GENETIC ANALYSIS OF BODY WEIGHT, CONFORMATION TRAITS AND SOME HAEMATOBIOCHEMICAL PARAMETERS IN GRAMAPRIYA AND ITS CROSSES WITH DESI CHICKEN OF BIHAR

THESIS SUBMITTED TO THE

BIHAR AGRICUTURAL UNIVERSITY

(FACULTY OF VETERINARY SCIENCE AND ANIMAL HUSBANDRY)

Sabour, (Bhagalpur), BIHAR

In partial fulfillment of the requirements
FOR THE DEGREE OF
Master of Veterinary Science
IN
(ANIMAL GENETICS AND BREEDING)
BY

Manoj Kumar Srivastava

Registration No – M/AGB/137/BVC/2013-14

(P.G. Deptt. of Animal Genetics and Breeding)

BIHAR VETERINARY COLLEGE
PATNA 800014

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2015

DEPARTMENT OF ANIMAL GENETICS & BREEDING

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CERTIFICATE-I

This is to certify that the thesis entitled "***GENETIC ANALYSIS OF BODY WEIGHT, CONFORMATION TRAITS AND SOME HAEMATOBIOCHEMICAL PARAMETERS IN GRAMAPRIYA AND ITS CROSSES WITH DESI CHICKEN OF BIHAR***". *submitted in partial fulfillment of requirement for the degree of Master of Veterinary Science (Animal Genetics & Breeding) of faculty of Post-Graduate Studies, Bihar Agricultural University, Sabour, Bhagalpur, Bihar is the record of bonafide research carried out by* ***Dr.Manoj Kumar Srivastava*** *under my supervision and guidance. No part of the thesis has been submitted for any other Degree or Diploma.*

It is further certified that such help or information received during the course of this investigation and prepa ation of the thesis have been duly acknowledged.

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We, the undersigned members of the Advisory Committee of ***Dr.Manoj Kumar Srivastava,*** a Candidate for the degree of Master of Veterinary Science with major in Animal Genetics & Breeding, have gone through the manuscript of the thesis and agree that the thesis entitled ***"GENETIC ANALYSIS OF BODY WEIGHT, CONFORMATION TRAITS AND SOME HAEMATOBIOCHEMICAL PARAMETERS IN GRAMAPRIYA AND ITS CROSSES WITH DESI CHICKEN OF BIHAR"*** may be submitted by ***Dr. Manoj Kumar Srivastava,*** in partial fulfillment of the requirement for the degree.

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Place Patna

Date 27/7/15.

MKSrivastava

(Manoj Kumar Srivastava)

Dedicated to My Beloved Father

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INTRODUCTION

INTRODUCTION

Poultry industry in India has emerged as most dynamic and fast growing segment in agriculture sector with annual growth rate of approximately 8-10 per cent. As a result, India ranks second in egg production and third in broiler production in the world (The Economic Times, 25 Dec' 2014). Bihar ranks 15th in egg production and 9th in poultry meat production among different states of the country (Bihar Basic Animal Husbandry Statistics 2012).

Poultry meat is the most widely used source of animal protein. It has low fat, low cholesterol, low calories and high protein as compared to other animal protein. Domestic poultry meat production in India is estimated to have remained at 3.5 million tons in calendar year 2013 with per capita consumption of 2.8 kg per annum, while table egg production is estimated to have increased from 66 billion eggs in 2012 to 70 billion eggs in 2013, with per capita egg consumption at 57 eggs per annum. Total poultry market size is estimated at $ 9.93 billion at the wholesale price level indicating value growth of 8% over 2012 (ICRA, May 2014). The poultry sector in India employs about 03 million people, of which about 80 percent are producers. The remaining 20 percent are involved in feed, pharmaceutical, marketing and other services.

The egg production has been increased tremendously, yet per capita availability of egg in Bihar is 08egg/head/annum (Bihar Basic Animal Husbandry Statistics 2012). However, per capita availability of eggs and broiler meat is far below the ICMR recommended level of 180 eggs and 11 kg meat per annum (X^{th} Five Year Plan 2002-07). Although the vast increase in poultry egg and meat production during last five decades is mainly due to the use of specialized strains of high genetic potentialities and its crosses, yet there is a big gap between availability and requirement.

The importance of backyard poultry is well recognized by Government of India and special programmes are formulated for its promotion. The first dual purpose coloured backyard bird named Giriraja was introduced in 1989. Later on several varieties viz. Vanaraja, Krishibro, Gramapriya, Krishilayer, krishipriya, CARI Nirbheek, CARI Shyama, Hitcari, UpCari, Nandanum, Kroiler, and Swarandhara etc were released, which resemble indigenous fowl in body conformation, multi coloured plumage, dull shanks, pink skin and single comb. These improver birds have more economically viable characteristics which are of great importance for village production of eggs and meat.

Gramapriya bird has been developed by crossing desi male and Dahlem Red female at Project Directorate of Poultry Hyderabad. It is a multi-coloured egg purpose with moderate body weight chicken variety developed for free range and rural backyard rearing. These birds lay more number of eggs than native chickens and eggs are tinted brown in colour and heavier than native chicken eggs. These birds have better adaptability to adverse conditions and better immunocompetence which gives the strength for the maximum survivability of birds under rural poultry farming conditions. Initial brooding up to 8 weeks in nursery unit is required before these birds are let out for semi free-range or free-range management. The Gramapriya distributed in villages does natural mating with native chickens resulting in upgrading of native chickens and enhancement of production performance in the villages. Two varieties of Gramapriya are available i.e. White Gramapriya and Colored Gramapriya. The white variety gives more number of eggs as compared to the colored variety. The feather color of colored Gramapriya bird is mostly brown and occasionally multiple color is also seen. It resembles desi hen in flavor and delicacy. Due to its moderate body weight the males of Gramapriya are best suited for preparation of tandoori type desi chicken dishes. The female produces good number of eggs.

Muzaffarpur and Gaya are local desi chicken of Bihar and their names have been given as they are native of these two districts of Bihar and are found in abundance. Being local and desi, they have better disease resistance and they can thrive well even in unfavorable conditions.

A breeder requires improvement in body weight as well as simultaneous improvement of conformation traits. Body weight trait is good indicator of growth. Body conformation, which constitutes bone structure, may be considered a better measure of body capacity of laying hens. Shank and keel lengths are indicators of skeletal growth and associated with egg production of laying hens.

Haemato-biochemical parameters are indices of internal environment of living body. Breed, strain, age and sex are found to play a significant role in affecting the haematobiochemical parameters. Haematological and biochemical status is a reflection of many factors such as sex, age, breed, diet, management, stress level, etc.

Haematological parameters are important tools to assess the level of stresses due to environmental and nutritional factors and also provide useful information on immune status of animals. Certain haematological parameters are established markers of some production traits in poultry e.g. high PCV and high hemoglobin are associated with high feed conversion ratio of ingested feed. Besides, high serum protein indicates good feathering ability and tissues growth in poultry. High level of circulating lymphocyte is indicator for ability of birds to be survived in stressful condition. Therefore, haematological parameters can be used for making strategy for breeding programmes for genetic improvement of indigenous poultry apart from their usefulness for diagnostic purpose.

The blood biochemical analysis is a valuable tool for evaluating the health of animal and helps both in diagnosis and clinical monitoring of diseases. Its evaluation indicates the extent of damage in various vital organs and status of the disease. Serum biochemical profiling has been used in several species of domestic livestock to monitor herd health and to detect subclinical diseases. The quality of meat is dependent upon the haematobiochemical parameters especially lipid profiles which may result into preferential consumer's choice.

The genetic potentiality of local native chickens can be improved by introduction of improved genotypes suitable for rural poultry production especially in backyard poultry farming. Therefore, there is a strong need to establish breeding programmes that allow improvement in performance of local chickens.

Very few information of body weight, conformation traits and haematobiochemical parameters of Grampriya and their crosses are available in literature. Since, Gramapriya, a dual purpose chicken is suitable for backyard poultry farming, attempts have been made in this experiment to cross local desi chicken from Muzaffarpur and Gaya districts of Bihar with Gramapriya for higher egg and meat production and better adaptability and disease resistance in agroclimatic region of Patna with the following objectives:

1. To estimate the mean, standard error and coefficient of variation percentage of various body weight, conformation traits and some haematobiochemical parameters in different genetic groups of chicken.

2. To study the effect of sex on various body weight, conformation traits and some haematobiochemical parameters in different genetic groups.

3. To study the effect of different genetic groups on various body weights, conformation traits and some haematobiochemical parameters.

4. To estimate the coefficient of phenotypic correlation among various body weight and conformation traits.

Chapter-II

REVIEW OF LITERATURE

REVIEW OF LITERATURE

AVERAGE BODY WEIGHT AT DIFFERENT WEEKS OF AGE IN VARIOUS BREEDS OF CHICKENS

Growth is a complex phenomenon which is influenced by genetic as well as various non-genetic factors. Besides the genotype, the various other factors which affect this character are sex, age, nutrition, housing system and other managemental conditions. Body weight is the most important character for the economy of a broiler chicken farm. A broiler bird must have optimum body weight during growing periods. The aim of the breeder is to increase the body weight to the maximum level at market age by exploiting various genetic and non-genetic factors.

The average body weight at different ages in various breeds of chicken as reported by various research workers are summarized and tabulated below:-

Table-1: Average body weight (g) at various ages in different breeds of chickens-

Age	Breeds of chicken	Average body weight(g)	Authors
Day Old	RIR NH RIR (F) x NH (M) NH (F) x RIR (M)	32.22±1.22 39.94±0.67 33.82±0.34 38.48±1.16	Hussaini (1963)

Day Old	RIR (F) x WC(M) M F	 29.50±1.69 32.40±3.32	Dwivedi (1965)
	Arbor Acre broiler M F	 32.22 32.02	Mathur and Ahmed (1968)
	WR RIR RIR (F) x WR (M)	36.18 33.37 33.37	Husain (1972)
	WR x WR WR x WC WC x WR WC x WC	35.10 33.66 34.78 32.71	Sapra *et al.* (1972)
	Naked Neck Black Bengal Aseel Overall indigenous RIR WL WC Overall exotic Overall crossbred	30.38±0.41 30.67±0.33 36.15±0.46 32.09 35.58±0.49 31.26±0.90 35.73±0.28 33.57 34.34	Chhabra and Sapra (1973)
	WR M F WC M F WR (F) x WC (M) M F	45.00±2.00 43.00±1.00 44.00±2.00 43.00±2.00 43.00±1.00 43.00±2.00	Ramappa and Gowda (1973)
	WC	40.05±3.96	Siddappa *et al.* (1978)
	WR M F	31.52 31.69	Singh *et al.* (1979)
	Purebred (overall) (RIR, WPR, WC, AO) cross	38.11 38.11	Verma and Choudhary (1980)

Day Old	Desi chicken		33.05	Kumar and Acharya (1980)
	WL x RIR	M	40.31±0.24	Verma *et al.* (1981)
		F	39.61±0.36	
	WR	M	36.78±0.72	Sharma (1984)
		F	36.09±0.59	
		C	36.30±0.46	
	RC	M	37.81±1.09	
		F	37.60±0.50	
		C	37.66±0.46	
	WR (F) x RC (M)	M	37.33±0.54	Sharma (1984)
		F	36.76±0.54	
		C	37.02±0.38	
	RC (F) x WR (M)	M	36.81±0.64	
		F	36.07±0.61	
		C	36.33±0.45	
	RIR	M	33.3±0.55	Krishnamurthy (1992)
		F	33.1±0.58	
		C	33.2±0.40	
	Strains of WLH			Gupta *et al.* (1999)
		MM	27.99	
		NN	27.26	
		PP	28.94	
		MN	29.75	
		MP	29.07	
		NP	29.65	
		NM	27.17	
		PM	28.23	
		PN	27.94	
	Aseel	M	32.50±0.30	Singh *et al.* (1999b)
		F	33.49±0.47	
	Naked Neck	M	34.21±0.36	
		F	33.47±0.39	
	Dahlem Red	M	38.61±0.53	
		F	35.67±0.44	
	D × A	M	34.90±0.41	
		F	36.06±0.47	

Day Old	AXD	M	45.65±0.38	Singh *et al.* (1999b)
		F	46.44±0.40	
	DXN	M	36.52±0.57	
		F	39.00±0.57	
	NXD	M	45.72±0.77	
		F	44.41±0.65	
	Synthetic Broiler Naked neck cross		43.98±0.82	Padhi *et al.* (1999b)
	Synthetic broiler		37.15±1.70	
	Naked Neck		32.91±0.81	
	Synthetic broiler(SB)	M	36.6±0.36	Padhi *et al.* (1999a)
		F	38.3±0.31	
	Black Nicobari (BN)	M	33.1±0.53	
		F	32.6±0.29	
	White Nicobari (WN)	M	36.8±0.43	
		F	35.9±0.33	
	SB X BN	M	36.3±0.63	
		F	36.1±0.69	
	SB X WN	M	37.3±0.85	
		F	38.0±0.81	
	Red Cornish		40.27±0.08	Sati *et al.* (1999)
	Naked neck desi		35.7	Haque and Howlider (2000)
	Rhode Island Red		39.5	
	White Leghorn		41.2	
	Fayoumi(Fy)		34.4	
	NaDRIR		39.9	
	NaDWL		36.2	
	NaDFy		35.3	
	Red Cornish (control line)	M	41.30	*Singh et al.* (2000)
		F	40.20	
	overall		40.75	
	Desi birds		20.06±0.32	Singh (2003)
	White Leghorn		34.9±0.12	Chaudhary *et al.* (2009)

