesadão males. (Souza et al., 2011).

Khwaja et al. (2012) conducted a comparative study on meat composition of Fayoumi, Rhode Island Red(RIR) and their reciprocal crossbred chickens (RIFI, FIRI) and it was found that the dry matter, crude protein, crude fat, total ash (%) of breast muscle and thigh muscle of Fayoumi, RIR, RIFI, FIRI were( 27.30, 83.60, 6.75, 4.25 and 29.32, 67.42, 17.69, 5.00), (26.83, 84.10, 6.55, 4.21 and 28.36, 67.35, 17.89, 5.00), (27.35, 83.65, 6.48, 4.23 and 29.35, 67.45, 18.20, 5.10) and( 26.75, 84.25, 06.59, 4.25 and 28.46, 67.55, 18.56, 5.00) respectively at 20 weeks of age. The breast and thigh meat composition had no significant (P>0.05) difference among pure and crossbred chickens. Poultry meat quality attributes might be affected by several factors such as genotype, rearing condition and feeding that impact on muscle metabolism as well as on chemical composition. Overall comparison of dry matter between breast and thigh revealed that there was higher percentage of dry matter in thigh muscle than breast in all breeds.

An experiment was conducted by (Debata et al. 2012) to evaluate the growth performance and carcass traits of three coloured breeds of chicken, Black Rock, Red Cornish, and Vanaraja. The moisture content in meat of the three breeds were 73.87, 74.79 and 73.41%, respectively in the males. The CP% of the male birds of the three breeds were 22.29, 21.57 and 22.18%, respectively. Similarly the proximate composition of the female birds showed that the moisture % varied from 74.44 to 75.61. The CP content of the three breeds were 20.12, 19.81 and 19.03%. There was no significant difference (P>0.05) in any of the proximate composition of the meat like moisture %, crude protein %, ether extract % and ash % of the male and female
birds. But there was less CP % of the meat of the females than males probably due to higher leg muscle of the males. The ether extract % of meat of the both males and females varied from 3.26 to 4.73% which was in lower side than whole body meat because the meat taken for analysis was only from the leg muscle.

Choo *et al.* (2014) conducted an experiment to compare the growth performance, carcass characteristics, and meat quality of the egg type male growing chicken (EM), white-mini broiler (WB), and commercial broiler (ROSS 308, CB). The moisture content of EM (72.77%) was the lowest (p<0.05), and the protein content (25.19) was highest (p<0.05), where as the fat and ash content were not different among groups. Fat % was highest (1.77) in EM and lowest in CB (1.74) and ash % was highest in CB (0.29) and lowest in ME (0.27).
MATERIALS AND METHODS

Experimental programme

Location of Research work

The experiment was carried out in the Poultry Complex of the faculty of Veterinary Science and Animal Husbandry, Orissa University of Agriculture and Technology, Bhubaneswar. It is situated 63 km away from Bay of Bengal and has an altitude of 255 m above mean sea level. Geographically it is located at 20°15' North Latitude and 85°50' East longitude. Average maximum temperature ranges from 35°C to 40°C and average minimum temperature ranges from 13°C to 15°C. The relative humidity ranges from 40% to 95%. Average annual rainfall is about 1522 mm, out of which 1293 mm is received during June to September and rest 229 mm is received during October to May as per Agromet services, OUAT.

Birds, feeding and management

Selection of genotypes

Performance of two genotypes of broiler chicken was utilized in the study. The genotypes were; (i) Group-I: Colored synthetic broiler (CSML ♂ x CSFL ♀) crosses; (ii) Group-II: (Hansli x CSML) ♂ x CSML ♀ crosses. Adult Colour synthetic male line (CSML) males and Colour synthetic female line (CSFL) females at the age of 40 weeks were housed in breeding pens in the ratio 1:7. Seven CSML males and fifty CSFL females were used for the cross breeding. Simultaneously, (Hansli X CSML) males and as well as CSML females were maintained in the same ratio to obtain pure eggs. Eggs from two genetic groups were collected daily for ten days, identified appropriately with markers and set in the incubator. A total of 120 straight run day-old chicks, 60 each of the 2 genotype groups were taken and divided into 3 replicates each comprising 20 chicks. The chicks were numbered by wing band, weighed and randomly distributed in separate pens according to treatments.
Housing of the birds

The experimental shed was properly cleaned and washed by using tap water. Ceiling, walls and floor were thoroughly cleaned and disinfected by using malathion solution (5ml: 1 litre water). After cleaning and disinfection, the house was left vacant for two weeks. The floor space allotted per bird was 1 sq ft. Rice husk and saw dust at a depth of about 5 cm was used in the experimental shed as litter material. Cleaned and disinfected feeder and waterer were provided to each replicate group housed in particular pen. The chickens of all treatments were provided with identical care and management throughout the experimental period. Proper hygiene and strict sanitary measures were taken during the experimental period. Waterers were washed and cleaned daily in the morning and feeders were washed and cleaned weekly before being used. Potash was used to disinfect the feeders and waterers.

Vaccination schedule

The experimental birds were vaccinated against Marek’s disease on the first day. On 6th and 21th day, vaccination was done for Ranikhet disease (Lasota strain). IBD vaccination for Gumboro disease was done on 14th and 28th day.

Brooding and lighting management

The chicks were brooded up to three weeks with a brooding space of 0.5 ft²/chick by using a 100 watt bulb in each experimental shed. The temperature on the brooding floor, at the edge of the heat source, was maintained at 32 to 35°C (90-95°F) for the first week. The temperature was reduced by 3°C (5°F) every week till a temperature of 20°C (70°F) was reached.

Feeds and feeding

Adlibitum feeding was done and the amount consumed was recorded daily. Experimental chickens were fed with a standard broiler starter ration containing 22 % crude protein and 3150 kcal/ kg ME for four weeks followed by a finisher diet containing 20 % crude protein and 3150 kcal/ kg ME from fifth week till the end of the experiment at eight weeks.
Materials and Methods

Composition of rations

| Sl. No. | Ingredients(kg) | Starter mash | Finisher mash |
|---------|----------------|--------------|---------------|
| 1       | Maize          | 60           | 60            |
| 2       | Soya bean meal | 34           | 30            |
| 3       | De-oiled rice bran | 2.5  | 1.5          |
| 4       | Vegetable oil(lt) | 3.5  | 5.5          |
| 5       | Mineral mixture | 3            | 3             |

Nutritive value

| Sl. No. | Nutrient | Starter mash | Finisher mash |
|---------|----------|--------------|---------------|
| 1       | CP%      | 22           | 20            |
| 2       | ME(kcal/kg) | 3150       | 3150          |

Composition of feed additives

| Sl. No. | Ingredient(g) | Starter mash | Finisher mash |
|---------|---------------|--------------|---------------|
| 1       | Vel dot       | 50           | 200           |
| 2       | Toxin binder  | 200          | 100           |
| 3       | Trace mineral | 100          | 100           |
| 4       | Choline       | 50           | 50            |
| 5       | Vetrinmix- DS | 10           | 10            |
| 6       | Ambiplex-E    | 25           | 25            |
| 7       | Methionine    | 100          | 100           |
| 8       | Lysine        | 100          | 100           |
| 9       | Salt          | 300          | 300           |

Feed was given on sheet during the first week and water were supplied in fountain waterer. After two weeks, trough feeder and round waterer were used. Chicks were supplied with 5% glucose solution on arrival in the experimental shed to overcome stress. After that they were supplied with solutyl (tylosin tartrate) at a dose rate of 8g/1000 chicks and tetracycline (5g in 4.5 litres) in drinking water for another 3 days. On 5th and 6th day, they were supplied with curd in water. Multi –vitamin premix (Vimeral, Vetitone) supplied on 7th, 21st, and 35th day. Coccidiostat was supplied on 25th day at a dose rate of 30 g in 25 litres of drinking water for 3 days. Feed and fresh drinking water were supplied to the experimental chickens daily in the morning and in the afternoon.
Biosecurity measures

Adequate hygienic measures and appropriate sanitation programmes were carried out during the experimental period. The experimental area was restricted by making fences and was kept open only to researcher, supervisor and workers related to the experiment by following special care. Before entrance into the experimental shed, special hygienic and sanitary measures were taken to avoid the entrance of diseases and germs from outside. Hands and feet were washed with soap; feet were dipped in a water bath containing disinfectant and clean apron was worn as a part of hygienic measurement. Hygienic management of feeding, watering, vaccination programs and litter management were taken during the experimental period. Disinfectants and bleaching powder were regularly sprayed on the road and surroundings of the experimental shed to prevent disease outbreak and kerosene was spread carefully to control ant.

The experiment was conducted for a period of 8 weeks from 3rd April to 28th May 2016.

Parameters studied

Body weight

Live weight of mixed sexes was recorded at day-old followed by weekly intervals up to 8 weeks of age using a digital electronic balance nearest to 1.0 g accuracy. The birds were weighed in the morning before supplying the feed.

Body weight gain

Weekly cumulative body weight gain was calculated by subtracting the day-1 average body weight from the weekly average body weight of the respective week.

Feed intake

The amounts of feed supplied from day-old to 8 weeks were recorded replicate-wise on weekly basis. Adlibitum feeding was practiced and the feed offered
was recorded. The left over feeds were weighed weekly and the amount of feed intake by the birds for that week was calculated.

- Cumulative feed intake (g/bird) = \( \frac{\text{Total feed consumed up to a particular week}}{\text{No of birds}} \)

**Feed conversion ratio (FCR)**

Feed conversion ratio (FCR) was calculated by using the following formula:

- Cumulative FCR = \( \frac{\text{Feed consumed (g) up to a particular week}}{\text{Body weight gained (g) up to that week}} \)

**Mortality**

Mortality of the chick was recorded daily replicate-wise. The mortality of all the chicks of the replicate groups belonging to a treatment were added and expressed on weekly basis.

**Body linear measurements**

All body linear measurements were determined at 6 week and 8 week using measuring tapes (calibrated in centimetres) except breast angle which was measured by goniometer. The procedures used for measuring the various traits were as follows:

1. **Beak length**: Distance between the base and tip of the beak
2. **Head width**: The widest region in the head.
3. **Breast angle**: A goniometer was placed at 1cm from the extreme of the tool had to be adjusted on the left breast and the mobile arm, on the right breast and expressed as degree.
4. **Shank length**: Length of the tarso meta-tarsus from the hock joint to the meta-tarsal pad of the bird.
5. **Shank width**: Diameter of the tarso meta-tarsus just below the spur of the individual bird.
6. **Body length**: Distance from the tip of the beak through the body trunk to the tail.
7. **Height of the bird**: Measured from tip of the beak to the tip of the middle toe.
8. **Body girth**: Circumference of breast region of the bird.
9. **Keel length**: It was measured from the chest bone to the end towards the abdomen region.
Carcass traits

At the end of eight weeks, six healthy birds, one from each replicate were sacrificed for carcass parameters. Two male and one female from each treatment group of (Hansli x CSML♂ x CSML♀) and (CSML♂ x CSFL♀) were taken to record their carcass parameter. The details of the procedure are outlined below.

Before slaughter the selected birds were deprived of feed but not water for 12 hours to facilitate proper bleeding and also to know their actual live weights. Birds were weighed individually in the morning prior to sacrifice for record of live weight.

The birds were sacrificed by improved Kosher method by severing the jugular vein and carotid artery below the left ear lobe by a single incision and allowed to bleed for five minutes. After complete bleeding and cessation of movement the carcass weight was recorded. The carcass was then scalded at 55-58°C for 1 minute 30 seconds and de-feathered manually starting from the tail, wing sides, legs, back and neck region of the scalded bird. Left over pin feathers were removed with pinning knife. The oil gland from the tail region, the head from the occipital joint and the feet from the hock joint were severed and removed.

Evisceration was performed by giving a transverse incision at the abdomen between the keel and vent and then a circular incision around the vent to cut open the abdominal cavity. The entire visceral organs were pulled out through the opening made. The inedible organs like wind pipe, oesophagus, crop and all other portions of the intestinal tract, vent, spleen, lungs, epicardium, testes and gall bladder were separated from it. The arteries were trimmed and the heart was removed from the viscera. The pericardium and blood clots were removed from the heart. The gizzard was removed by cutting it loose in front of the proventriculus and then cutting both incoming and outgoing tracts. Then, it was split open with knife, emptied and washed and the lining removed by hand.

The eviscerated carcass along with the edible offal was weighed and recorded as edible carcass yield. The total meat yield was calculated by subtracting the giblet weight (the weight of the heart without pericardium, liver without gall bladder and gizzard without the serous lining) from the weight of the edible carcass.
Percentage yield of different carcass traits

All the above recorded weights were subjected to further analysis to get their respective percentage yield, based on the calculation given below.

(a) Dressing % = \( \frac{\text{Dressed weight}}{\text{Live weight}} \times 100 \)

(b) Giblet Weight % = \( \frac{\text{Giblet weight}}{\text{Live weight}} \times 100 \)

(c) Neck % = \( \frac{\text{Neck weight}}{\text{Eviscerated weight}} \times 100 \)

(d) Wings % = \( \frac{\text{Wing weight}}{\text{Eviscerated weight}} \times 100 \)

(e) Breast % = \( \frac{\text{Breast weight}}{\text{Eviscerated weight}} \times 100 \)

(f) Back % = \( \frac{\text{Back weight}}{\text{Eviscerated weight}} \times 100 \)

(g) Thigh % = \( \frac{\text{Thigh weight}}{\text{Eviscerated weight}} \times 100 \)

(h) Drumstick % = \( \frac{\text{Drumstick weight}}{\text{Eviscerated weight}} \times 100 \)

Chemical analysis of meat

Proximate composition

The proximate composition such as moisture, crude protein, ether extract and total ash content of the chicken meat from the breast and thigh muscles were made according to the procedure of AOAC (1995).

Moisture: About 20g of minced meat was taken in an aluminum moisture cup and dried in a hot air oven for 18 hours at 100±5°C. The cups were cooled in
Materials and Methods

desiccators and weighed. This process was repeated till a congruent weight was obtained. Loss in weight was reported as moisture content.