Day Old	Vanaraja M F P	38.13±0.33 36.98±0.42 37.63±0.26	Padhi *et al.* (2012a)
	Vanaraja M F P	38.89±0.002 38.53±0.003 38.74±0.001	Padhi *et al.* (2012b)
	Vanaraja Gramapriya Aseel	35.91±0.26 33.24±0.31 29.32±0.20	Jha and Prasad (2012)
	Gramapriya	37.56 ± 0.25	Nishant Patel (2012)
	Hazra Aseel Kadaknath	31.48±0.28 29.72±0.21 28.54±0.33	Jha *et al.* (2013)
	VR ♂♂ x VR ♀♀ Sex Pooled Male Female	 37.45±0.17 39.96 ±0.29 34.93±0.18	Ali wafa (2014)
	GP ♂♂ x GP ♀♀ Sex Pooled Male Female	 36.07±0.18 36.98±0.23 35.15±0.27	
	VR ♂♂ x GP ♀♀ Sex Pooled Male Female	 36.78±0.18 37.54±0.31 36.008±0.18	
	GP ♂♂ x VR ♀♀ Sex Pooled Male Female	 37.19± 0.18 38.32±0.24 36.056±0.26	
	GP x GAYA(Desi) GP x MZF (Desi)	30.19±0.14 30.57±0.19	R.P.Sharma (2014)
	PD-1 line PD-3 line PD-4 line Ghagus	37.30 ± 0.01 35.80 30.32 ± 0.13 29.59 ±0.13	DPR Annual Report 2013-14 Directorate of poultry Research

4th week	WR(M)XRC(F) M F C	222.50 202.67 209.56	Sharma(1984)
	Overall mean (OBNP,IC-3, SML-2,IR-3) M F	738.96 661.76	*Padhi et al.* (1997)
	IC-3 IR-3 IC-3XIR-3	472.00 514.57 516.67	Reddy *et al.* (1998)
	Strains of WLH MM NN PP MN MP NP NM PM PN	 150.78 128.83 163.53 148.33 187.43 188.93 135.93 146.68 157.48	Gupta *et al.* (1999a)
	Synthetic broiler Naked neck cross Synthetic broiler Naked neck	284.00±15.27 129.66±9.53 94.03±5.03	Padhi *et al.* (1999)
	Synthetic broiler-SB M F Black Nicobari -BN M F White Nicobari-WN M F SB X BN M F SB X WN M F	 228.0±6.98 215.3±5.45 96.65±3.02 87.8±1.66 111.6±3.38 94.3±2.03 178.3±7.21 168.7±6.06 147.8±8.4 144.9±12.4	Padhi *et al.* (1999b)
	White Leghorn	181.9±1.10	Chaudhary *et al.* (2009)

4th week	CARI Shyama	235.88±9.47	Malik *et al.* (2009)
	White Leghorn	141.73±1.54	Jaya Laxmi *et al.* (2010)
	White Leghorn	138.55±1.51	Jaya Laxmi *et al.* (2011)
	Coloured broiler dam line	668.57±7.08	Malik(2011)
	Black Rock Red Cornish Vanaraja	455.87±8.87 456.61±6.56 448.46±7.32	Debata *et al.* (2012)
	Vanaraja Grampriya Aseel	316.47±2.47 168.85±1.53 127.83±1.18	Jha and Prasad(2012)
	Vanaraja M F P	364.86±5.11 343.95±5.16 355.80±3.73	Padhi *et al.* (2012a)
	Vanaraja M F P	327.37±0.03 302.81±0.04 316.72±0.02	Padhi *et al.* (2012b)
	Hazra Aseel Kadaknath	162.45±2.48 127.43±1.28 114.86±1.63	Jha *et al.* (2013)
	VR ♂♂ x VR ♀♀ Sex Pooled Male Female	 300.93 ±1.46 323.47± 2.09 278.37± 2.04	Ali wafa (2014)
	GP ♂♂ x GP ♀♀ Sex Pooled Male Female	 278.34± 1.22 305.88±1.76 250.81 ± 1.68	
	VR ♂♂ x GP ♀♀ Sex Pooled Male Female	 271.70±1.83 307.34 ± 2.63 236.07 ±2.55	
	GP ♂♂ x VR ♀♀ Sex Pooled Male Female	 291.54±0.87 314.32 ±1.26 268.77 ±1.19	

4th week	PD-1 line		307.90 ±0.22	DPR Annual Report 2013-14 Directorate of poultry Research
	PD-3 line		142.10	
	GML		285 ± 0.02	
8th week	Synthetic Broiler (SB)	M	725.9±28.5	Padhi *et al.* (1999b)
		F	698.3±19.9	
	Black Nicobari (BN)	M	236.5±9.1	
		F	206.2±3.8	
	White Nicobari (WN)	M	252.0±0.76	
		F	212.1±4.6	
	SB X BN	M	463.4±30.6	
		F	449.0±24.6	
	SB X WN	M	444.1±22.6	
		F	370.6±28.8	
	Red Cornish		1353.44±0.48	Sati *et al.* (1999)
	Red Cornish (Control line)	M	1680.40	Singh *et al.* (2000)
		F	1602.52	
	Overall		1641.46	
	White Leghorn		473.1±2.40	Chaudhary *et al.* (2009)
	CARI Shyama	M	545.50±17.97	Malik *et al.* (2009)
		F	414.54±9.03	
		C	460.29±7.66	
	DO8 chicken	M	707.14±19.66	Malik *et al.* (2011)
		F	626.94±7.89	
		C	646.91±7.97	
	Coloured broiler dam line		1760±0.001	Malik(2011)
	Black Rock		974.19±21.43	Debata *et al.* (2012)
	Red Cornish		1039.17±21.29	
	Vanaraja		1003.08±20.28	
	Vanaraja		832.51±4.53	Jha and Prasad (2012)
	Grampriya		498.76±3.86	
	Aseel		273.78±3.57	
	Gramapriya		463.40 ± 2.93	Nishant Patel (2012)
	Hazra		384.54±4.23	Jha *et al.* (2013)
	Aseel		273.72±3.52	
	Kadaknath		238.86±3.76	

8th week	VR ♂♂ x VR ♀♀ Sex Pooled Male Female	 639.86 ± 4.53 723.97± 6.53 555.76 ± 6.28	Ali wafa (2014)
	GP ♂♂ x GP ♀♀ Sex Pooled Male Female	 520.62 ± 4.49 580.83 ± 6.63 460.40 ±6.04	
	VR ♂♂ x GP ♀♀ Sex Pooled Male Female	 488.28 ± 4.88 583.17 ± 6.89 393.38 ±6.79	Ali wafa (2014)
	GP ♂♂ x VR ♀♀ Sex Pooled Male Female	 512.72 ± 3.52 560.76 ±5.14 464.69 ± 4.83	
	PD-4 line Ghagus PD-1 x IWI x PD-3 Male Female	617 382.2 ± 4.07 624 ± 9 511± 8	DPR Annual Report 2013-14 Directorate of Poultry Research
12th week	CARI Shyama M F C	873.34±22.70 725.59±27.09 793.39±19.00	Malik *et al.* (2009)
	DO8 chicken M F C	1096±30 1013±16 969.5±19	Malik *et al.* (2011)
	Rajasree chicks M F	765.7 697.8	Daida *et al.* (2012)
	Black Rock Red Cornish Vanaraja	1376.31±26.17 1438.16±29.56 1399.83±27.8	Debata *et al.* (2012)
	Vanaraja Grampriya Aseel	1072.63±5.59 824.68±4.75 416.25±4.72	Jha and Prasad(2012)
	Gramapriya	877.51 ± 5.52	Nishant Patel (2012)
	Hazra Aseel	614.83±5.39 416.25±4.78	Jha *et al.* (2013)

	Kadaknath	372.98±4.85	
12th week	VR ♂♂ x VR ♀♀ Sex Pooled Male Female	 1313.27 ± 6.20 1425± 8.85 1200.5 ± 8.70	Ali wafa (2014)
	GP ♂♂ x GP ♀♀ Sex Pooled Male Female	 880.12 ±10.36 1012.4±15.21 747.79±14.06	
	VR ♂♂ x GP ♀♀ Sex Pooled Male Female	 823.82 ± 5.44 917.10 ± 7.83 730.55 ±7.56	
	GP ♂♂ x VR ♀♀ Sex Pooled Male Female	 1030.17 ± 8.53 1175.5 ± 12.38 884.80 ±11.75	
	PD-1xIWI x PD-3	1670 ± 62	Annual Report 2013-14 DPR-Hyderabad
	GP x GAYA (Desi) GP x MZF (Desi)	892.0±9.69 853.49±13.50	R.P.Sharma
16th week	White Leghorn	1000 ± 4.02	Chaudhary et al. (2009)
	CARI Shyama M F C	1225±27 999±24 1108±20	Malik et al. (2009)
	White leghorn	909.57 ± 5.56	Jaya Laxmi et al. (2010)
	DO8 chicken M F C	1611±29 1460±19 1519±16	Malik *et al.* (2011)
	White Leghorn	907.46±4.92	Jaya Laxmi *et al.* (2011)
	Rajasree chicks M F	920.9 851.0	Daida *et al.* (2012)
	Black Rock Red Cornish	1681.32±31.64 1827.54±38.26	Debata *et al.* (2012)

16th week	Vanaraja	1725.75±32.48	
	Vanaraja Grampriya Aseel	1567.85±6.38 1263.46±5.90 628.36±5.35	Jha and Prasad(2012)
	Gramapriya	1310.54±6.36	Nishant Patel (2012)
	Hazra Aseel Kadaknath	1056.82±6.31 678.37±5.36 624.56±5.80	Jha *et al.* (2013)
	VR ♂♂ x VR ♀♀ Sex Pooled Male Female	 1807.58 ± 11.2 1962.6± 16.45 1652.6 ± 15.38	Ali wafa (2014)
	GP ♂♂ x GP ♀♀ Sex Pooled Male Female	 1153.22 ± 5.33 1278.2 ± 7.64 1028.2 ± 7.43	
	VR ♂♂ x GP ♀♀ Sex Pooled Male Female	 1114.05 ± 3.80 1185.8 ± 5.60 1042.3 ± 5.14	
	GP ♂♂ x VR ♀♀ Sex Pooled Male Female	 1605.32 ± 7.12 1735.7 ±10.17 1474.8 ± 9.98	
	PD-4 line Ghagus PD-1xIWI x PD-3	1071±0.34 956.3±18.9 1670±62	DPR Annual Report 2013-14 Directorate of Poultry Research
20th week	DO8 chicken M F C	2292±36 1760±35 1976±35	Malik *et al.* (2011)
	White Leghorn	1155.56±5.99	Jaya Laxmi *et al.*(2011)
	Vanaraja	2036±0.57	Padhi and Chatterjee (2012)
	Rajasree chicks M F	1160.6 1006.9	Daida *et al.* (2012)

20th week	Black Rock Red Cornish Vanaraja	1976.31±39.29 2202.30±44.32 2040.54±41.27	Debata *et al.* (2012)
	Vanaraja Grampriya Aseel	2103.39±7.39 1574.31±6.87 1038.75±6.83	Jha and Prasad (2012)
	Gramapriya	1730.46±14.20	Nishant Patel (2012)
	Hazra Aseel Kadaknath	1294.38±7.35 1038.72±6.73 957.45±6.84	Jha *et al.* (2013)
	Red Cornish Vanaraja	2554.32g 2340.26g	Debata *et al.*(2013)
	VR ♂♂ x VR ♀♀ Sex Pooled Male Female	 2437.46±15.2 2882.7± 21.79 1992.2 ± 21.35	Ali wafa (2014)
	GP ♂♂ x GP ♀♀ Sex Pooled Male Female	 1688.59±9.46 1840.8 ±13.91 1536.4 ± 12.82	
	VR ♂♂ x GP ♀♀ Sex Pooled Male Female	 1551.65±9.19 1723.2 ± 13.46 1380.1 ±12.53	
	GP ♂♂ x VR ♀♀ Sex Pooled Male Female	 2056.26 ± 7.39 2267.1 ± 10.72 1845.4 ±10.18	
	PD-1 line PD-3 line GML PD-4 line Srinidhi PD-1xIWI x PD-3 Female	1925 ± 0.54 1339 ±0.53 1896 ± 0.39 2155 ± 18.2 1986 1709 ± 21	DPR Annual Report 2013-14 Directorate of Poultry Research
	Vanaraja Indigenous	1693.52 ±11.13 783.14 ± 5.03	Islam *et al.* (2014)

20th week	Vanaraja(male) Indigenous(male)	1561.96 ±34.17 694.35 ± 13.84	Deka *et al.* (2014)
	Vanaraja(female) Indigenous(female)	1443.70 ± 46.76 639.57 ± 23.00	Deka *et al.* (2014)
	GP x GAYA(Desi) GP x MZF (Desi)	1084.82±49.78 1405.46±23.06	R.P.Sharma (2014)

M=Male, F=Female, C=Combined sex, GP= Gramapriya, WL=White Leghorn, WC=White Cornish, RC=Red Cornish, WPR=White Plymouth Rock, NH=New Hampshire, RIR=Rhode Island Red, PB=Pure Bred, RC=Red Cornish, WR=White Rock VR= Vanaraja, .

AVERAGE CONFORMATION TRAITS AT DIFFERENT WEEKS OF AGE IN VARIOUS GENETIC GROUPS OF CHICKENS

Shank and keel are indicators of skeletal growth (Tierce and Nordskog,1985).Besides, they are also associated with egg production in laying hens (Miller,1983).

Normal skeletal development in the rearing period of chicken production is important in terms of obtaining high levels of fertility, as shank length is highly correlated with fertility. Selection of males with good shank length and thickness will result in having good body conformation during life and also will increase male fertility. Males with a good balance of shank and keel lengths have high fertility rate. Shank and keel lengths can be used in predictive equations to predict body weight in broilers. They are also the most commonly used estimates of frame size in breeder management. Besides, they are often considered as parameters for monitoring growth and development of chickens.

Shank Length:

Chhabra *et al.* (1972) conducted an experiment to study shank length as well as growth pattern in different broiler breeds of chicken and their crosses. They observed mean shank length in WR X WR, WR X WC, WC X WC and WC X WR crosses to be 6.98cm, 7.16cm, 7.07cm and 7.20cm respectively at 10th week of age.

Aggarwal *et al.* (1979) studied the shank length in a 4 X 4 complete diallel crosses involving 4 broiler strains of chicken belonging to Rock and Cornish breeds. They observed the mean shank length at 10th week of age to range from 69.0 ± 0.5 mm to 81.0 ± 0.5 mm in males, 67.0 ± 0.4 mm to 76.0 ± 0.6 mm in females and 68.0 ± 0.4 mm to 78.01 ± 0.4 mm in sexes pooled respectively among different genetic groups.