Crude protein (Micro-Kjeldahl distillation method): About 2g minced meat was weighed and transferred to a kjeldahl flask. 25 ml of conc. H$_2$SO$_4$ and a pinch of digestion mixture (95 parts sodium sulphate and 5 parts copper sulphate) was added to it and digested until the solution turned colourless. The digested samples were made to 250 ml volume by adding distilled water. 5 ml of the aliquot was taken in to a micro-kjeldahl distillation unit and 10 ml of 40% sodium hydroxide was added to it and 10 ml of Tashiros’s indicator was taken in a conical flask and the sample was heated by passing steam in to it until 30 ml of distilled was collected in the conical flask. Then it was titrated with standard N/10 H$_2$SO$_4$ to light pink end point.

\[
\text{Total protein } \% = \frac{\text{ml of N/10 H}_2\text{SO}_4 \text{ consumed} \times 0.0002 \times 250 \times 6.25 \times 100}{\text{Weight of the sample aliquot} \times \text{volumetaken}}
\]

Ether extract: About 2g of minced meat was taken in a thimble and extracted for 8 hours with petroleum ether (B.P. range 40-60$^0$C) in a Soxhlet extractor. Flasks were dried in the oven at 80$^0$C for 30 minutes and then cooled in desiccators and weighed.

\[
\text{Ether extract } \% = \frac{W_2 - W_1}{W_0} \times 100
\]

Where $W_0$ = weight of the sample

$W_1$ = Weight of empty oil flask

$W_2$ = Weight of oil flask + ether extract

Total ash: About 2g of minced meat was weighed in silica crucible and heated until charred. The crucible was then placed in a muffle furnace at 600$^0$C for one hour until white ash was obtained. The crucible was cooled in desiccators and weighed. This process was continued till a constant weight was obtained.

\[
\text{Total Ash } \% = \frac{W_2 - W_1}{W_1 - W_0} \times 100
\]

Where $W_0$ = Weight of the empty crucible

$W_1$ = Weight of empty crucible with sample

$W_2$ = Weight of the crucible with ash
Statistical analysis

The data obtained from the study were statistically analyzed according to Snedecor and Cochran (1994). The data were analyzed for t-test to test the difference between means wherever necessary.
Figure 3.1: Eggs in incubator tray
Figure 3.2: Candling of eggs
Figure 3.3: Chicks in hatcher
Figure 3.4: Recording of body weight at day old
Figure 3.5: Brooding of chicks
Figure 3.6: ND vaccination on 6\textsuperscript{th} day

Figure 3.7: Birds in deep litter system of housing

Figure 3.8: Recording of body weight at 8 week of age

Figure 3.9: Weighing of residual feed
Figure 3.10: Measurement of breast angle

Figure 3.11: Measurement of keel length

Figure 3.12: Measurement of shank length

Figure 3.13: Measurement of body length

Figure 3.14: Measurement of beak length

Figure 3.15: Measurement of body girth
Figure 3.16: Dressed bird
Figure 3.17: Weighing of wings
Figure 3.18: Weighing of drumstick
Figure 3.19: Weighing of gizzard
Figure 3.20: Weighing of liver
Figure 3.21: Weighing of thigh
CHAPTER-4

RESULTS
RESULTS

Body weight

The mean weekly body weights for the chicks in the two groups are presented in Table 4.1. and Fig 4.1. The body weights increased progressively from day 0 till the end of the 8\textsuperscript{th} week. For the chicks in group-I and group-II, respectively, the body weights recorded were 41±0.37 and 39.82±0.52 in day 0, 101.07±1.78 and 85.74±1.78 in 1\textsuperscript{st} week, 204.17±4.57 and 159.81±4.39 in 2\textsuperscript{nd} week, 363.70±8.06 and 272.86±9.57 in third week, 537.02±11.52 and 406.45±12.86 in 4\textsuperscript{th} week, 699.80±15.86 and 524.80±18.03 in 5\textsuperscript{th} week, 873.80±20.87 and 649.24±19.86 in 6\textsuperscript{th} week, 1074.80±24.65 and 804.33±24.46 in 7\textsuperscript{th} week, and 1354.39±29.35 and 995.47±28.96 in 8\textsuperscript{th} week.

While the initial body weights at day 0 were not significantly (p ≥ 0.05) different between the groups, the chicks in group-I registered significantly (p ≤ 0.01) higher weights compare to those in group-II at every stage from 1\textsuperscript{st} to 8\textsuperscript{th} week.

Table 4.1 Weekly body weight (g) of chicks

| Age (Weeks) | Group - I  | Group - II | Significance |
|-------------|------------|------------|--------------|
| 0 day       | 41±0.37    | 39.82±0.52 | NS           |
| 1\textsuperscript{st} | 101.07±1.68 | 85.74±1.78 | **           |
| 2\textsuperscript{nd} | 204.17±4.57 | 159.81±4.39 | **           |
| 3\textsuperscript{rd} | 363.70±8.06 | 272.86±9.57 | **           |
| 4\textsuperscript{th} | 537.02±11.52 | 406.45±12.86 | **           |
| 5\textsuperscript{th} | 699.80±15.86 | 524.8±18.03 | **           |
| 6\textsuperscript{th} | 873.80±20.87 | 649.24±19.86 | **           |
| 7\textsuperscript{th} | 1074.80±24.65 | 804.33±24.46 | **           |
| 8\textsuperscript{th} | 1354.39±29.35 | 995.47±28.96 | **           |

* Mean values differ significantly (p≤0.05)

** Mean values differ significantly (p≤0.01)
**Results**

Fig. 4.1 Weekly body weight (g) of chicks

Fig. 4.2 Weekly cumulative weight gain (g) of chicks
Body weight gain

The mean weekly cumulative weight gains for the chicks in the two groups are presented in Table 4.2 and Fig 4.2.

The weight gains increased progressively from 1\textsuperscript{st} week till the end of the 8\textsuperscript{th} week. For the chicks in group-I and group-II, respectively, the weight gains recorded were 60.07±0.63 and 45.92±0.63 in 1\textsuperscript{st} week, 163.16±3.91 and 120.00±2.75 in 2\textsuperscript{nd} week, 316.64±7.16 and 233.03±10.56 in 3\textsuperscript{rd} week, 487.07±11.73 and 366.63±13.49 in 4\textsuperscript{th} week, 647.14±0.81 and 484.98±18.04 in 5\textsuperscript{th} week, 818.24±17.20 and 609.42±21.41 in 6\textsuperscript{th} week, 1015.89±8.49 and 764.52±9.56 in 7\textsuperscript{th} week, and 1290.82±12.72 and 955.65±18.34 in 8\textsuperscript{th} week.

The chicks in group-I recorded significantly (p ≤ 0.05 or 0.01) higher gains compared to those in group-II at every stage from 1\textsuperscript{st} to 8\textsuperscript{th} week.

Table 4.2 Weekly cumulative weight gain (g) of chicks

| Age (weeks) | Group-I       | Group-II      | Significance |
|-------------|---------------|---------------|--------------|
| 1\textsuperscript{st} | 60.07±0.63    | 45.92±0.63    | **           |
| 2\textsuperscript{nd} | 163.16±3.91   | 120.00±2.75   | *            |
| 3\textsuperscript{rd} | 316.64±7.16   | 233.03±10.56  | *            |
| 4\textsuperscript{th} | 487.07±11.73  | 366.63±13.49  | **           |
| 5\textsuperscript{th} | 647.14±0.81   | 484.98±18.04  | **           |
| 6\textsuperscript{th} | 818.24±17.20  | 609.42±21.41  | *            |
| 7\textsuperscript{th} | 1015.89±8.49  | 764.52±9.56   | **           |
| 8\textsuperscript{th} | 1290.82±12.72 | 955.65±18.34  | **           |

* Mean values differ significantly (p≤0.05)
** Mean values differ significantly (p≤0.01)

Feed intake

The mean weekly cumulative feed intakes for the chicks in the two groups are presented in Table 4.3 and Fig 4.3.

The feed intake increased progressively in successive weeks from 1\textsuperscript{st} to 8\textsuperscript{th} week. For the chicks in group-I and group-II, respectively, the intakes recorded were 94.17±4.17 and 73.34±1.67 in 1\textsuperscript{st} week, 379.00±19.52 and 314.67±4.67 in 2\textsuperscript{nd} week,
Results

777.25±18.64 and 687.50±16.33 in 3rd week, 1158.30±22.14 and 1053.50±19.04 in 4th week, 1725.04±23.75 and 1500.50±15.18 in 5th week, 2412.31±44.10 and 1930.52±34.91 in 6th week, 3073.72±55.22 and 2425.65±37.32 in 7th week, and 3955.73±74.01 and 3112.32±26.35 in 8th week.

The chicks in group-I showed higher intakes in every week compared to those in group-II. The differences are found significant (p < 0.05 or 0.01) at 1st, 5th, 6th, 7th and 8th week.

Table 4.3 Weekly cumulative feed intake (g) of chicks

| Age     | Group-I      | Group-II     | Significance |
|---------|--------------|--------------|--------------|
| 1st week| 94.17±4.17   | 73.34±1.67   | *            |
| 2nd week| 379.00±19.52 | 314.67±4.67  | NS           |
| 3rd week| 777.25±18.64 | 687.50±16.33 | NS           |
| 4th week| 1158.30±22.14| 1053.50±19.04| NS           |
| 5th week| 1725.04±23.75| 1500.50±15.18| *            |
| 6th week| 2412.31±44.01| 1930.52±34.91| **           |
| 7th week| 3073.72±55.22| 2425.65±37.32| **           |
| 8th week| 3955.73±74.01| 3112.32±26.35| **           |

* Mean values differ significantly (p<0.05)
** Mean values differ significantly (p<0.01)

Feed conversion ratio

The mean weekly cumulative FCRs for the chicks in the two groups are presented in Table 4.4 and Fig 4.4.

The FCR increased with advance in age from 1st to 8th week. For the chicks in group-I and group-II, respectively, the FCRs recorded were 1.57±0.09 and 1.60±0.06 in 1st week, 2.32±0.07 and 2.62±0.07 in 2nd week, 2.46±0.04 and 2.96±0.07 in 3rd week, 2.38±0.06 and 2.88±0.05 in 4th week, 2.67±0.04 and 3.10±0.06 in 5th week, 2.95±0.06 and 3.17±0.12 in 6th week, 3.03±0.07 and 3.17±0.07 in 7th week, and 3.07±0.06 and 3.26±0.08 in 8th week.

The chicks in group-II showed higher FCRs as compared to those in group-I at every week till the end of the experiment. The differences were found significant (p ≤ 0.01) at 2nd, 3rd, 4th and 5th week.
Results

Fig 4.3 Weekly cumulative feed intake of chicks

Fig 4.4 Weekly cumulative FCR of chicks
Table 4.4 Weekly cumulative FCR of chicks

| Age    | Group-I   | Group-II   | Significance |
|--------|-----------|------------|--------------|
| 1st week | 1.57±0.09 | 1.60±0.06  | NS           |
| 2nd week | 2.32±0.07 | 2.62±0.07  | **           |
| 3rd week | 2.46±0.04 | 2.96±0.07  | **           |
| 4th week | 2.38±0.06 | 2.88±0.05  | **           |
| 5th week | 2.67±0.04 | 3.10±0.06  | **           |
| 6th week | 2.95±0.06 | 3.17±0.12  | NS           |
| 7th week | 3.03±0.07 | 3.17±0.07  | NS           |
| 8th week | 3.07±0.06 | 3.26±0.08  | NS           |

* Mean values differ significantly (p ≤ 0.05)

** Mean values differ significantly (p ≤ 0.01)

Mortality

The week-wise incidences of mortality for the chicks in the two groups are presented in Table 4.5.

While there was no mortality in group-II, group-I recorded one mortality in 3rd week. Thus, the incidence of mortality recorded were 1.66 % and 0% for the chicks in group-I and group-II, respectively.

Table 4.5 Weekly mortality of chicks

| Age    | Group-I | Group-II |
|--------|---------|----------|
| 1st week | 0       | 0        |
| 2nd week | 0       | 0        |
| 3rd week | 1       | 0        |
| 4th week | 0       | 0        |
| 5th week | 0       | 0        |
| 6th week | 0       | 0        |
| 7th week | 0       | 0        |
| 8th week | 0       | 0        |
| Total   | 1       | 0        |
| Mortality % | 1.66 | 0        |
Body linear measurements

The mean body linear measurements for the chicks in the two groups recorded at 6th and 8th week are presented in Table 4.6.

For the chicks in group-I and group-II and at 6th and 8th week, respectively, the values recorded were 50.65±0.21 vs. 55.54±0.24 and 59.99±0.35 vs. 59.00±0.27 for breast angle, 2.63±0.08 vs. 3.00±0.02 and 3.38±0.07 and 3.34±0.33 for beak length, 5.38±0.10 vs. 4.07±0.68 and 6.12±0.05 vs. 4.57±0.07 for head length, 2.31±0.02 and 3.50±0.08 vs. 2.91±0.05 for head width, 32.92±0.30 vs. 28.3±0.25 and 36.55±0.31 vs. 34.41±0.44 for body length, 28.80±0.18 vs. 23.54±0.14 and 34.38±0.20 vs 30.05±3.94 for body girth, 8.23±0.17 vs 7.25±0.07 and 10.90±0.12 vs. 8.9±0.12 for shank length, 1.76±0.04 vs. 1.45±0.01 and 2.12±0.04 vs. 1.60±0.02 for shank width, 9.15±0.12 vs. 8.13±0.05 and 12.33±0.15 vs. 9.86±0.13 for keel length, 32.63±0.30 vs. 29.28±0.17, and 38.65±0.20 vs. 34.53±0.50 for body height.

| Parameter         | 6th week Group-I | 6th week Group-II | Significance | 8th wk Group-I | 8th wk Group-II | Significance |
|-------------------|------------------|------------------|--------------|----------------|----------------|--------------|
| Breast angle      | 50.65±0.21       | 55.54±0.24       | **           | 59.99±0.35     | 59.00±0.27     | NS           |
| Beak length       | 2.63±0.08        | 3.00±0.02        | *            | 3.38±0.07      | 3.34±0.33      | NS           |
| Head length       | 5.38±0.10        | 4.07±0.68        | **           | 6.12±0.05      | 4.57±0.07      | **           |
| Head width        | 2.86±0.06        | 2.31±0.02        | *            | 3.50±0.08      | 2.31±0.05      | **           |
| Body length       | 32.92±0.30       | 28.3±0.25        | **           | 36.55±0.31     | 34.41±0.44     | **           |
| Body girth        | 28.80±0.18       | 23.54±0.14       | **           | 34.38±0.20     | 30.05±3.94     | **           |
| Shank length      | 8.23±0.17        | 7.25±0.07        | **           | 10.90±0.12     | 8.9±0.12       | **           |
| Shank width       | 1.76±0.04        | 1.45±0.01        | **           | 2.12±0.04      | 1.60±0.02      | **           |
| Keel length       | 9.15±0.12        | 8.13±0.05        | **           | 12.33±0.15     | 9.86±0.13      | **           |
| Body height       | 32.63±0.30       | 29.28±0.17       | **           | 38.65±0.20     | 34.53±0.50     | **           |

* Mean values differ significantly (p≤0.05)
** Mean values differ significantly (p≤0.01)

At 6th week, chicks in group-II showed significantly (p≤0.01 or p≤0.05)) greater breast angle and beak length, while the chicks in group-I showed significantly (p≤0.01) greater body length, body girth, shank length, shank width and keel length.
At 8th week, chicks in group-II showed significantly (p≤0.05 or 0.01) lower values compared to those in group-I in respect of all parameters except for beak length and breast angle which is not differ significantly (p≥0.05).

**Carcass traits**

The mean carcass traits and mean percentage value of cut up parts for the chicks in the two groups are presented in Table 4.7 and 4.7a, respectively.

For the chicks in group-I and group-II, respectively, the values (g) obtained were 1366.00±12.85 and 1052.34±24.73 for live weight, 923.67±13.33 and 721.33±20.19 for dressed weight, 843.00±14.16 and 653.34±7.23 for eviscerated weight, 5.34±0.34 and 3.34±0.34 for heart weight, 30.34±0.34 and 27.34±0.34 for liver weight, 48.00±2.00 and 34.00±1.73 for gizzard weight, 115.34±3.18 and 95.67±3.49 for drumstick weight, 150.34±9.17 and 106.67±4.64 for weight of thigh, 112.34±3.49 and 86.00±3.06 wing weight, 188.67±7.84 and 152.67±6.36 for breast weight, 192.67±7.97 and 143.34±5.21 for back weight, 78.66±5.37 and, 63.00±2.52 for neck weight.