Verma *et al.* (1979) reported the mean shank lengths in White Leghorn X Rhode Island Red chickens to be 3.30 cm, 4.40 cm and 4.95 cm at 4th, 6th and 8th week of age respectively in males. The corresponding values in females were noted to be 3.16 cm, 3.85 cm and 4.61 cm. respectively.

Mahapatra *et al.* (1983) conducted an experiment to study the shank length at 10th, 11th, and 12th week of age in Aseel Peela, Aseel kagar and their crossbreds. They reported the average shank lengths pooled over ages to be 6.24 cm, 6.88 cm and 6.79 cm in Aseel Peela, Aseel Kagar and their crossbred birds respectively.

Sharma (1984) conducted an experiment to study the shank length in White Plymouth Rock (WPR) and Red Cornish (RC) breeds of chicken and their reciprocal crosses at 8th week of age. He reported the mean shank lengths in WR (M) X WR (F), RC (M) X RC (F), RC (M) X WR (F) and WR (M) X RC (F) genetic groups to be 6.71 cm, 6.85 cm, 7.13 cm, and 6.90 cm respectively. The corresponding values in females were observed to be 6.04 cm, 6.17 cm, 6.56 cm and 6.25 cm and in combined sexes to be 6.25 cm, 6.34 cm, 6.82 cm and 6.48 cm respectively.

Venkatesh (1985) conducted an experiment to study the effect of sex on shank length of White Plymouth Rock and Red Cornish crosses in chicken. He reported the mean shank length at 8th week of age to be 6.67 cm, 6.46 cm and 6.64 cm in males of RC (M) X WR (F), WR (M) X RC (F) and pooled over crosses respectively. The corresponding values in females were observed to be 6.25 cm, 6.11 cm and 6.20 cm.

Malik *et al.* (1997) examined the inheritance of shank length in a synthetic strain of broiler chicken and reported the mean shank lengths at 6th week of age to be 7.08 cm and 6.89 cm in males and females respectively.

Reddy *et al.* (1998) conducted an experiment to study the broiler traits in Red Cornish and shank lengths in IC-3 strain of

Red Cornish, IR-3 strain of White Rock and their crosses pooled over sexes to be 5.60 cm, 5.85 cm, and 5.75 cm respectively at 6th week of age.

Padhi *et al.* (1999a) observed the average shank lengths at 8th week of age in normal, homozygous and heterozygous birds for Naked Neck gene to be 4.3 cm, 4.65 cm and 4.89 cm respectively.

Padhi *et al.* (1999b) studied the performance of Nicobari fowls, Synthetic broiler and their crosses and reported the average shank lengths of male Black Nicobari(BN), White Nicobari (WN), Synthetic Broiler (SB), SB X BN and SB X WN to be 4.09 cm, 4.09 cm, 5.75 cm, 5.27 cm and 4.27 cm respectively at 8th week of age. The corresponding values in females were found to be 3.70 cm, 3.83 cm, 5.46 cm, 5.06 cm and 3.88 cm.

Singh *et al.* (1999a) conducted an experiment to study the genetic effect on conformation traits in pure and crossbred chicken. They observed the average shank lengths in Aseel (A), Naked Neck (N) and Dahlem Red (D) males at 5th week of age to be 4.65 cm, 4.66 cm and 5.01 cm respectively. The corresponding values in females were found to be 4.51 cm, 4.39 cm and 4.79 cm. The average shank lengths at 5th week of age in D X A, A X D, D X N, N X D males were obtained to be 4.93 cm, 4.95 cm, 4.84 cm and 4.93 cm respectively, whereas the corresponding values in females were found to be 4.83 cm, 4.76 cm, 4.65 cm and 4.45 cm.

Singh *et al.* (2000) observed the average shank length at 8th week of age in control line of Red Cornish breed of chicken to be 6.37 cm, 6.01 cm and 6.24 cm in male, female and combined sexes respectively.

Khurana *et al.* (2006) reported the mean shank length to be 2.77$\pm$0.02 cm, 3.82$\pm$0.02 cm, 5.40$\pm$0.02 cm, 7.18$\pm$0.03 cm, 7.31$\pm$0.03 cm, 7.59$\pm$0.03 cm, 7.50$\pm$0.03 cm, 7.53$\pm$0.04 cm, 7.51$\pm$0.04 cm at 2nd, 4th, 8th, 16th, 24th, 32nd, 40th, 46th, 52nd week of age respectively in White Leghorn.

Padhi *et al.* (2012a) observed the average 6th week shank lengths in males of PD-1, Vanaraja and control broiler to be 70.70$\pm$0.40 mm, 73.30$\pm$0.62 mm and 81.62$\pm$0.73 mm respectively and 68.04$\pm$0.33 mm, 70.20$\pm$0.52 mm and 78.49$\pm$0.63 mm in females respectively.

Padhi *et al.* (2012b) reported the mean shank length to be 72.29$\pm$0.003 mm in male and 68.93$\pm$0.004 mm in female at 6th week of age in Vanaraja male line.

Padhi and Chatterjee (2012) conducted an experiment to study the inheritance of shank length in PD1 (Vanaraja male line). They reported the mean shank lengths to be 71.93$\pm$0.01 mm, 106.57$\pm$0.01 mm, 106.58$\pm$0.01 mm, 106.66$\pm$0.01 mm and 108.01$\pm$0.24 mm at 6th, 20th, 22nd, 40th and 72nd week of age respectively.

Jha and Prasad (2012) reported the mean shank length to be 87.43±0.67 mm, 79.86±0.73 and 71.95±0.85 mm in Vanaraja, Gramapriya and Aseel birds respectively at 40th week of age.

Ali wafa (2014) compared the growth pattern and conformation traits for genetic groups consisting of Gramapriya and Vanaraja chickens. He reported the shank length in GP♂♂ x GP♀♀ genetic group to be 7.04 ±0.01cm, 8.70±0.04 cm, 9.03±0.07 cm, 9.37±0.08 cm, and 9.48 ± 0.14cm at 4th 8th 12th 16th and 20th week of age, whereas the corresponding values in VR♂♂ x VR♀♀ were found to be 7.11 ± 0.016cm, 8.72 ± 0.196 cm, 9.11 ± 0.03cm 9.58 ± 0.06cm and 10.14 ± 0.09cm respectively. He further reported the shank length in GP♂♂ x VR♀♀ genetic group to be 7.09 ± 0.02cm 8.53 ± 0.03cm, 8.73 ± 0.05cm, 9.08 ± 0.11cm and 9.28 ± 0.14cm respectively, whereas the corresponding values in VR♂♂ x GP♀♀ genetic group were noted as 6.73 ± 0.02cm 8.25 ± 0.04cm, 8.39 ± 0.04cm, 8.49 ± 0.071cm and 8.61 ± 0.06 cm respectively.

Keel length:

Mahapatra *et al.* (1983) conducted the study in different genetic groups of chicken and reported the average keel lengths pooled over 10th, 11th and 12th weeks of age in Aseel Peela, Aseel Kagar and their crossbreds to be 7.04 cm, 7.72 cm and 7.61 cm respectively.

Sharma (1984) reported the average 8th week keel lengths in WR (M) X WR (F), RC (M) X RC (F), RC (M) X WR (F) and WR (M) X RC(F) genetic groups to be 8.02 cm, 8.20 cm, 8.67 cm and

8.30 cm respectively in males whereas the corresponding average values in females were noted to be 7.05 cm, 7.20 cm, 7.79 cm and 7.37 cm. Besides, the corresponding values of keel length in pooled over sexes were found to be 7.35 cm, 7.45 cm, 8.18 cm and 7.67 cm.

Venkatesh (1985) conducted an experiment to study the effect of age, sex and breed on carcass characteristics of White Rock and Red Cornish crosses in chicken and observed the mean keel lengths at 8th week of age to be 7.68 cm, 7.56 cm and 7.62 cm in males of RC (M) X WR (F), WR (M) X RC (F) and pooled over crosses respectively. They noted the corresponding values in females to be 7.29 cm, 7.04 cm and 7.14 cm.

Malik *et al.* (1997), in a study of the genetic and phenotypic parameters of keel length in a synthetic broiler strain of chicken, observed the average 6th week keel lengths to be 8.09 cm and 7.89 cm in males and females respectively.

Singh *et al.* (1999a) conducted an experiment to study the effect of different genetic groups on conformation traits in chicken and reported the mean keel lengths in Aseel (A), Naked Neck (N) and Dahlem Red (D) males at 5th week of age to be 5.60 cm, 5.67 cm and 5.87 cm respectively. The corresponding values in females were found to be 5.44 cm, 5.36 cm and 5.53 cm. They further observed the average keel lengths at 5th week of age in D X A, A X D, D X N and N X D males to be 5.94 cm, 6.06 cm, 5.87 cm and 6.04 cm respectively, whereas the corresponding values in females were found to be 5.84 cm, 5.85 cm, 5.79 cm and 5.60 cm.

Singh *et al.* (2000) reported the average keel lengths at 8th week of age to be 8.23 cm, 7.81 cm and 8.02 cm in control line of Red Cornish male, female and combined sexes respectively.

Khurana *et al.* (2006) reported the mean keel length to be 7.22±0.03 cm, 10.25±0.05 cm, 10.43±0.10, 10.23±0.12 cm, 10.49±0.12 cm, 10.40±0.12 cm and 10.52±0.12 cm at 8th, 16th, 24th, 32nd, 40th, 46th, and 52nd week of age respectively in White Leghorn.

Kalita *et al.* (2011) studied the different traits of Vanaraja reared under intensive system of management and reported the mean keel length at 40th week of age to be 72.58±9.56 mm.

Ali wafa (2014) compared the conformation traits in four genetic groups of chicken involving Gramapriya and Vanaraja at different weeks of ages. He reported the mean lengths of keel to be 4.74±0.01cm, 6.04±0.02cm, 6.18±0.03cm, 6.35±0.05cm and 6.40±0.05cm at 4th, 8th, 12th, 16th and 20th week of ages respectively in Gramapriya (GP♂♂) x Gramapriya (GP♀♀) genetic group. He further observed that among all the four genetic groups viz. Vanaraja (VR♂♂) x Vanaraja (VR♀♀), GP♂♂ x GP♀♀, VR♂♂ x GP♀♀ and GP♂♂ x VR♀♀, the genetic group VR♂♂ x VR♀♀ had the lengthiest keel at all the ages.

Effect of sex on body weight at different weeks of age

Scientists have studied sexual dimorphism for body weights in different groups of chicken. Males, in general, have heavier body weight than their female counterparts at different weeks of age. The reports given by various authors are reviewed as below:

Verma *et al.* (1981) reported that the mean body weights of males was higher than females by 0.7 g, 8.26 g and 36.2 g at day old, 4 and 8 weeks of age respectively in WL X RIR cross.

Gupta (1983) studied the body weights of White Rock at different ages and reported that the average body weights of male chicks were significantly (P<0.01) heavier than their female counterparts by 23.36 g and 41.80 g at 4th and 6th week of age respectively.

Padhi *et al.*(1999b) studied the sexual dimorphism for body weights in different genetic groups of chicken and reported that the males of Black Nicobari (BN) were significantly (P<0.01) heavier by 8.85 g, 8.80 g and 30.3 g than females at 4th, 6th and 8th week of age respectively. The corresponding increment in males of White Nicobari (WN) breed was observed to be17.3 g, 28.8 g and 39.9 g, whereas in Synthetic Broiler strain (SB) it was observed to be 12.7 g, 64.3 g and 27.6 g.

Singh *et al.* (2000) observed that the average body weights of male chicks were significantly (P<0.01) heavier by 1.10g, 49.45g and 77.88g than their female counterparts at day old, 5th and 8th week of age respectively in Red Cornish.

Padhi *et al.* (2012) reported that Vanaraja males were significantly ($P<0.05$) heavier than females by 0.36g, 7.58g, 24.56g and 55.66g respectively at day old, 2ndweek, 4thweek and 6thweek of age.

Singh *et al.* (2012) reported that PB-2 males were significantly ($P<0.05$) heavier than PB-2 females by 60.83 g and 216.94g at 3rdand 5thweek of age respectively, but in control line sex differences were found to be non-significant.

Ali wafa (2014) reported that males had significantly ($P<0.01$) heavier body weights than their female counter parts in different genetic groups of chicken at various ages. He observed that males of VR♂♂ x VR♀♀, GP♂♂ x GP♀♀, VR♂♂ x GP♀♀ and GP♂♂ x VR♀♀ were significantly ($P<0.01$) heavier than their female counterparts by 5.038g, 1.835g, 1.539g and 2.271g respectively. The corresponding increases at 4th week of age were observed to be 45.1g, 55.07g, 71.27g and 45.55g respectively, whereas at 8th week of age the corresponding increases in body weight were found to be 168.10g, 120.40g, 189.79g and 96.07g respectively. The corresponding values of increment at 12th week of age were noted as 225.40g, 264.61g, 186.55g and 297.0g respectively. He further reported that at 16th week of age corresponding increases were 310.00g, 250.00g, 143.50g and 269.0g respectively, whereas increment in body weight at 20th week of age in corresponding groups were found to be 890.50g, 304.40g, 343.10g and 421.70g respectively.

Sexual dimorphism in Conformation traits

Shank length

Sharma (1984) conducted an experiment to study the sexual dimorphism in different groups of chicken and observed significantly (P<0.05) lengthier shank in males than those of females in pure White Plymouth Rock(WR) and Red Cornish(RC) genetic groups as well as in WR(F) x RC(M) and RC(F) x WR(M) genetic groups.

Malik *et al.*(1997) observed lengthier male shank length by 0.19 cm than their female counterparts at 6th week of age in synthetic broiler chicks.

Padhi *et al.*(1999b) reported that the average shank lengths of the males of Black Nicobari (BN), White Nicobari (WN), Synthetic Broiler(SB), SB X BN and SB X WN were lengthier than their female counterparts by 0.39 cm, 0.26 cm, 0.29 cm, 0.21 cm and 0.39 cm respectively at 8th week of age.