For the chicks in group-I and group-II, respectively the values (%) obtained were 67.62±0.38 and 68.53±0.31 for dressed weight, 2.65±0.08 and 1.57±0.03 for giblet weight, 9.31±0.51 and 9.64±0.29 for neck, 13.33±.38 and 13.15±0.12 for wing, 13.33±0.38 and 21.98±1.05 for back, 22.41±.21 and 23.35±0.40 for breast, 17.81±0.86 and16.32±0.39 for thigh, and 13.70±0.55 and 14.63±0.28 for drumstick.

Chicks in group-I showed significantly (p≤0.05 or 0.01) higher live weight, dressed weight, eviscerated weight, liver weight, drumstick weight, wings weight, back weight and giblet%, where as the heart weight, gizzard weight, thigh weight, breast weight, neck weight, neck%, wing%, back%, breast%, thigh%, drumstick% showed no significant(p>0.05) difference between the groups. Numerically the dressing% was higher in group-II than group-I but did not differ significantly (p>0.05).
### Table 4.7 Carcass traits of chicks

| Parameter          | Group-I(g)        | Group-II(g)       | Significance |
|--------------------|-------------------|-------------------|--------------|
| Live body weight   | 1366.00± 12.85    | 1052.34± 24.73    | **           |
| Dressed weight     | 923.67 ±13.33     | 721.33±20.19      | *            |
| Eviscerated weight | 843.00 ±14.16     | 653.34±17.23      | *            |
| Heart              | 05.34±0.34        | 03.34± 0.34       | NS           |
| Liver              | 30.34±0.34        | 27.34±0.34        | *            |
| Gizzard            | 48.00±2.00        | 34.00±1.73        | NS           |
| Drumstick          | 115.34±3.18       | 95.67±3.49        | *            |
| Thigh              | 150.34±9.17       | 106.67±4.64       | NS           |
| Wing               | 112.34±3.49       | 86.00±3.06        | *            |
| Breast             | 188.67±7.84       | 152.67±6.36       | NS           |
| Back               | 192.67±7.97       | 143.34±5.21       | **           |
| Neck               | 78.66±5.37        | 63.00±2.52        | NS           |

* Mean values differ significantly (p≤0.05)
** Mean values differ significantly (p≤0.01)

### Table 4.7a Cut up parts as percentage of eviscerated weight and dressed weight

| Parameter   | Group-I | Group-II | Significance |
|-------------|---------|----------|--------------|
| Dressing %  | 67.62±0.38 | 68.53±0.31 | NS           |
| Giblet %    | 2.65±0.08  | 1.57±0.03  | *            |
| Neck %      | 9.31±0.51  | 9.64±0.29  | NS           |
| Wing %      | 13.33±0.38 | 13.15±0.12 | NS           |
| Back %      | 13.33±0.38 | 21.98±1.05 | NS           |
| Breast %    | 22.41± 1.21| 23.35±0.40 | NS           |
| Thigh %     | 17.81±0.86 | 16.32±0.39 | NS           |
| Drumstick % | 13.70± 0.55| 14.63±0.28 | NS           |

* Mean values differ significantly (p≤0.05)
** Mean values differ significantly (p≤0.01)
Proximate composition of meat

The proximate compositions of meat from thigh and breast muscle of the chicks in the two groups are presented in Table 4.8.

Thigh muscle: For the chicks in group-I and group-II, respectively, the values (%) obtained were 68.19±3.79 and 69.49±1.13 for moisture, 53.36±10.0 and 54.82±5.04 for crude protein, 37.23±7.59 and 34.50±2.98 for ether extract, 0.7±0.28 and 0.50±0.36 for crude fibre, 4.33±0.99 and 3.77±0.31 for total ash and, 0.06±0.02 and 0.04±0.02 for acid insoluble ash.

Breast muscle: For the chicks in group-I and group-II, respectively, the values obtained were 73.99±0.70 and 74.41±0.34 for moisture %, 76.81±4.35 and 78.05±1.15 for crude protein %, 9.69±4.38 and 8.17±0.99 for ether extract %, 0.40±0.17 and 0.57±0.34 for crude fibre %, 5.33±0.67 and 5.87±0.43 for total ash % and, 0.22±0.16 and 0.11±0.90 for acid insoluble ash %.

Though no significant (P>0.05) difference was observed between the groups in proximate composition, birds in group-II showed numerically higher moisture and crude protein, and lower ether extract for both thigh and breast muscle.

Table 4.8 Proximate composition of thigh and breast muscle

| Parameters       | Thigh muscle | Breast muscle | Significance |
|------------------|--------------|---------------|--------------|
|                  | Group I      | Group II      | Group I      | Group II      |              |
| Moisture         | 68.19±3.79   | 69.49±1.13    | 73.99±0.70   | 74.41±0.34    | NS           |
| Crude protein    | 53.36±10.0   | 54.82±5.04    | 76.81±4.35   | 78.05±1.15    | NS           |
| Ether extract    | 37.23±7.59   | 34.50±2.98    | 9.69±4.38    | 8.17±0.99     | NS           |
| Crude fibre      | 0.70±0.28    | 0.50±0.36     | 0.40±0.17    | 0.57±0.34     | NS           |
| Total ash        | 4.33±0.99    | 3.77±0.31     | 5.33±0.67    | 5.87±0.43     | NS           |
| Acid insoluble ash | 0.06±0.02 | 0.04±0.02    | 0.22±0.16    | 0.11±0.90     | NS           |
CHAPTER-5

DISCUSSION
Discussion

**Body weight and weight gain**

The body weight of group-I were significantly ($p \leq 0.01$) higher than that of group-II for all ages except day old body weight because group-I is a cross of broiler parent line and native chicken (Hansli).

Hansli being a local chicken has slower rate of growth as compared to broiler parent lines, as reported by Ekka et al. (2016). The 8\textsuperscript{th} week body weight of group-II in the present experiment was 995.47g. And similar finding have been reported by Pathak et al. (2015) (670.68 g) and Kalita et al. (2011) (670.83g) in crosses involving broiler parent line (PB2) X native chicken.

Kgwatalala and Segoko (2013) reported the 8\textsuperscript{th} week body weight of Australorp X native crosses as 727.61g and Njdebo et al. (2013) reported the body weight of Ross 308 X native chicken as 924.43g at 7\textsuperscript{th} week of age. The body weight of group-II in the present experiment was higher than the 8\textsuperscript{th} week body weight of different broiler and native chickens.