Singh *et al.*(2000) reported the average shank of males of Red Cornish breed to be lengthier than their female counterparts by 0.36 cm at 8th week of age.

Padhi *et al.* (2012) reported the average shank of males of Vanaraja to be significantly (P<0.05) lengthier than their female counterparts by 0.31 cm at 6th week of age.

Singh *et al.* (2012) observed the average shank of males of broiler chickens of PB-2 lines to be lengthier than females by 0.22 cm and 0.34 cm at 3rd and 5th week of age respectively.

Ali wafa (2014) studied the effect of sex on shank length in VR♂♂ x VR♀♀, GP♂♂ x GP♀♀, VR♂♂ x GP♀♀ and GP♂♂ x VR♀♀ genetic groups at 4th, 8th, 12th, 16th and 20th week of age. He observed that males had, in general, lengthier shank in all the genetic groups at all the ages. He observed that at 4th week of age VR♂♂ x VR♀♀, GP♂♂ x GP♀♀ and VR♂♂ x GP♀♀ males had significantly (P<0.01) lengthier shank than their female counterparts by 0.527cm, 0.64cm and 1.08cm respectively. At 8th week of age males of GP♂♂ x GP♀♀, VR♂♂ x GP♀♀ and GP♂♂ x VR♀♀ had significantly (P<0.01) lengthier shank by 0.70cm, 1.30cm and 0.84cm than their female counterparts respectively. He further observed that males of genetic groups of VR♂♂ x VR♀♀, GP♂♂ x GP♀♀, VR♂♂ x GP♀♀ and GP♂♂ x VR♀♀ had significantly (P<0.01) lengthier shank by 1.29cm,1.16cm,1.30cm and 0.65cm respectively than their female counterparts at 12th week of age. The corresponding significant (P<0.01) increase at 16th week of age were observed to be 1.86cm, 0.76cm, 1.39cm and 0.38cm respectively. Besides, the males of VR♂♂ x VR♀♀, GP♂♂ x GP♀♀, and VR♂♂ x GP♀♀ had also significantly (P<0.01) lengthier shank by 1.14cm,0.69cm, and 1.44cm respectively than their female counterparts at 20th week of age.

Keel length

Sharma (1984) conducted the study on the effect of sex on various genetic groups in chicken and observed that males of White Plymouth Rock (WR), Red Cornish (RC), WR(F) X RC(M) and RC(F) X WR(M had significantly (P<0.05) lengthier keels than their female counterparts by 0.97 cm, 1.00 cm, 0.88 cm and 0.93 cm respectively at 8th week of age.

Malik *et al.*(1997) studied the effect of sex on keel length in synthetic broiler chicken and the average keel length of males to be significantly (P<0.05) lengthier by 0.20 cm than females at 6th week of age.

Singh *et al.*(2000) observed the mean keel length of males of Red Cornish to be lengthier than their female counterparts by 0.42cm at 8th week age .

Ali wafa (2014) conducted an experiment to study the effect of sex on body weight and conformation traits in four genetic groups of chicken and reported that sex played highly significant (P<0.01) role on keel length at different ages in all the four genetic groups viz. VR♂♂ x VR♀♀, GP♂♂ x GP♀♀, VR♂♂ x GP♀♀ and GP♂♂ x VR♀♀. He observed that males had significantly (P<0.01) lengthier keels than their female counterparts in all the genetic groups. He found that mean keel of males of GP♂♂ x GP♀♀ genetic group was significantly (P<0.01) lengthier by 0.36cm, 0.31cm, 0.53cm, 0.82cm and 0.85cm at 4th, 8th, 12th, 16th and 20th weeks of age respectively. He further noted that keel of males of VR♂♂ x VR♀♀, VR♂♂ x GP♀♀ and GP♂♂ x VR♀♀ genetic groups had significantly (P<0.01) lengthier keels than their female counter parts at all the ages under studied.

Effect of genetic groups at different weeks of ages:

Body weight:

Significant (P<0.05 or 0.01) effect of genetic group on body weight at different ages of chicken have been reported by various authors { Waters,(1931); Maw,(1933);Hoffman et al. (1961); Hussaini,(1963); Niphon Chandra et al.(1971); Kaushal et al. (1973);Sharma(1984); Redady et al. (1998); Singh et al. (1999b); Haque and Howlider; (2000)}.

Jha and Prasad (2012) compared the production performance of Vanaraja, Gramapriya and Aseel chicken at different weeks of age. They reported significant (P<0.01) effect of genetic groups on body weight at different ages ranging from zero day to forty weeks of age.

Ali wafa (2014) evaluated the performance of body weight and conformation traits in four genetic groups of chicken viz. Vanaraja (VR♂♂) x Vanaraja (VR♀♀), Gramapriya (GP♂♂) x Gramapriya (GP♀♀), VR♂♂ x GP♀♀ and GP♂♂ x VR♀♀ at various ages ranging from zero days to 20th week of age. He reported significant (P<0.01) effect of genetic groups on body weight at all the ages.

Shank length:

Lerner (1937) reported genetic differences in size of shank length within White Leghorn breed which formed a valid criterion in study on inherent body size differences in the fowl.

Chhabra et al. (1972) conducted an experiment to study the effect of nine genetic groups in a 3X3 diallel crosses involving White Rock (WR), White Cornish (WC) and New Hampshire (NH) breeds on shank length at 10th week of age and reported that the mean shank length of NH X WC genetic group excelled all other genetic groups.

Aggarwal et al. (1979) studied 4X4 complete diallel cross involving 4 broiler strains belonging to two breeds viz. Rock and Cornish resulting in 16 genetic groups (4 pure breeds, 6 crosses and 6 reciprocals) for shank length at 10th week of age and observed that the crossbreds as well as the strain crosses had significantly longer shanks than purebreds.

Mahapatra et al. (1983) reported significant effect of genetic groups on shank length pooled over ages in chicken. They reported that the average shank length pooled over ages of Aseel Kagar (AK) was significantly (P<0.05) lengthier than Aseel Peela (AP) by 0.44 cm.

Sharma (1984) conducted an experiment to study the effect of genotypes in 4 genetic groups involving White Plymouth Rock

WR), Red Cornish (RC), WR(F) X RC(M) and RC(F) X WR(M) at 8th week of age. He reported that the average shank length of WR(F) X RC(M) was significantly longer than WR, RC and RC(F) X WR(M) genetic groups by 0.57cm,0.48cm and 0.34cm respectively.

Reddy et al. (1998) reported significant ($P<0.05$) effect of genetic groups involving Red Cornish (IC-3), White Rock (IR-3) and IC-3 X IR-3 on shank length at 6th week of age.

Padhi et al. (1999b) evaluated the performance of five genetic groups viz. Black Nicobari (BN), White Nicobari (WN), Synthetic Broiler (SB), SB X BN and SB X WN on 8th week shank length in chicken and observed that BN and WN genetic groups had significantly ($P<0.05$) shorter shank length than SB and SB X BN genetic groups in both males and females.

Singh et al. (1999a) conducted an experiment to study the genetic effect on shank length involving Aseel(A), Naked Neck (N), Dahlem Red(D), DxA, AxD, DxN, and NxD genetic groups in chicken. They reported that the mean shank length of Dahlem Red male significantly ($P<0.05$) increased over Aseel and Naked Neck males by 0.36cm and 0.35cm respectively. The corresponding significant ($P<0.05$) increment in female was noted as 0.28cm and 0.40cm respectively. Besides, mean shank length of females of DxN genetic group significantly ($P<0.05$) increased over DxN and AxD genotypes by 0.18 cm, and 0.20cm respectively.

Ali wafa (2014) conducted an experiment to study the effect of genetic group on various body weight and conformation traits in chicken at different ages. He observed that genetic group played significant (P<0.01) role on shank length at 4^{th},8^{th}, 12^{th}, 16^{th} and 20^{th} weeks of ages. He further reported that genetic group Vanaraja(VR♂♂)xVanaraja (VR♀♀) and Vanaraja (VR♂♂) x Gramapriya (GP♀♀) had the lengthiest and shortest shank lengths respectively at all the ages.

Keel length:

Mahapatra et al.(1983) observed significant (P<0.05) role of genetic group on keel length in Aseel Peela, Aseel Kagar and their crossbreds.

Sharma (1984) reported significant (P<0.05) effect of genetic group on 8^{th} week keel length in White Rock, Rock Cornish and their crosses.

Venkatesh (1985) reported significant (P<0.05) role of genotypes on keel length at 8^{th} week of age in White Rock and Red Cornish crosses.

Malik et al. (1997) observed significant (P<0.05) effect of genetic group on 6^{th} week keel length in synthetic broiler strains of chicken.

Singh et al.(1999) reported significant (P<0.05) effect of genetic groups involving Aseel, Naked Neck, Dalhem Red and their crosses at 5^{th} week of age.

Singh et al. (2000) observed significant (P<0.05) influence of genetic groups involving different lines of Red Cornish at 8th week keel length.

Ali Wafa (2014) conducted an experiment to study the effect of genetic groups on body weight and conformation traits in four genetic groups viz Vanaraja (VR♂♂) x Vanaraja (VR♀♀), Gramapriya (GP♂♂) x Gramapriya (GP♀♀), VR♂♂ x GP♀♀ and GP♂♂ x VR♀♀ at 4th, 8th, 12th, 16th and 20th weeks of ages and reported highly significant (P<0.01) effect of genetic groups on keel length at all the ages.

HAEMATOBIOCHEMICAL PARAMETERSS:

Blood haematological and biochemical parameters play an important role to understand growth production, fertility and body composition between different breeds and species of birds. (Singh et al. 1998, Herr, 2002; Madubuike and Ekenyem, 2006)

Haematological values of chicken are influenced by age, sex, breed, climate , geographical location, season, day length, time of day, nutritional status, life habit of species, present status of individual and such other physiological factors (Dukes 1955).Therefore, for proper management, feeding, prevention and disease control it is desirable to know the normal physiological values under local conditions.

Analysis of normal haematobiochemical parameters of chickens is essential for diagnosis of various pathological and metabolic disorders. Its evaluation indicates the extent of damage in various vital organs and status of the disease. It can be used as diagnostic tool in order to assess the health status of an individual and/or flock. Haematobiochemical changes are commonly used to determine the body status and to assess the impact of environmental, nutritional and/or pathological stresses. Biochemical profiling has been used in flock to detect subclinical disease.

Haemoglobin and PCV are directly related with health status of poultry.

RBC show immunity status and WBC is related with health abnormality and infection of poultry.

SGOT is an enzyme found mainly in heart muscle, liver cells, skeletal muscle and kidneys. Elevated levels are found in myocardial infarction, hepatitis, acute renal disease etc.

SGPT is mainly found in liver. Increased levels are found in hepatitis, cirrhosis and other hepatic disease.

Cholesterol is found in blood, bile and brain tissue. The cholesterol concentration is much higher in the thigh meat than that of breast meat. Cholesterol concentration is associated with arteriosclerotic vascular disease.

Glucose is found in blood and muscles and it is main source of energy for body function.

The present study has been conducted in three different genetic groups consisting of Gramapriya and two desi (local) chickens with a view to find out the effect of genetic groups on different haematological and biochemical parameters.

Haemoglobin:

Bhatti et al. (2002) studied the effect of biovet in different strains of laying hens and reported Hb(g)% in control group of Crossbred, Desi, Fayoumi and Nick chick to be 11.80±0.76, 12.40±0.55, 13.08±0.87 and 10.80±0.84(g)% respectively.

Islam et al. (2004) studied the hematological parameters of Fayoumi, Assil and local Chickens reared in Sylhet region in Bangladesh at different ages. They observed that haemoglobin concentration increased with the advancement of age, being lowest at one month and highest at twelve months of age in all three breeds. They reported Hb concentration (g %) in Fayoumi, Assil and local at six month of age to be 7.90±0.06, 9.14±0.08 and 8.57 ± 0.04 respectively. They observed significant (P<0.01) breed differences with respect to Hb (g%) concentration which was found to be highest in Assil followed by local and Fayoumi.

Kamruzzaman et al. (2005) studied the effect of probiotics and antibiotic supplementation on body weight and haematobiochemical parameters in Shaver Star Bro strain of broilers at 55 days of age and reported Hb(g%) in control group to be 6.20± 0.71.

Ahmed et al. (2007) found the haemoglobin content (g/dl) to be 7.64±0.15 in control group of broilers at six weeks of age in an experiment to find out the effect of enzyme and vitamin supplementation.

Jayabarathi and Mohamudha (2010) observed Hb (g%) to be 7.2, 7.1and 7.2 in three control groups (C_1,C_2, and C_3) respectively in an experiment related to biochemical analysis in growing hens fed with commercial poultry feeds.

Peters et al.(2011) estimated the haematological parameters of Normal feathered, Frizzled and Naked neck genotypes of Nigerian native chickens at 20 weeks of age. They reported that sex had highly significant (P<0.01) effect on Hb(g%) with males having mean values of 12.73±0.13 (g%) compared to their female counterparts having 10.56±0.17 (g%) mean values. They further observed that genotypes also played highly significant (P<0.01) effect on Hb(g%). The highest values were recorded in Normal feathered chickens (11.98±0.12 g%) followed by Naked neck birds (11.55 ± 0.41g%) and the Frizzled birds (11.42 ± 0.31g%).

Prameela Rani et al. (2011)conducted an experiment to study haematological and biochemical changes of stunting syndrome in broiler chicken and reported Hb(g%) in control group at 8 and 11 weeks of age to be 8.61±0.25 and 10.57±0.51 respectively.

Elagib and Ahmed (2011) compared the haematological parameters of indigenous chicken of Sudan of three different ecotypes at matured ages ranging from 1.5-2.0 years. They observed that sex had significant (P<0.05) effect on Hb(gdL^{-1}) in all the three ecotypes. Males had significantly (P<0.05) higher Hb(gdL^{-1}) than their female counterparts in all the three ecotypes. Hb(gdL^{-1}) in Betwil, BareNeck and Large Beladi were observed to be 18.90,18.59 and 20.66 respectively in males, whereas the corresponding values in females were found to be 15.99,16.10 and 16.44 respectively. They, however, could not find significant differences among the Hb(gdL^{-1}) of three different ecotypes.

Prahsanth et al. (2012) studied the effect of strain, age and sex on blood haematological and biochemical parameters in domestic bird(*Gallus gallus domesticus*).

They reported non-significant effect of strain with respect to Hb (gm/dl) at 25 weeks of age in both males and females. They observed significantly ($P<0.01$) Hb(gm/dl) value of males in PB1 and PB2 strains of domestic birds to be 16.17±0.25 and 16.13±0.19 respectively. The corresponding values in females were noted as 13.49±0.37 and 12.96±0.23 (gm/dl) respectively.

Pandian et al. (2012) evaluated haematological profile and erythrocyte indices in different breeds of poultry among adult birds. They reported Hb(g%) in Kadakanath, Nicobari, Aseel, Rhode Island Red (RIR) and White Leghorn (WLH) breeds of chicken to be 11.10±0.38,12.50± 0.43,12.90±0.69, 8.70±0.27 and 8.80±0.45 respectively. They observed that breeds of chicken had significant ($P<0.01$) effect on Hb(g%). Aseel had highest Hb(g%) followed by Nicobari and Kadakanath, which were significantly ($P<0.01$) higher than Rhode Island Red and White Leghorn .However, Hb(g%) of Rhode Island Red (RIR) and White Leghorn did not differ significantly.

Kundu et al. (2013) compared haematology of adult Vanaraja, Nicobari fowls and their various F_1 crosses. They reported significant ($P<0.05$) effect of genetic groups as well as sex on Hb(g%). Males had higher Hb(g%) than their counterpart females. They reported Hb(g%) of males of Vanaraja, White Nicobari, Black Nicobari and Brown Nicobari to be 16.17±2.19, 16.80±0.76, 15.47±0.44 and 14.37±1.42 (g%) respectively. The corresponding values in female counterparts were noted as 12.98±0.94, 12.33±0.63, 11.56±0.69 and 11.73±0.15 (g%) respectively.

Adeyemo and Sani (2013) studied haematological parameters and serum biochemical indices of 08 week old broilers chicken under nutritional experiment and reported Hb(g%) to be 8.7 in control group.

Kanduri et al. (2013) reported Hb(g%) at 6 weeks of age in broiler chicken to be 8.49gm/dl in positive control group in an experiment to study the effect of different feeds.

PCV:

In an experiment with Biovet in different strains of laying hens Bhatti et al. (2002) reported PCV% to be 36.10±0.89, 37.20±0.84, 36.1±0.89 and 35.80±0.48 in control groups of crossbreds, Desi, Fayoumi and Nick chick chickens respectively.

Islam et al. (2004) reported significant ($P<0.01$) effect of breed on PCV% in Fayoumi, Assil and local chickens of Bangladesh. They found PCV% in Fayoumi, Assil and local chickens to be 28.05±0.63, 29.20±1.36 31.25±0.77 respectively.

Kamruzzaman et al. (2005) reported PCV% in control group of 55 days old broilers to be 32.20±0.37 in an experiment with probiotics and antibiotic supplementation on body weight.

Ahmed et al. (2007) studied the effect of enzyme and vitamin supplementation on physio-biochemical parameters in six weeks broiler chickens and reported PCV% to be 27.99±0.18.

Elagib and Ahmed (2011) studied PCV% of indigenous chicken at mature ages ranging from 1.5-2.0 years under three different ecotypes in Sudan. They observed significant (P<0.05) effect of sex on PCV%. Males had significantly (P<0.05) higher PCV% than females. The PCV% in males of Betwil, BareNeck and Large Beladi were found to be 46.30, 47.70 and 49.20 respectively, whereas the corresponding values of their female counterparts were noted as 42.50, 36.20 and 38.40 respectively. However, the three different ecotypes had no significant role on PCV%.

Peters et al.(2011) conducted an experiment to study the haematological parameters in Normal feathered, Frizzled and Naked neck genotypes of Nigerian native chickens. They observed that sex and genotypes both had significant (P<0.05) effect on PCV% at 20 weeks of age. They reported PCV% in males of Normal feathered, Frizzled and Naked neck chickens to be 36.7±0.33, 37.7±0.54 and 39.80±0.80 respectively. The corresponding values in females were obtained as 34.50±0.48, 30.0±0.52 and 29.50±0.56 respectively.

Prameela Rani et al. (2011) carried out an experiment to study the haematological and biochemical changes of stunting syndrome in broiler chickens at 8 and 11 weeks of age and reported PCV% to be 32.82±0.58 and 32.96±0.56 respectively in control groups.

Pandian et al. (2012) compared haematological profiles of different breeds of adult birds and found significant (P<0.01) effect of breeds on PCV%. The highest PCV% value (40.16±1.84%) was observed to be Aseel followed by Nicobari (28.33±1.14%), White Leghorn (26.16±1.04), Kadakanath (25.16±1.53) and Rhode Island Red (24.83 ±0.94%).

Prahsanth et al. (2012) reported significant (P<0.05) effect of sex on PCV% at 25 weeks of age in two strains, PB1 and PB2, of domestic birds (*Gallus gallus domesticus*). PCV% at 25 week of age in males of strain1 and strain 2 were obtained as 42.13±0.77 and 41.90±0.69 respectively. The corresponding values in females were noted as 39.07±0.61 and 38.10±0.30 respectively.

Adeyemo and Sani (2013) reported PCV% to be 28.0 in a haematological study of broiler chickens of 08 week of age fed with Aspergillus niger hydrolysed cassava peel meal.

Abdi-Hachesoo et al.(2013) studied haematological parameters of adult indigenous chickens in north west of Iran and reported that males had significantly (P<0.05)higher PCV% than their female counterparts. They observed the PCV% in males and females to be 46.10±2.85% and 35.50±2.20% respectively.

RBC:

Bhatti et al. (2002) estimated the haematological parameters after treatment with Biovet in different genetic groups of laying hens and reported RBC ($x10^6$ /mm^3) to be 4.24±0.25, 4.48±0.16, 4.36±0.26 and 4.18±0.20 in crossbred, Desi, Fayoumi and Nick chick strains of laying hens respectively in control group.

Islam et al. (2004) studied the effect of age and breed on RBC in Fayoumi, Assil and Local chickens reared in Sylhet region of Bangladesh. They reported that Fayoumi had significantly ($P<0.01$) higher erythrocyte number than Assil and Local chickens at six months of age. They observed these values in Fayoumi, Assil and Local chickens at six month of age to be 3.3±0.03 ($X10^6$/mm^3), 2.58±0.13 ($X10^6$ /mm^3) and 2.43 ± 0.12 ($X10^6$ /mm^3) respectively.

Kamruzzaman et al. (2005) observed the value of TEC to be 2.49±0.09 (X 10^6/mm^3) in control group of Shaver Star Bro strain of broilers at 55 days of age in an experiment on effect of probiotics and antibiotic supplementation on body weight and haematobiochemical parameters.

Ahmed et al. (2007) reported TEC content (million/mm^3) to be 2.71±0.04 in control group of broiler chickens at six weeks of age in an experiment to find out the effect of enzyme and vitamin supplementation.

Elagib and Ahmed (2011) compared the haematological parameters of indigenous chicken of Sudan under three different ecotypes, at mature ages ranging from 1.5-2.0 years. They observed that sex had significant ($P<0.05$) effect on RBC in all the three ecotypes. The values of RBC of Sudanese indigenous chicken were found to be higher in males than females. Males had significantly ($P<0.05$) higher RBC ($x10^6/mm^3$) values than their female counterparts in all the three ecotypes. The mean values of RBC ($x10^6/mm^3$) in Betwil, BareNeck and Large Beladi ecotypes were observed to be 2.83,2.83 and 2.70 respectively in males, whereas the corresponding values in females were found to be 2.50,1.70 and 2.10 respectively. They reported significant ($P<0.05$) differences among the RBC ($x10^6/mm^3$) values of three different ecotypes.

Peters et al.(2011) conducted an experiment to study the haematological parameters in Normal feathered, Frizzled and Naked neck genotypes of Nigerian native chickens. They observed that males had significantly ($P<0.01$) higher mean value of RBC than their female counterparts among all the three genotypes at 20 weeks of age. They reported RBC ($m\mu/mm^3$) in males of Normal feathered, Frizzled and Naked neck chickens to be 4.12 ± 0.03, 4.20 ± 0.08 and 4.46 ± 0.08 respectively. The corresponding values in females were obtained as 3.72 ± 0.10, 3.38 ± 0.06 and 3.36 ± 0.05 respectively.

Prameela Rani et al. (2011) conducted an experiment to study the haematological and biochemical changes of stunting syndrome in broiler chickens at 8 and 11 weeks of age and reported RBC (millions/cumm) in control groups to be 3.19±0.12 and 3.21±0.13 respectively.

Prahsanth et al. (2012) studied the effect of strain, age and sex on blood haematological and biochemical parameters in domestic birds(*Gallus gallus domesticus*). They reported non-significant effect of strain and sex on RBC ($x10^6/mm^3$) at 25 weeks of age. They observed RBC ($x10^6/mm^3$) values of males in PB1 and PB2 strains of domestic birds to be 4.30±0.07 ($x10^6/mm^3$) and 4.2±1.14 ($x10^6/mm^3$) respectively. The corresponding values in females were noted as 3.59±0.06 ($x10^6/mm^3$) and 3.45±0.10 ($x10^6/mm^3$) respectively.

Pandian et al. (2012) evaluated haematological profile and erythrocyte indices in different breeds of poultry among adult birds. They reported that breed had significant (P<0.01) effect on RBC ($X10^6/\mu l$) in poultry. The mean values of RBC ($X10^6/\mu l$) in Kadakanath, Nicobari, Aseel, Rhode Island Red (RIR) and White Leghorn (WLH) breeds of chicken were observed to be 2.96±0.06, 2.93±0.08, 2.82±0.13, 2.52±0.08 and 2.03±0.02 respectively. Kadakanath had highest RBC ($X10^6/\mu l$) value followed by Nicobari, Aseel, Rhode Island Red (RIR) and White Leghorn (WLH). Kadakanath, Nicobari and Aseel had significantly (P<0.01) higher RBC ($X10^6/\mu l$) values than Rhode Island Red (RIR) and White Leghorn (WLH). However, the mean values of RBC ($X10^6/\mu l$) of Kadakanath, Aseel and Nicobari did not differ significantly.

Kundu et al. (2013) compared haematology of adult Vanaraja, Nicobari fowls and their various F_1 crosses. They reported significant ($P<0.05$) effect of genetic groups on RBC. Red blood cell (RBC) concentration of Vanaraja female was found to be comparatively very high. They observed the RBC values of Vanaraja, White Nicobari, Black Nicobari and Brown Nicobari to be 0.84±0.23, 1.47±0.01, 1.13±0.01 and 0.95±0.02 respectively. The corresponding values in their female counterparts were noted as 1.53±0.22, 1.10±0.01, 1.33±0.06 and 1.25±0.06 respectively.

Adeyemo and Sani (2013) studied haematological parameters and serum biochemical indices of 08 week old broiler chickens in an experiment fed with Aspergillus niger hydrolyzed cassava peel meal based diet and reported RBC ($x10^6/mm^3$) to be 2.51 in control group.

Kanduri et al. (2013) reported RBC ($x10^6$/cumm) in broiler chicken to be 2.98 in positive control group at six week of age in an experiment to study the performance assessment of broiler poultry birds fed on herbal and synthetic amino acids.

WBC:

Bhatti et al. (2002) observed the estimates of WBC (Thousand/ mm^3) to be 14.00±0.35, 13.80±01.04, 13.32±0.58 and 12.90±0.89 in control group of crossbreds, Desi, Fayoumi and Nick chick laying hens respectively.

Jayabarathi and Mohamudha (2010) studied the biochemical parameters in growing hens fed with commercial poultry feed and reported WBC count(cu.mm) to be 3000,3500 and 3500 in three control groups (C_1,C_2, and C_3) respectively.

Elagib and Ahmed (2011) compared haematological parameters of indigenous chickens of Sudan under three different ecotypes. They observed that sex had significant ($P<0.05$) effect on WBC ($\times 10^3$/ mm^3) in each ecotype. The values of WBC ($\times 10^3$/ mm^3) in males of Betwil, BareNeck and Large Beladi ecotypes were found to be 2.34 ($\times 10^3$/ mm^3) , 2.27 ($\times 10^3$/ mm^3) and 2.27 ($\times 10^3$/ mm^3) respectively, whereas the corresponding values in their female counterparts were noted as 2.31($\times 10^3$/ mm^3), 2.43 ($\times 10^3$/ mm^3) and 2.19 ($\times 10^3$/ mm^3) respectively.

Peters et al.(2011) compared haematological parameters of Normal feathered, Frizzled and Naked neck genotypes of Nigerian native chickens and reported that sex and genotypes had no significant effect on WBC (no./mm^3) at 20 weeks of age. They observed WBC (no./mm^3) of males of Normal feathered, Frizzled and Naked neck chickens to be 5560±49.89, 5580±51.64 and 5760±77.75 respectively. The corresponding values in females were obtained as 5560±58.12, 5600±51.64 and 5560±58.12 respectively.

Prameela Rani et al.(2011) conducted an experiment to study the haematological and biochemical changes of stunting syndrome in broiler chicken and reported the WBC (thousand/cumm) to be 28.70±0.80

(thousand/cumm) and 28.14±3.86 (thousand/cumm) at 8 and 11 weeks of age respectively.

Prahsanth et al.(2012) reported that sex and strain had non-significant effect on TLC ($x10^3/mm^3$) at 25 weeks of age in domestic birds (*Gallus gallus domesticus*). They observed TLC values to be 22.20±0.99 and 22.13 ±2.30 in males and females respectively in strain PB1 whereas the corresponding values in strain PB2 were found to be 21.57±1.46 and 19.32±1.18 respectively.