**Feed intake and feed conversion ratio**

There was no significance difference ($P \geq 0.05$) in cumulative feed intake between the group-II and group-I at 6\textsuperscript{th}, 7\textsuperscript{th} and 8\textsuperscript{th} week of age. However the cumulative feed intake for 2\textsuperscript{nd}, 3\textsuperscript{rd}, 4\textsuperscript{th} and 5\textsuperscript{th} week of group-II was significantly ($P \leq 0.05$ or 0.01) lower than the group-I. The cumulative feed consumption up to 8\textsuperscript{th} week of group-I was significantly ($p \leq 0.01$) higher (3955.73g) than the group-II (3112.32g). Similar feed consumption of 3717.83 and 2860.53 g up to 8 weeks of age have been reported by Howlider (2001) for Redbro X Local Naked neck and Local Naked neck X Redbro crosses, respectively. Ekka et al. (2016) reported feed consumption of 2539.14g up to 8\textsuperscript{th} week of age, which is lower than that of 8\textsuperscript{th} week fed consumption of group-II. Broilers are selected for high growth, high feed intake and better feed conversion efficiency. The cross under study is a back cross of Hansli X CSML with CSML for which the feed consumption could have increased.
The chicks in group-II showed significantly ($P \leq 0.01$) higher FCRs at 2nd, 3rd, 4th and 5th week as compared to those in group-I. Lower FCR values of group-I could be due to better feed conversion efficiency as it is a cross of two broiler parent lines. The group-II which derived 25% germplasm from native chicken variety (Hansli) which has poor feed conversion efficiency (3.26) as reported by Ekka et al. (2016), could have contributed to the higher FCR values during the said period. Similar 8th week FCR values for improved and native crosses, ranging from 3.2 to 3.8 have been reported by Nwachukwu et al. (2016) and Howlider (2001).

**Mortality**

Among the genotypes under study, group-I has 1.66% mortality and group-II had zero mortality which could be due to group-II involves of 25% germplasm from Native chicken variety that is Hansli. So, that better adaptability to local climatic conditions. Similar results of zero mortality for local fayoumi X improved RIR were reported by Ojo et al. (2011). Jha et al. and Ojo et al. (2012) reported 8.3% and <2% of mortality for Dahlem Red X Desi and native chicken X Dominant Black crosses during 0-8 weeks of age. From the findings of previous works it is found that the mortality in different genotypes as recorded in the present investigation were lower than or similar to earlier reported values for improved and their crosses. The mortality in chicks is influenced by several factors including the management practices. Therefore, a wide variation in mortality for the same genotype has been reported by different workers.

**Body linear measurements**

All parameters except beak length are significantly ($p \leq 0.05$) higher in group-II than group-I. The group-I is a cross of broiler parent lines which are selected over generations for higher breast angle, keel length, and shank length. That could be the reason for obtaining higher values for these parameters in group-I than group-II which is a cross involving native population.

Chicks in group-I showed lower values ($p \leq 0.01$ or 0.05) for breast angle and beak length at 6th week, while at 8th week, these differences were found nonexistent. It might be due to differences between the two genotypes in growth pattern of these two organs.
Ekka et al. (2016) found higher breast angle in the CSML and Hansli x CSML cross than the Hansli breed. Similarly, they also reported higher beak length, head width, body length, body girth and all other body measurements in CSML than the Hansli and Hansli x CSML crosses. It may be due to the fact that CSML has higher body weight throughout the experimental period of 8 weeks and has been developed from two broiler parent lines.

**Carcass traits**

Higher carcass values were exhibited by group-I, though the differences were not statistically significant for some traits. This is because of higher live weight of the chicks in the group-I.

When the cut-up parts were expressed as percentage of eviscerated weight and dressed weight, no difference was found between the groups, except for giblet weight which showed higher values (p≤0.05) in favour of group-I. This could be due to the fact that, group-I had significantly (p≤0.05) higher liver weight than group-II.

Arora et al. (2010) reported that the carcass quality of F₂ chicken involving Kadaknath and White Plymouth Rock like % of abdominal fat, gizzard, liver, heart, breast, legs and back, no differences was observed among various skin colour groups. They also reported that melatonic and non-melatonic carcasses did not show any significant difference for meat texture and fatness traits.

**Chemical composition of meat**

Birds in group-II showed higher (P≥0.05) moisture and protein, and lower ether extract, compared to those in group-I. This might be due to the effect of the Hansli inheritance in the cross bred (group-II). Similar findings were also reported by Ekka et al. (2016) who found higher moisture and protein, and lower ether extract in Hansli x CSML cross bred, compared to CSML. It was further reported that Hansli had higher moisture and protein, and lower ether extract compared to Hansli X CSML or CSML.
CHAPTER-6

SUMMARY AND CONCLUSION
SUMMARY AND CONCLUSION

The present study was carried out in the Poultry Complex of the faculty of Veterinary Science and Animal Husbandry, Orissa University of Agriculture and Technology, Bhubaneswar for a period of 0-8 weeks.

The initial body weights at day 0 were not significantly (p ≥ 0.05) different between the groups, the chicks in group-I registered significantly (p ≤ 0.01) higher body weights compare to those in group-II at every stage from 1st to 8th week.

The chicks in group-I recorded significantly (p ≤ 0.05 or 0.01) higher weight gains compared to those in group-II at every stage from 1st to 8th week.

The chicks in group-I showed higher feed intakes in every week compared to those in group-II. The differences are found significant (p ≤ 0.05 or 0.01) at 1st, 5th, 6th, 7th and 8th week.

The chicks in group-II showed higher FCRs as compared to those in group-I at every week till the end of the experiment. The differences were found significant (p ≤ 0.01) at 2nd, 3rd, 4th and 5th week.

There was no mortality in group-II, group-I recorded one mortality in 3rd week. Thus, the incidence of mortality recorded were 1.66 % and 0% for the chicks in group-I and group-II, respectively.

At 6th week, chicks in group-II showed significantly (p≤0.01 or p≤0.05)) greater breast angle and beak length, while the chicks in group-I showed significantly (p≤0.01) greater body length, body girth, shank length, shank width and keel length.

At 8th week, chicks in group-II showed significantly (p≤0.05 or 0.01) lower values compared to those in group-I in respect of all parameters except for beak length and breast angle which is not differ significantly (p≥0.05).

Chicks in group-I showed significantly (p≤0.05 or 0.01) higher live weight, dressed weight, eviscerated weight, liver weight, drumstick weight, wings weight, back weight and giblet %, where as the heart weight, gizzard weight, thigh weight,
breast weight, neck weight, neck%, wing%, back%, breast%, thigh%, drumstick% showed no significant (p>0.05) difference between the groups. Numerically the dressing% is higher in group-II than group-I but did not differ significantly (p>0.05).

Birds in group-II showed numerically higher moisture and protein, and lower ether extract, compared to those in group-I.

CONCLUSION

Group-I (CSML X CSFL) was found to have superior growth performance and carcass characteristics, while group-II (Hansli X CSML) X CSML showed superior meat quality in terms of higher crude protein and lower ether extract.
REFERENCES

Adebambo AO, Ikeobi CON, Ozoje M and Oduguwa OO. 2011. Combining abilities of growth traits among pure and crossbred meat type chickens, *Archivos de zootecnia*, 60(232): 953-963.

Ahmed ST, Ali MA, and Howlider MAR. 2007. Effect of crossbreeding on performance to reduce market age of different genetic groups of chicken. *The Bangladesh Veterinerian*. 24: 34-43.

Al Rahman MO, Ali MS, Islam MS and Khanam JS. 2016. Evaluation on growth and meat production performances of four different crosses of chicken in Bangladesh, *International Journal of Innovation and Applied Studies*, 14(3): 750.

Ayorinde KL, Ojo SFE and Toye AA. 2012. A comparative study of growth performance and feed efficiency in Dominant Black Strain, Fulani Ecotype chicken and progeny from their reciprocal crosses, *Asian Journal of Agriculture and Rural Development*, 2(2): 120.

Bekele F, Adnoy I, Goen HM and Kathle J. 2010. Production performance of dual purpose crosses of two indigenous with two exotic chicken breeds in subtropical environment. *International Journal of Poultry Science*, 9 (7): 702-710.

Bharadwaj RK, Shive Kumar, Kumar D, Ashok Kumar, Sharma RK and singh S K. 2005. Study on economic traits of purebred and crossbred chicken, *Indian poultry science association, IPSACON-2005*.