Kanduri et al. (2013) assessed the haematological performance of six week old broiler poultry birds fed on herbal and synthetic amino acids and reported total leucocytes count ($x10^3$/cumm) to be 26.12 in positive control group.

SGOT:

Kamruzzaman et al. (2005) observed the effect of probiotics and antibiotic supplementation on body weight and haematobiochemical parameters in Shaver Star Bro strain of broilers at 55 days of age and reported SGOT (U/L) to be 187.32± 3.71 in control group .

Ahmed et al. (2007) observed the effect of enzyme and vitamin supplementation on physio-biochemical parameters in broiler chickens and reported the estimates of SGOT(U/L) to be 341±3.18 in control group of broilers at six weeks of age.

Jayabarathi and Mohamudha (2010) reported the estimates of SGOT(U/L) to be 200,201 and 201 in three control groups (C_1,C_2, and C3) respectively in an experiment related to biochemical analysis in growing hens fed with commercial poultry feeds.

Biswas et al. (2011) conducted an experiment to study the effect of antioxidants on physio-biochemical and haematological parameters in broiler chicken of six weeks age at high Altitude and reported estimate of SGOT (n mole/min/mg protein) to be 56.12±2.10 in control group.

Prahsanth et al. (2012) reported the estimate of AST/SGOT (IU/L) in domestic birds (*Gallus gallus domesticus*) at 25 weeks of age in PB-1 and PB-2 strains to be 137.6± 9.45 IU/L and 138.4± 8.73 IU/L respectively, whereas the corresponding values in their female counterparts were reported to be 131.3±6.45 and 172.6±20.74 respectively.

Abdi-Hachesoo et al.(2013) studied the biochemical parameters of adult indigenous chicken in North-West of Iran and reported the estimates of AST IU/L to be 191± 0.89 and 125.20 ± 11.76 IU/L in cocks and hens respectively. They further reported the estimates of AST in males were significantly higher ($P<0.01$) than the estimates of females.

Kanduri et al. (2013) reported the estimate of SGOT(U/I) at 6 weeks of age in broiler chicken to be 160.11 in positive control group in an experiment to study the performance assessment of broiler poultry birds fed on herbal and synthetic amino acids.

Adriani et al. (2014) estimated SGOT in broiler chickens of one month age fed with noni juice (Morind citrifolia) and palm sugar (Arenga piata).They reported the estimate to be 234.67 (U/L) in control group of chicken.

SGPT:

Ahmed et al.(2007) conducted an experiment to find out the effect of enzyme and vitamin supplementation on physio-biochemical parameters in broiler chickens. They reported the estimates of SGPT (IU) in six week old broilers to be 6.36 ± 0.32 (IU) in control group.

Jayabarathi and Mohamudha (2010) studied the biochemical parameters in growing hens fed with commercial poultry feed and reported the estimates of SGPT (U/L) to be 5.3,5.0 and 5.0 in control groups (C_1, C_2 and C_3) respectively.

Prahsanth et al.(2012) reported the estimate of ALT (IU/L) in PB-1 and PB-2 strains of (*Gallus gallus domesticus*) at 25 weeks of age in males to be 52.28 ± 25.49 IU and 16.98 ± 3.94 IU respectively. The corresponding values in females were noted to be 27.09±3.49 and 19.54 ± 4.81 respectively.

Abdi-Hachesoo et al.(2013) reported the estimate of ALT (IU/L) in adult male and female indigenous chicken of Iran to be 7.80 ± 1.62 IU/L and 7.20±1.40

IU/L respectively. They further observed that cocks had significantly ($P<0.05$) higher estimate than hens.

Kanduri et al. (2013) studied the performance assessment of broiler chickens fed on herbal and synthetic amino acids and reported the estimate of SGPT at six weeks of age to be 20.97 U/I in positive control group.

Cholesterol:

Bhatti et al. (2002) conducted an experiment to study the biochemical parameters after treatment with biovet in different strains of laying hens. They observed the estimates of cholesterol (mg/dl) to be 147.42±72.96, 145.72±62.17, 140.99±61.42 and 130.77±50.55 in control groups of crossbred, Desi, Fayoumi and Nick chick respectively.

Islam et al. (2004) observed the value of cholesterol to be 137.52 ± 1.72 (mg/dl) in control group of Shaver Star Bro strain of broilers at 55 days of age in an experiment to study the effect of probiotic supplementation on body weight and haematobiochemical parameters.

Das et al. (2005) reported the serum cholesterol level to be 142.53±0.66 (mg/dl) in control group of six weeks old Vencob broiler chickens in an experiment to study the effect of probiotics on certain blood parameters and carcass characteristics of broiler chicken.

Jayabarathi and Mohamudha (2010) reported the level of cholesterol (mg/dl) to be 124,110 and 112 in three control groups (C_1,C_2, and C3) respectively in an experiment related to biochemical analysis in growing hens fed with commercial poultry feeds.

Prahsanth et al. (2012) studied the effect of strain, age and sex on blood haematological and biochemical parameters in domestic bird (*Gallus gallus domesticus*). They reported significant (P<0.05) effect of age and sex with respect to cholesterol (mg/dl) at 25 weeks of age in both males and females. They further observed the cholesterol (mg/dl) values of males in PB1 and PB2 strains to be 103.7±4.05 and 143.4±16.39 respectively. The corresponding values in their female counterparts were noted as 95.28±04.9 and139.3±7.02 (mg/dl) respectively.

Abdi-Hachesoo et al.(2011) observed the values of cholesterol (mg/dl) during comparative studies on blood profiles of adult indigenous and Ross-308 broiler breeds. They reported that breed had significant (P<0.05) effect on cholesterol value (in females only), While males did not show significant effect. They reported cholesterol values (mg/dl) among males of indigenous and Ross-308 breeds to be 167.60±35.68 and 74.50±18.71 and their female counterparts to be 152.60±28.11 and 181.50±33.22 (mg/dl) respectively.

Peters et al.(2011) conducted an experiment to study the influence of sex and genotypes in Normal feathered, Frizzled and Naked neck genotypes of Nigerian native chickens at 20 weeks of age. They observed that sex played highly significant ($P<0.01$) effect on blood cholesterol level in each genetic group. Males had significantly ($P<0.01$) higher estimates of cholesterol than their female counterparts. They observed the estimates of cholesterol in Normal Feathered, Frizzled and Naked neck males to be 169.6±1.12, 176.0±2.37 and 183.1±3.27 mg/dl respectively. The corresponding values in female counterparts were noted as 158.0 ± 2.21, 137.2 ± 2.32 and 137.5±2.21 respectively. They further reported the estimates of cholesterol (mg/dl) in Normal feathered Frizzled and Naked neck genotypes to be 168.30±1.84, 156.50 ± 4.73 and 160.30 ± 5.57 mg/dl respectively. The estimates of cholesterol of Normal feathered were significantly ($P<0.05$) higher by 7.2mg/dl, than the estimates of cholesterol of Frizzled chickens. However, the estimates of cholesterol of Normal feathered and Naked neck genotypes did not differ significantly. Besides the mean cholesterol level of Frizzled chicken also did not differ significantly with mean value of naked neck.

Abdi-Hachesoo et al.(2013) reported that sex had no significant effect on cholesterol (mg/dl) value during an study on adult indigenous chickens in North west of Iran. They observed estimates of cholesterol (mg/dl) to be 167.60±35.68 and 152.60±28.11 in males and females respectively.

Kanduri et al. (2013) reported serum cholesterol (mg/dl) at 6 weeks of age in broiler chicken to be 148.38 mg/dl in control group in an experiment to study the performance assessment of broiler poultry birds fed on herbal and synthetic amino acids.

Khawaja et al. (2013) studied the production performance, egg quality and biochemical parameters of three way crossbred chickens in sub-tropical environment and reported that there was non-significant ($P>0.05$) difference in cholesterol values among all crossbred chickens. Cholesterol values (mg/dl) in RIFI (Rhode Island Red male x Fayoumi female); FIRI (Fayoumi male x Rhode Island Red female) and RLH (White Leghorn male x FIRI female) were reported to be 138.00 ± 10.00 130.70 ± 09.00 and 134.33 ± 20.20 respectively.

Glucose:

Bhatti et al. (2002) estimated the biochemical parameters of laying hens of four different genetic groups viz; crossbred, Desi, Fayoumi and Nick chick after feeding Biovet, a probiotic, in poultry feeds. They reported the estimates of glucose (mg/dl) to be 228.18 ±66.09, 214.34 ± 35.58, 192.17 ± 16.29 and 226.61 ± 18.86 in the respective control groups of four different genetic strains.

Das et al. (2005) studied the effect of probiotics on some blood parameters in broiler chicken at six week of age and reported the glucose (mg/dl) value to be 181.52 ± 0.04 in control group.

Abdi-Hachesoo et al.(2011) compared the blood profiles of adult indigenous and Ross-308 broiler breeds. They reported significant ($P<0.01$) effect of breeds (among females only) on glucose (mg/dl) level whereas the males of both the breeds did not differ significantly with respect to glucose level. However, they could not find significant effect of breed on glucose level. They observed glucose level (mg/dl) to be 260.60 ±35.68 and 260.50±18.71 in males of indigenous and Ross-308 respectively. The corresponding values among females were observed to be 245.60±28.11 and 274.50±33.22 respectively.

Peters et al.(2011) studied the effect of sex and genotypes on level of glucose in Normal Feathered, Frizzled and Naked neck genotypes of Nigerian native chickens at 20 weeks of age. They reported that sex had highly significant ($P<0.01$) effect on glucose level (mg/dl). Males had significantly ($P<0.01$) higher glucose level their female counterparts in each genetic group. Males had 68.30 ± 0.75, 71.80 ± 0.76 and 75.50 ± 1.34 (mg/dl) glucose levels in Normal Feathered, Frizzled and Naked neck chickens respectively. The corresponding values in their female counterparts were observed to be 65.20 ± 0.93, 56.70 ± 0.75 and 54.60 ± 1.33 (mg/dl) respectively. They further observed that genotypes also played significant ($P<0.005$) role on glucose (mg/dl). The highest value (66.75 ± 0.68) of glucose was estimated to be in Normal Feathered chicken followed by Naked neck (65.05 ± 2.57) and Frizzled (64.25 ± 1.81). The estimate of glucose in

Normal feathered was significantly (P<0.05) higher than Frizzled chicken. However, the mean value of glucose (mg/dl) of Normal feathered and Naked neck chickens did not differ significantly. Besides, the mean value of glucose of Frizzled chicken (mg/dl) also did not differ significantly with the mean value of glucose of Naked neck.

Prameela Rani et al. (2011) conducted an experiment to study haematological and biochemical changes of stunting syndrome in broiler chickens at 8 and 11 weeks of age and reported glucose (g%) in control groups to be 186.58±5.58 and 197.46±5.67 respectively.

Prahsanth et al. (2012) studied the effect of strain, age and sex on blood haematological and biochemical parameters in domestic birds (*Gallus gallus domesticus)*. They reported non-significant effect of strain and sex with respect to glucose (mg/dl) at 25 weeks of age in two strains of PB1 and PB2. They observed the values of glucose (mg/dl) in males of PB1 and PB2 strains to be 221.6±7.89 and 223.6±5.95 respectively. The corresponding values in their female counterparts were noted as 250.2±09.35 and 224.8±18.61 (mg/dl) respectively.

Abdi-Hachesoo et al. (2013) studied biochemical parameters of adult indigenous chickens in North West of Iran and reported that sex had no significant effect on glucose (mg/dl). They observed the estimates of glucose (mg/dl) in male and female to be 260.0 (mg/dl) and 245.6(mg/dl) respectively.

Khawaja et al. (2013) studied production performance, egg quality and biochemical parameters of three way crossbred chickens in sub-tropical environment and reported that there was no significant effect of genetic groups on blood glucose values among all crossbred chickens. They observed the glucose value (mg/dl) in RIFI (Rhode Island Red male x Fayoumi female), FIRI (Fayoumi male x Rhode Island Red female) and RLH (White Leghorn male x FIRI female) to be 215.00±13.00 240.00±11.00 and 257.00 ± 8.00 respectively.

ıenotypic correlations

Falconer (1960) has defined phenotypic correlation as the association tween two characters that can be directly observed which may be due to ɿetic, environmental or due to the combination of both the factors.

A number of conformation traits are known to be good indicators of ɪdy growth and market value of broiler apart from body weight (Edward,)00). Poultry breeders have tried to establish the relationship that exist :tween body weight and body conformations traits as this information flect on the performance of the broiler chickens. Besides, this helps the :eeders to organize the breeding programme in order to achieve an ɔtimum combination of body weights and good conformation for maximum :onomic return (Okon *et al.*, 1997). Apart from these, the inter- lationships among body measurement can be applied speedily in the :lection and breeding programme.

Correlations among economic traits are one of the key factors in ɔrmulating strategies in breeding experiments especially response to election, as the direction and magnitude of correlations between two traits vould determine the genetic changes in principal as well as in the orrelated traits.

The findings of coefficients of correlations will be helpful to formulating ɪreeding strategy by taking advantage of correlated response.