Bharambe VY and Garud PK. 2012. Comparative Performance of Some Improved Poultry Crossbreds Under Konkan Region of India, *Indian J. Hill Farm*, 25(1): 48-52.

Bosco AD, Mugnai C, Castelini C. 2011. Performance and meat quality of pure Ancona and Cornish × Ancona chickens organically reared, *European poultry science*, 75(1):7-12.
Castellini C, Mugnai C, Pedrazzoli M and Dal Bosco A. 2006. Productive performance and carcass traits of Leghorn chickens and their crosses reared according to the organic farming system, InProceedings of XII European Poultry Conference, Verona. Abstracts and Procedures CD, ID (Vol. 10704).

Chatterjee RN, Rai RB, Pramanik SC, Sunder J, Senani S and Kundu A. 2007. Comparative growth, production, egg and carcass traits of different crosses of Brown Nicobari with White Leghorn under intensive and extensive management systems in Andaman, India, Livestock Research for Rural Development, 19(12):

Chen KW and Sun YJ. 1997. The current status and future development of quality chicken packaging lines. China Poultry, 13: 8-9.

Choo YK, Kwon HJ, Oh ST, Um JS, Kim BG, Kang CW, Lee SK and An BK. 2014. Comparison of growth performance, carcass characteristics and meat quality of Korean local chickens and silky fowl, Asian-Australasian journal of animal sciences, 27(3): 398-405.

Dal Bosco A, Mugnai C and Castellini C. 2011. Performance and meat quality of pure Ancona and Cornish× Ancona chickens organically reared, Arch. Geflügelk, 75: 7-12.

Dariusz M, Celej M, Jankowski J, Majewska T and Mikulska M. 2011. Growth Performance, Carcass Traits and Meat Quality of Slower-growing and Fast-growing Chickens Raised with and without Outdoor Access, Asian-Australian Journal of Animal Science, 24(10): 1407-1416.

Das PK. 2003. Performance of fast and slow growing broiler strain in rainy season under Bangladesh condition. M. S. Thesis, Submitted to the Department of Poultry Science., BAU, Mymensingh.

Debata D, Panigrahi B, Panda N, Pradhan CR, Kanungo S and Pati PK. 2012. Growth performance and carcass traits of Black Rock, Red Cornish and Vanaraja chicken reared in the coastal climatic condition of Odisha, Indian Journal of Poultry Science, 47(2): 214-217.
Dubey P, Joshi S and Chouhan L. 2013. Juvenile growth rate and feed conversion efficiency in Kadaknath breed of fowl, IPSACON National Symposium on poultry production Feed, Food and Environmental Safety, CARI, Izatnagar, Bareilly, India,

Dutta R, Kumar , Saiful Islam M and Ashraful Kabir M. 2013. Production Performance of Indigenous Chicken (Gallus domesticus L.) in Some Selected Areas of Rajshahi, Bangladesh, American Journal of Experimental Agriculture, 3(2): 308-323.

Dwivedi ISD. (1965). Further crosses of the crossbreds for broiler production. M.V.Sc. thesis submitted to Agra Univ. Agra.

Ekka R, Behura NC, Samal L, Nayak GD, Pati PK and Mishra PK. 2016. Growth performance and linear body measurements of Hansli, CSML and Hansli× CSML cross under intensive system of rearing. M.V.Sc. thesis submitted to Odisha University of Agriculture and Technology, Odisha.

Faruque S Islam MS, Afroz MA and Rahman MM. 2013. Evaluation of the performance of native chicken and estimation of heritability for body weight, Journal of Bangladesh Academy of Sciences, 37(1): 93-101.

Fujimura S, Koga H, Takeda H, Tone N, Kadowaki M and Ishibashi T. 1996. Chemical compositions of pectoral meat of Japanese native chicken Hinai-jidori and broiler of the same and marketing age, Animal Science Technology, 67:541–548.

Haque MF. 2005. Hatching and growth performance of synthetic population as obtained from commercial broilers. M.S. thesis, Department of Poultry Science, Bangladesh agricultural University, Mymensingh.

Howlider MAR. 2001. A report on effect of the dwarf gene on the performance of broiler strain in hot humid tropics. Bangladesh Agricultural Research Council, Farm Gate, Dhaka.
Jha D, Prasad S, Soren SK and Bharti A. 2013. Production performance of indigenous chicken in intensive farming system, *Indian Journal of Poultry Science*, 48(1): 105-108.

Jha DK and Prasad S. 2013. Performance of improved varieties and indigenous breed of chicken in Jharkhand, *Indian Journal of Poultry Science*, 48(1): 109-112.

Jha DK, Prasad S, Patel N and Baskar K. 2013. Comparative evaluation of dahlem red and desi crosses chicken reared under intensive system of poultry management, *Journal of Agricultural Technology*, 9(6): 1405-1410.

Jha DK, Prasad S, Soren SK and Mahto D. 2012. Performance of Vanaraja birds under deep litter system of management, *Indian Veterinary Journal* 89(1): 75-76.

Kalita N, Pathak N and Ahmed M. 2013. Effect of strain and sex on carcass characteristics of PB-2 × indigenous and Dahlem Red chicken *IPSACON*, National Symposium on poultry production : Feed, Food and Environmental safety, Izatnagar, Bareilly, India CARI, 4.

Kalita N, Pathak N and Ahmed M. 2011. Evaluation of Crossbred (PB-2 × Indigenous) under intensive system of rearing, *Indian Poultry Science Association and National Symposium (IPSACON 2012-13)*.

Kgwatalala PM and Segokgo P. 2013. Growth Performance of Australorp x Tswana Crossbred Chickens under an Intensive Management System, *International Journal of Poultry Science*, 12(6): 358.

Khatun A. 2012. Study on growth and meat yield characteristics of different line crosses of chicken. *(Doctoral dissertation)*.

Khawaja T, Khan SH, Mukhtar N and Parveen A. 2012. Comparative study of growth performance, meat quality and haematological parameters of Fayoumi, Rhode Island Red and their reciprocal crossbred chickens, *Italian Journal of Animal Science*, 11(2): 39.
Khawaja T, Khan SH, Mukhtar N, Ullah N and Parveen A. 2013. Production performance, egg quality and biochemical parameters of Fayoumi, Rhode Island Red and their reciprocal crossbred chickens, *Journal of Applied Animal Research*, 41(2): 208-217.

Khawaja T, Khan SH, Parveen A and Iqbal J. 2016. Growth performance, meat composition and haematological parameters of first generation of newly evolved hybridized pure chicken and their crossbred parents, *Veterinarski arhiv*, 86(1): 135-148.

Krishna CH, Mahender M, Ramana DBV and Chandra AS. 2007. Performance of coloured layers under backyard rearing system in South Telangana region of Andhra Pradesh, *Indian Journal of Animal Production and Management*, 23(1-4): 102-106.

Mondal A, Patel M, Kumar A, Singh B, Ghosh AK, Bhardwaj RK and Girish PS. 2007. A. Performance of different crossbred chickens in intensive system. *Indian Journal of Poultry Science*. 42(2):211-214.

Mondal G, Kakati BK, Das TK and Mehdi M. (2012). Evaluation of locally available feeds on performance of Vanaraja birds under Kargil condition. *Indian Journal of Animal Sciences*, 82(9): 1067-1069.

Muchenje V and Sibanda S. 1997. Informal Survey report on Poultry Production System in Chicken and Sanyati Farming Area. *Crop Livestock Farming System Research Methodologies Training Workshop*. UZ/RVAU/DIAs/Danida Project Report, 23-24.

Munisi WG, Katule AM, and Mbaga SH. 2015. Comparative growth and livability performance of exotic, indigenous chickens and their crosses in Tanzania. *Livestock Research for Rural Development*, 27:66.