The estimates of phenotypic correlations among various body weight ɪnd conformation traits are summarized as below:

le-2: Phenotypic correlations among body weight at different ks of age in pure and crossbred chicken

Traits	Breed of chicken	Phenotypic correlation coefficient	Authors
week body weight 16-week body weight	White Leghorn	0.377	Jaya Laxmi *et al.*(2010)
-week body weight 20-week body weight		0.246	
6-week body weight 20-week body weight		0.306	
0-week body weight 40-week body weight		0.278	
:0-week body weight : 40-week body weight	Vanaraja	0.36	Padhi and Chatterjee(2012)
)ay old Body wt. : 4thweek body wt.	Gramapriya X Gramapriya	0.270	Ali Wafa (2014)
)ay old Body wt. : 8thweek body wt.		0.257	
)ay old Body wt. X 12thweek body wt.		0.299	
Day old Body wt. X 16thweek body wt.		0.031	
Day old Body wt. X 20thweek body wt.		0.015	
4thweek Body wt. X 8thweek body wt.		0.298	
4thweek Body wt. X 12thweek body wt.		0.265	

4th week Body wt. X 16th week body wt.	Gramapriya X Gramapriya	0.012	Ali Wafa (2014)
4th week Body wt. X 20th week body wt.		0.157	
8th week Body wt. X 12th week body wt.		0.350	
8th week Body wt. X 16th week body wt.		0.232	
8th week Body wt. X 20th week body wt.		0.230	
12th week Body wt. X 16th week body wt.		0.308	
12th week Body wt. X 20th week body wt		0.255	
16th week Body wt. X 20th week body wt		0.579	
Day old Body wt. X 4th week body wt.	Gramapriya X Vanaraja	0.371	Ali Wafa (2014)
Day old Body wt. X 8th week body wt.		-0.980	
Day old Body wt. X 12th week body wt.		-0.018	
Day old Body wt. X 16th week body wt.		0.021	

Day old Body wt. X 20th week body wt.	Gramapriya X Vanaraja	0.094	Ali Wafa (2014)
4th week Body wt. X 8th week body wt.		0.204	
4th week Body wt. X 12th week body wt.		-0.041	
4th week Body wt. X 16th week body wt.		0.045	
4th week Body wt. X 20th week body wt.		0.003	
8th week Body wt. X 12th week body wt.		-0.018	
8th week Body wt. X 16th week body wt.		0.160	
8th week Body wt. X 20th week body wt.		0.042	
12th week Body wt. X 16th week body wt.		0.141	
12th week Body wt. X 20th week body wt		0.200	
16th week Body wt. X 20th week body wt		-0.003	

ble-3 : Phenotypic correlations among body weight and Shank length at different weeks of age in pure and crossbred chicken

Traits	Breed of chicken	Phenotypic correlation coefficient	Authors
20-week body weight x 16-week shank length	White Leghorn	0.22	Khurana *et al.* (2006)
20-week body weight x 32-week shank length		0.24	
20-week body weight x 40-week shank length		0.27	
40-week body weight x 20-week shank length	Vanaraja	0.10	Padhi and Chatterjee (2012)
20-week body weight x 20-week shank length	Vanaraja	0.30	Padhi and Chatterjee (2012)
20-week body weight x 40-week shank length		0.24	
3-week body weight x 3-week shank length	Broiler chickens	0.457	Singh *et al.* (2000)
5-week body weight x 5-week shank length		0.571	
Day old Body wt. X 4th week shank length	Gramapriya X Gramapriya	-0.080	Ali wafa (2014)
Day old Body wt. X 8th week shank length		-0.101	
Day old Body wt. X 12th week shank length		0.081	
Day old Body wt. X 16th week shank length		0.011	

Day old Body wt. X 20th week shank length	Gramapriya X Gramapriya	-0.052	Ali Wafa (2014)
4th week Body wt. X 4th week shank length		0.910	
4th week Body wt. X 8th week shank length		0.205	
4th week Body wt. X 12th week shank length		0.045	
4th week Body wt. X 16th week shank length		0.258	
4th week Body wt. X 20th week shank length		0.058	
8th week Body wt. X 4th week shank length		0.268	
8th week Body wt. X 8th week shank length		0.864	
8th week Body wt. X 12th week shank length		0.040	
8th week Body wt. X 16th week shank length		0.072	
8th week Body wt. X 20th week shank length		-0.145	
12th week Body wt. X 4th week shank length		0.262	

12th week Body wt. X 8th week shank length	Gramapriya X Gramapriya	0.329	Ali wafa (2014)
12th week Body wt. X 12th week shank length		0.028	
12th week Body wt. X 16th week shank length		-0.046	
12th week Body wt. X 20th week shank length		-0.002	
16th week Body wt. X 4th week shank length		-0.028	
16th week Body wt. X 8th week shank length		0.216	
16th week Body wt. X 12th week shank length		0.065	
16th week Body wt. X 16th week shank length		0.124	
16th week Body wt. X 20th week shank length		0.022	
20th week Body wt. X 4th week shank length		0.134	
20th week Body wt. X 8th week shank length		0.227	
20th week Body wt. X 12th week shank length		0.145	
20th week Body wt. X 16th week shank length		0.048	

20th week Body wt. X 20thweek shank length		0.071	
Day old Body wt. X 4thweek shank length	Gramapriya X Vanaraja	0.0641	Ali wafa (2014)
Day old Body wt. X 8thweek shank length		0.2109	
Day old Body wt. X 12thweek shank length		-0.1461	
Day old Body wt. X 16thweek shank length		-0.2497	
Day old Body wt. X 20thweek shank length		-0.0483	
4th week Body wt. X 4thweek shank length		0.101	
4th week Body wt. X 8thweek shank length		0.185	
4th week Body wt. X 12thweek shank length		0.074	
4th week Body wt. X 16thweek shank length		0.103	
4th week Body wt. X 20thweek shank length		0.096	
8th week Body wt. X 4thweek shank length		0.140	
8th week Body wt. X 8thweek shank length		0.885	

8th week Body wt. X 12thweek shank length	Gramapriya X Vanaraja	-0.070	Ali wafa (2014)
8th week Body wt. X 16thweek shank length		0.094	
8th week Body wt. X 20thweek shank length		0.141	
12th week Body wt. X 4thweek shank length		0.119	
12th week Body wt. X 8thweek shank length		0.073	
12th week Body wt. X 12thweek shank length		0.025	
12th week Body wt. X 16thweek shank length		0.006	
12th week Body wt. X 20thweek shank length		0.096	
16th week Body wt. X 4thweek shank length		-0.042	
16th week Body wt. X 8thweek shank length		0.093	
16th week Body wt. X 12thweek shank length		0.096	
16th week Body wt. X 16thweek shank length		0.018	

16th week Body wt. X 20th week shank length	Gramapriya X Vanaraja	0.171	Ali wafa (2014)
20th week Body wt. X 4th week shank length		0.060	
20th week Body wt. X 8th week shank length		0.084	
20th week Body wt. X 12th week shank length		0.044	
20th week Body wt. X 16th week shank length		0.093	
20th week Body wt. X 20th week shank length		0.049	

le-4 : Phenotypic correlations among body weight and Keel ;th at different weeks of age in pure and crossbred chicken

Traits	Breed of chicken	Phenotypic correlation coefficient	Authors
20-week body weight x 16-week keel length	White Leghorn	0.33	Khurana *et al.* (2006)
20-week body weight x 32-week keel length		0.28	
20-week body weight x 40-week keel length		0.28	
Day old Body wt. X 4th week keel length	Gramapriya X Gramapriya	-0.0267	Ali Wafa (2014)
Day old Body wt. X 8th week keel length		-0.1853	
Day old Body wt. X 12th week keel length		0.039	
Day old Body wt. X 16th week keel length		0.0793	
Day old Body wt. X 20th week keel length		0.0526	
4th week Body wt. X 4th week keel length		0.822	
4th week Body wt. X 8th week keel length		0.224	

4th week Body wt. X 12th week keel length	Gramapriya X Gramapriya	0.001	Ali Wafa (2014)
4th week Body wt. X 16th week keel length		-0.227	
4th week Body wt. X 20th week keel length		0.143	
8th week Body wt. X 4th week keel length		0.237	
8th week Body wt. X 8th week keel length		0.752	
8th week Body wt. X 12th week keel length		0.041	
8th week Body wt. X 16th week keel length		0.081	
8th week Body wt. X 20th week keel length		0.007	
12th week Body wt. X 4th week keel length		0.171	
12th week Body wt. X 8th week keel length		0.254	
12th week Body wt. X 12th week keel length		0.068	
12th week Body wt. X 16th week keel length		0.115	

12th week Body wt. X 20thweek keel length	Gramapriya X Gramapriya	0.050	Ali Wafa (2014)
16th week Body wt. X 4thweek keel length		- 0.018	
16th week Body wt. X 8thweek keel length		0.308	
16th week Body wt. X 12thweek keel length		0.007	
16th week Body wt. X 16thweek keel length		0.051	
16th week Body wt. X 20thweek keel length		0.084	
20th week Body wt. X 4thweek keel length		0.107	
20th week Body wt. X 8thweek keel length		0.242	
20th week Body wt. X 12thweek keel length		0.050	
20th week Body wt. X 16thweek keel length		0.234	
20th week Body wt. X 20thweek keel length		0.098	
Day old Body wt. X 4thweek keel length	Gramapriya X Vanaraja	-0.005	Ali Wafa (2014)

Day old Body wt. X 8th week keel length	Gramapriya X Vanaraja	0.177	Ali Wafa (2014)
Day old Body wt. X 12th week keel length		-0.118	
Day old Body wt. X 16th week keel length		-0.073	
Day old Body wt. X 20th week keel length		0.059	
4th week Body wt. X 4th week keel length		0.024	
4th week Body wt. X 8th week keel length		0.250	
4th week Body wt. X 12th week keel length		0.237	
4th week Body wt. X 16th week keel length		0.088	
4th week Body wt. X 20th week keel length		-0.227	
8th week Body wt. X 4th week keel length		0.023	
8th week Body wt. X 8th week keel length		0.723	
8th week Body wt. X 12th week keel length		- 0.020	

8th week Body wt. X 16thweek keel length	Gramapriya X Vanaraja	0.080	Ali wafa (2014)
8th week Body wt. X 20thweek keel length		0.058	
12th week Body wt. X 4thweek keel length		-0.088	
12th week Body wt. X 8thweek keel length		0.135	
12th week Body wt. X 12thweek keel length		0.081	
12th week Body wt. X 16thweek keel length		0.014	
12th week Body wt. X 20thweek keel length		0.163	
16th week Body wt. X 4thweek keel length		-0.059	
16th week Body wt. X 8thweek keel length		0.193	
16th week Body wt. X 12thweek keel length		0.110	
16th week Body wt. X 16thweek keel length		0.126	
16th week Body wt. X 20thweek keel length		0.101	

20th week Body wt. X 4th week keel length	Gramapriya X Vanaraja	0.042	Ali wafa (2014)
20th week Body wt. X 8th week keel length		0.046	
20th week Body wt. X 12th week keel length		0.126	
20th week Body wt. X 16th week keel length		0.166	
20th week Body wt. X 20th week keel length		0.101	

e-5: Phenotypic correlations between shank length and keel th at different weeks of age in pure and crossbred chicken

Traits	Breed of chicken	Phenotypic correlation coefficient	Authors
16-week shank length x 16-week keel length	White Leghorn	0.147	Khurana *et al.* (2006)
32-week shank length x 32-week keel length		0.244	
40-week shank length x 40-week keel length		0.238	
4thweek shank length. X 4thweek keel length.	Gramapriya X Gramapriya	0.748	Ali Wafa (2014)
4thweek shank length. X 8thweek keel length.		0.218	
4thweek shank length. X12thweek keel length.		0.032	
4thweek shank length. X 16thweek keel length.		-0.022	
4thweek shank length. X 20thweek keel length.		0.080	
8thweek shank length. X 4thweek keel length.		0.263	
8thweek shank length. X 8thweek keel length.		0.674	

8th week shank length. X12th week keel length.	Gramapriya X Gramapriya	0.031	Ali Wafa (2014)
8th week shank length. X 16th week keel length.		0.035	
8th week shank length. X 20th week keel length.		0.017	
12th week shank length. X 4th week keel length.		0.138	
12th week shank length. X 8th week keel length.		0.199	
12th week shank length. X12th week keel length.		0.046	
12th week shank length. X 16th week keel length.		0.106	
12th week shank length. X 20th week keel length.		0.030	
16th week shank length. X 4th week keel length.		0.085	
16th week shank length. X 8th week keel length.		0.161	
16th week shank length. X12th week keel length.		-0.009	
16th week shank length. X 16th week keel length.		0.090	

16th week shank length. X 20th week keel length.	Gramapriya X Gramapriya	0.046	Ali Wafa (2014)
20th week shank length. X 4th week keel length.		0.203	
20th week shank length. X 8th week keel length.		0.046	
20th week shank length. X12th week keel length.		0.026	
20th week shank length. X 16th week keel length.		0.175	
20th week shank length. X 20th week keel length.		0.006	
4th week shank length. X 4th week keel length.	Gramapriya X Vanaraja	0.442	Ali Wafa (2014)
4th week shank length. X 8th week keel length.		0.178	
4th week shank length. X12th week keel length.		0.057	
4th week shank length. X 16th week keel length.		0.050	
4th week shank length. X 20th week keel length.		-0.087	
8th week shank length. X 4th week keel length.		0.043	

8th week shank length. X 8th week keel length.	Gramapriya X Vanaraja	0.767	Ali Wafa (2014)
8th week shank length. X12th week keel length.		-0.015	
8th week shank length. X 16th week keel length.		0.149	
8th week shank length. X 20th week keel length.		0.103	
12th week shank length. X 4th week keel length.		-0.127	
12th week shank length. X 8th week keel length.		0.170	
12th week shank length. X12th week keel length.		0.028	
12th week shank length. X 16th week keel length.		0.050	
12th week shank length. X 20th week keel length.		0.154	
16th week shank length. X 4th week keel length.		0.058	
16th week shank length. X 8th week keel length.		0.011	
16th week shank length. X12th week keel length.		0.080	

16thweek shank length. X 16thweek keel length.	Gramapriya X Vanaraja	0.734	Ali Wafa (2014)
16thweek shank length. X 20thweek keel length.		-0.094	
20thweek shank length. X 4thweek keel length.		0.068	
20thweek shank length. X 8thweek keel length.		0.145	
20thweek shank length. X12thweek keel length.		-0.038	
20thweek shank length. X 16thweek keel length.		0.050	
20thweek shank length. X 20thweek keel length.		0.060	

-6 : Phenotypic correlations between shank length and shank
ı at different weeks of age in chicken

Traits	Breed of chicken	Phenotypic correlation coefficient	Authors
1	2	3	4
20-week shank length x 22-week shank length	Vanaraja	0.44	Padhi and Chatterjee (2012)
20-week shank length x 40-week shank length		0.46	
22-week shank length x 40-week shank length		0.57	

ıtobiochemical Correlation Coefficient:

ɜters et al. (2011) estimated the coefficients of phenotypic ıtions among various haematological parameters in Normal red, Frizzled and Naked neck genotypes of Nigerian native ns at 20 weeks of age. They observed that Hb(g%) was cantly ($P<0.01$) and positively correlated with PCV% and sterol(mg/dl). However, the positive correlations of Hb with RBC, ınd glucose were found to be statistically non-significant.