Mussaddeq Y, Daud S and Akhtar S. 2002. A Study on the Laying Performance of Cross (FAYxRIR) Chicken under Different Plans of Feeding, *International Journal of Poultry Science*, 1(6): 188-192.
Niranjan M, Sharma, RP, Rajkumar U, Reddy BLN, Chatterjee RN and Battacharya TK. 2008. Comparative evaluation of production performance in improved chicken varieties for backyard farming, *International Journal of Poultry Science*, 7(11): 1128-1131.

Ogbu C, Joseph J, Tule, Chijioke C and Nwosu. 2013. Effect of genotype and feeding plan on growth and laying parameters of nigerian indigenous chickens *G.J.B.A.H.S.*, 4(1): 251-256.

Oluyemi JA. 1990. Germplasm component of rural poultry development in Africa. Africa. 13-16 November, 1989. 49-55.

Padhi MK, Chatterjee RN and Rajkumar U. 2014. A study on performance of a crossbred chicken developed using both exotic and indigenous breeds under backyard system of rearing, *Journal of Poultry Science and Technology*, 2(2): 26-29.

Padhi MK, Chatterjee RN, Rajkumar U, Niranjan M and Haunshi S. 2016. Evaluation of a three-way cross chicken developed for backyard poultry in respect to growth, production and carcass quality traits under intensive system of rearing, *Journal of Applied Animal Research*, 44(1): 390-394.

Padhi MK, Rajkumar U, Haunshi S, Niranjan M, Panda AK, Bhattacharya TK, Reddy MR, Bhanja SK and Reddy BLN. 2012. Comparative evaluation of male line of Vanaraja, Control broiler, Vanaraja commercial in respect to juvenile and carcass quality traits, *Indian Journal of Poultry Science*, 47(2): 136-139.

Parvin S., 2005. Comparative performance of synthetic broiler and commercial broiler. M. S. thesis, Department of Poultry Science. Bangladesh Agricultural University, Mymensingh.

Pathak SS, Kalita N and Barua N. 2015. Productive and reproductive performances of indigenous and broiler parent line crossed with indigenous chickens, *The Indian Journal of Veterinary Sciences and Biotechnology*, 11(1): 56-60.

Podchalwar KS, Savaliya FP, Patel AB, Joshi RS, Hirani ND and Qadri FS. 2013. Studies on performance of three crossbred chickens suitable for rural farming, *Indian Journal of Poultry Science*, 48(2): 215-218.
Rahman MM, Baqui MA and Howlider MAR. 2004. Egg production performance of RIR× Fayoumi and Fayoumi× RIR crossbreed chicken under intensive management in Bangladesh, *Livestock Research for rural development*, 16(11): 2004.

Saadey SM, Galal A, Zaky HI and El-Dein AZ. 2008. Diallel crossing analysis for body weight and egg production traits of two native Egyptian and two exotic chicken breeds, *International Journal of Poultry Science*, 7(1): 64-71.

Sarker PK, Chowdhury SD, Kabir MH and Sarker PK. 2008. Comparative Study on the productivity and profitability of commercial broiler, cockerel of a layer strain and cross-bred (RIR× Fayoumi) Chicks, *Bangladesh Journal of Animal Science*, 37(2): 89-98.

Semakula J, Lusembo P, Kugonza DR, Mutetikka D, Ssennyonjo J and Mwesigwa M. 2011. Estimation of live body weight using zoometrical measurements for improved marketing of indigenous chicken in the Lake Victoria basin of Uganda, *Livestock Research for Rural Development*, 23(8).

Singh SP, Singh BP, Singh UB and Singh B. 2007. Estimation of crossbreeding parameters for traits of economic importance in meat type chickens, *Indian Journal of Veterinary Research*, 1(1): 22-28.

Smith AJ. 1990. The tropical Agriculturalist: *Poultry Macmillan Press*, London. 217.

Sogunle OM, Akinosi OK, Adeyami OA, Sobayo RA, Bello KO, Ekunseitan DA and Olani OA. 2013. Performance and Carcass yield of sexed Broiler chickens reared on Two Housing types, *Bull.anim.Hlth.Prod. afr* 61: 435-444.

Sogunle OM, Akinosi OK, Adeyemi OA, Sobaya RA, Bello KO, Ekunseitan DA and Olaniyi. 2008. Comparison of meat composition and sensory values of two different strains of broiler chickens, *Arch. Zootec.* 59(226): 311-314.

Sogunle OM, Egbeyle LT, Alajo OA, Adeleeye OO, Fafiolu AO, Onunkwor OB, Adegbite JA and Fanimo AO. 2010. Comparación de la composición de la carne y valores sensoriales en dos líneas de pollos para carne, *Archivos de zootecnia*, 59(226): 311-314.
Sola-Ojo FE and Ayorinde KL. 2011. Evaluation of reproductive performance and egg quality traits in progenies of dominant black strain crossed with Fulani Ecotype chicken, *Journal of Agricultural Science*, 3(1): 258.

Sola-ojo FE and Ayurinde. 2009. The Fulani Ecotype chicken: Growth and Feed Utilisation potential, *World Journal of Applied Science & Technology*, 1(1).

Souza XR, Faria PB and Bressan MC. 2011. Proximate composition and meat quality of reared under different production systems, *Rev. Bras. Cienc. Avic*, 13(1).

Stringhini JH, Laboissiere M, Muramatsu K, Susana N, Leandro M, and Cafe MB. 2003. Performance and carcass yield of four broiler strains raised in Goias, Brazil. *Revista Brasileira de Zootecnia*, 32(1): 183-190.

Ullengala R, Sharma RP, Padhi M, Rajaravindra KS, Reddy BLN, Niranjan M, Bhattacharya TK, Haunshi S. and Chatterjee RN. 2011. Genetic analysis of juvenile growth and carcass traits in a full diallel mating in selected colored broiler lines. *Tropical Animal Health and Production*, 43(6): 1129-1136.

Zollitish W, Knaus W, Aichinoer F, Lettever F. 1997. Effect of different dietary fat sources on performance and carcass characteristics of broiler. *Animal Feed Science and Technology* 66:63-73.
APPENDIX
## APPENDIX

### APPENDIX TABLE-1
Composition of Veldot- Coccidiostat

| Each 500 g contains | 125 g DOT (Dinitolmide) |
|---------------------|--------------------------|
| Feeding directions  | 500g/ton of feed         |
| Manufacturer        | VENKY’S (INDIA) LIMITED  |

### APPENDIX TABLE-2
Composition of mineral mixture- V N Tracemin

| Each kg contains     | Manganese 90g          |
|----------------------|------------------------|
|                      | ZINC 80 g              |
|                      | Iron 90g               |
|                      | Copper 15 g            |
|                      | Iodine 2.0g            |
|                      | Selenium 300mg         |
| Feeding directions   | 1kg/ton of feed for regular use |
|                      | 2kg/ton of feed in stress condition and breeders |
| Manufacturer         | vet-needs Labs (India) |

### APPENDIX TABLE-3
Composition of vitamin mixture- Amiplex forte

| Each 5ml contains   | Vitamin B1 7mg               |
|---------------------|-----------------------------|
|                     | Vitamin B2 2.5 mg            |
|                     | Vitamin B6 1mg               |
|                     | Vitamin B$_{12}$ 12.5 mcg    |
|                     | Biotin 12.5 mcg              |
|                     | Calcium Pantothenate 2.5 mg  |
|                     | Niacin 75.0 mcg              |
|                     | Cholin chloride 10 mg        |
|                     | Methionine 10 mg             |
|                     | Lysine 20 mg                 |
|                     | Amla 5 mg                    |
| Feeding directions  | 3-6 ml for 1000 birds       |
| Manufacturer        | vet-needs (India)           |