'CV was positively and significantly ($P<0.01$) correlated with RBC, ;e and cholesterol. It was further observed to be positively and cantly ($P<0.05$) associated with WBC.

hey further reported that RBC was positively and significantly 1) associated with glucose and cholesterol. However, positive ation of RBC with WBC was found to be statistically non-cant.

Chapter-III

MATERIALS AND METHODS

MATERIALS AND METHODS

The experiment was conducted on three genetic groups of ıicken involving Gramapriya, Desi (Muzaffarpur) and Desi (Gaya) aintained at Instructional Livestock Farm Complex (ILFC) of ihar veterinary college Patna on random mating for several enerations to study the growth performance, conformation traits nd haemato-biochemical parameters. Desi chickens were obtained om Gaya and Muzaffarpur districts of Bihar and were named as aya and Muzaffarpur respectively for identification purposes.

The three genetic groups were formed in the following manner r the present investigation:

1. Gramapriya ♂♂ X Gramapriya ♀♀
2. Desi (Muzaffarpur) ♂♂ X Gramapriya ♀♀
3. Desi (Gaya) ♂♂ X Gramapriya ♀♀

Twenty males and one hundred females under each genetic roup were taken to become the parents. The mating of males and emales were done in the ratio of 1 : 5 in each group on random asis. All the progenies were obtained from single hatch in each roup.

The number of male and female progenies at 4th week of age nder different genetic groups for body weight and conformation ait parameters was as below:

Sl. No.	Genetic group	Male	Female	Total
1	GP ♂♂ x GP ♀♀	95	99	194
2	MZF ♂♂ x GP ♀♀	99	109	208
3	GAYA ♂♂ x GP ♀♀	94	104	198
	Total	**288**	**312**	**600**

Males and females from each genetic group were taken at 20th eek of age for haematobiochemical studies.

The birds were maintained on deep litter system. Better niform management and standard ration and clean water were rovided *ad. lib* to all the birds throughout the experiment.

he traits under study were as below:

. Body weight traits:

1. Day old body weight (g)
2. 4 week body weight (g)
3. 8 week body weight (g)
4. 12 week body weight (g)
5. 16 week body weight (g)
6. 20 week body weight (g)

. Conformation traits:

ı) Shank length

1. 4 week shank length (cm)
2. 8 week shank length (cm)
3. 12 week shank length (cm)

4.16 week shank length (cm)

5.20 week shank length (cm)

b) Keel length

1. 4 week keel length (cm)
2. 8 week keel length (cm)
3. 12 week keel length (cm)
4. 16 week keel length (cm)
5. 20 week keel length (cm)

C. Haematobiochemical Parameters:

A-Haematological

1. Hemoglobin %
2. Packed Cell Volume %
3. Red Blood Corpuscles ($x10^6/mm^3$)
4. White Blood Corpuscles ($x10^3/mm^3$)

B-Biochemical

1.Serum Glutamic Oxaloacetic Transaminase (SGOT)(IU)

2.Serum Glutamic Pyruvic Transaminase (SGPT)(IU)

3.Cholesterol (mg/dl)

4.Glucose (mg/dl)

Measurement of the traits:

1. Body weight:

The birds were weighed individually immediately after hatching and subsequently at 4th week interval for a period of 20 weeks of age. Body weight of each bird was weighted on zero day, 4^{th}, 8^{th}, 12^{th}, 16^{th}, and 20^{th} week of age. It was recorded to the nearest 0.1 g sensitivity.

2. Conformation Traits:

A- Shank length:

This was measured with the help of slide caliper at 4^{th}, 8^{th}, 12^{th}, 16^{th}, and 20^{th} week of age on left shank. Shank length was measured as the distance between point of hock and base of foot.

B-Keel length:

This was also measured with the help of a slide caliper at 4^{th}, 8^{th}, 12^{th}, 16^{th} and 20^{th} week of age. It was measured as the distance from the anterior end to the posterior end of the keel bone.

Iaematobiochemical parameters:

The blood samples were collected from the wing veins using sterile needles and syringes and collected into well-labeled and sterilized bottles containing ethylene diamine tetra acetic acid (EDTA) as anti-coagulant. Blood samples for biochemical parameters were collected into another sample bottles without the anticoagulant.

A-Haematological

The samples were investigated for the following haematological parameters – haemoglobin, packed cell volume (PCV), red blood cell (RBC) and white blood cell (WBC).The haematological analysis were performed within two hours after blood collection as per the methods given below:

Sr.No	**Methods**	**Haematological Parameters**
1.	Sahli's acid hematin method	Hb
2.	Microhaematocrit measurement method	PCV
3.	Auto haemato analyser	RBC
4.	Auto haemato analyser	WBC

B-Biochemical

The collected samples of serum from each group were examined for SGOT, SGPT Cholesterol and Glucose as per the methods given below:

I. SGOT- By Modified IFCC method as described in diagnostic kit supplied by Coral clinical system, Goa, India.

II. SGPT- By Modified IFCC method as described in diagnostic kit supplied by Coral clinical system, Goa, India.

III. Cholesterol- By Modified CHOD/PAP method as described in diagnostic kit supplied by Coral clinical system, Goa, India.

IV. Glucose-By Modified GOD/POD Method as described in diagnostic kit supplied by Span diagnostic limited, Surat, India.

Statistical Analysis:

All the data were analyzed by fitting least squares analysis as per Harvey (1990) in the department of Animal Genetics and Breeding, BVC, Patna. Some data were also analyzed by Microsoft excel 2007. Data were standardized before analysis.

Mean, standard error and coefficient of variation:

The mean, standard error and coefficient of variation for all the body weight and conformation traits in all the genetic groups were computed using the formulae given by Snedecor and Cochran(1994).

$$\overline{X} = \frac{\sum_{i=1}^{n} x_i}{n}$$

$$S.E = \frac{S}{\sqrt{n}}$$

$$C.V.\% = \frac{S}{\overline{X}} \times 100$$

$$S = \sqrt{\frac{\Sigma x_i^2 - \frac{(\Sigma x_i)^2}{n}}{n-1}}$$

$\overline{X}$ = Mean

X_i = Measurement of a trait on i^{th} bird

n = number of Observations

The following linear statistical model was used for studying the effect of sex on various body weight and conformation traits under study

$$Y_{ij}=\mu + S_i + e_{ij}$$

Where,

Y_{ij} is the measurement of trait on the j^{th} bird of i^{th} sex.

μ is the overall population mean

S_i is the effect of i^{th} sex.

e_{ij} is the random error assumed to be normally and independently distributed with mean 0 and variance σ^2_e i.e. NID(0, σ^2_e).

Effect of genetic groups on various body weight and conformation traits.

The following linear statistical model was used to study the effect of genetic groups on various body weight and conformation traits:

$$Y_{ij}=\mu + G_i + e_{ij}$$

Where,

Y_{ij} is the measurement of a trait on the j^{th} bird of i^{th} genetic group

μ is the overall population mean

G_i is the effect of i^{th} genetic group

e_{ij} is the random error assumed to be normally and independently distributed with mean 0 and variance $\sigma^2{}_e$ i.e. NID(0, $\sigma^2{}_e$).

orrelation Co-efficient:-

The simple correlation coefficient on the basis of the henotypic values among different characters were computed by sing the formula given by Snedecor and Cochran(1998):

$$r_{xy} = \frac{covariance\ xy}{sd_x . sd_y}$$

Vhere,

χ represents one trait.

γ represents another trait.

$r_{\chi\gamma}$ = Coefficient of correlation between χ and γ traits.

sd_χ = Standard deviation of the trait χ

sd_y = Standard deviation of the trait γ

$$r_{xy} = \frac{\Sigma xy - \frac{(\Sigma x)(\Sigma y)}{n}}{\sqrt{\left[\Sigma x2 - \frac{(\Sigma x)^2}{n}\right]\left[\Sigma y2 - \frac{(\Sigma y)^2}{n}\right]}}$$

ıe correlation coefficients were tested for their significance ırough 't' test as below :

$$_{(N-2)d.f.} = \frac{r}{S.E.(r)}$$

/here S.E. (r) = $\sqrt{\frac{1-r^2}{N-2}}$

= Estimate of phenotypic correlation coefficient between two traits

= Paired number of observations.

Chapter-IV

RESULTS AND DISCUSSION

Results and discussion

AVERAGE BODY WEIGHT AT VARIOUS WEEKS OF AGE IN DIFFERENT GENETIC GROUPS:

AVERAGE ZERO DAY BODY WEIGHT:

Least squares means ± S.E. along with C.V.% of body weight (g) at different weeks of age in all the three genetic groups have been depicted in table-8. The mean body weights at zero day of age in GP♂♂ x GP♀♀, MZFP♂♂ x GP♀♀ and Gaya ♂♂ x GP♀♀ were observed to be 35.558±0.234 (g), 32.947± 0.231(g) and 28.237±0.228 (g) respectively. Jha and Prasad (2013) observed zero day body weight in GP♂♂ x GP♀♀ to be 33.24 ± 0.31 (g), Nishant Patel (2013) reported the zero day body weight in GP♂♂ x GP♀♀ to be 37.56±0.25(g), whereas Ali wafa (2014) reported mean zero day body weight in GP♂♂ x GP♀♀ to be 36.07 ±0.18 (g). Sharma (2014) also observed 30.57±0.19 (g) and 30.19± 0.14(g) zero day body weight in GP♂♂ x MZFP♀♀ and GP ♂♂ x GAYA♀♀ respectively. The findings of the present study are in close proximity with the findings of above authors.

However, the findings of zero day body weight by Hussaini (1963) in Rhode island Red, Dwivedi (1965) in females of RIR (F) x WC (M), Sapra et al (1972) in WR x WC, Singh et al.(1979)

. WR(M), Singh et al. (1999b) in Aseel, Padhi et al.(1999) in aked Neck and Black Nicobari and Jha et al.(2013) in Hazra iickens are very close to the finding of MZFP♂♂ x GP♀♀ in this :udy. Similarly, the zero day body of Gaya ♂♂ x GP♀♀ are in lose proximity with the findings of Dwivedi (1965) in males of IR(F) x WC(M), females of RIR(F) x WC(M), Chhabra and apra(1973) in Naked Neck, Gupta et al.(1999) in various trains of WLH and Jha et al.(2013) in Aseel.

However, Ramappa and Gowda (1973) in WR,WC and VRxWC, Verma et al.(1981) in WR x RIR, Sharma (1984) in VR(F) x RC(M), Singh et al.(1999b) in Aseel x Dahlem Red and Naked Neck x Dahlem Red, Singh et al. (2000) in Red Cornish and Ali Wafa (2014) in VR♂♂ x VR♀♀, GP♂♂ x VR♀♀ and VR♂♂ x GP♀♀ have reported higher estimates of day old body weight than the findings of the present study.

Environmental and managemental factors might be, possibly, responsible for the differences in body weight at this age.

AVERAGE 4th WEEK BODY WEIGHT:

Least squares means of 4th week body weight (g) of GP♂♂ x GP♀♀, MZFP♂♂ x GP♀♀ and Gaya ♂♂ x GP♀♀ have been esented in table-8. These were observed to be 281.907).2.271 (g), 225.600 ± 2.193 (g) and 188.893 ±2.248 (g) in P♂♂ x GP♀♀, MZFP♂♂ x GP♀♀ and Gaya ♂♂ x GP♀♀ spectively. Ali wafa (2014) reported the 4th week body weight ı GP♂♂ x GP♀♀ to be 278.34±1.22 (g) which is in close roximity with the findings of present study. However, Jha and rasad (2013) and Nishant Patel (2013) reported lower stimates of 4th week body weight of GP♂♂ x GP♀♀ which might e, probably, due to differences in environmental and ıanagemental practices. No information on 4th week body reight in MZFP♂♂ x GP♀♀ and Gaya ♂♂ x GP♀♀ could be made vailable for comparison.

However, Sharma (1984) in male of WR(M) X RC (F), Padhi et al.(1999b) in male of synthetic broiler, Malik et ıl.(2009) in CARI Shyama and Ali Wafa (2014) in VR♂♂ x VR♀♀, obtained 4th week body weight in close proximity with the indings of the present study. Besides, Gupta et al.(1999a) in some strains of WLH and Choudhary et al.(2009) in WLH also obtained 4th week body weight in close proximity with the body weight of Gaya ♂♂ x GP♀♀. Variations in the body weights at 4th week of age might be attributed to genetic and various non genetic factors.

VERAGE 8th WEEK BODY WEIGHT:

Least squares means of 8th week body weight (g) in GP♂♂ x P♀♀, MZFP♂♂ x GP♀♀ and Gaya ♂♂ x GP♀♀ were obtained as 66.318 ±4.850 (g), 414.194 ± 4.755 (g) and 363.516 ±4.832 (g) espectively. Jha and Prasad (2013), Nishant Patel (2013) and li wafa (2014) have reported lower estimates of 8th week body eight in GP♂♂ x GP♀♀ than the findings of the present study hich might be, possibly, due to differences in the nanagemental and environmental factors. Padhi et al.(1999b) n synthetic broiler x Black Nicobari obtained 449.0 ± 24.6 (g) th week body weight whereas Malik et al.(2009) obtained 14.54± 9.03 (g) in CARI shyama (F) which are in close roximity with the findings of the MZFP♂♂ x GP♀♀. Besides, Padhi et al. (1999b) in SB x WN obtained 8th week body weight o be 370 ± 28.8 (g) and Jha et al. (2013) in Hazra reported 384.54 ± 4.23 (g) which are very close to the 8th week body weight of Gaya ♂♂ x GP♀♀.

AVERAGE 12th WEEK BODY WEIGHT:

12th week body weight (sexes pooled) in GP♂♂ x GP♀♀, MZFP♂♂ x GP♀♀ and GAYA ♂♂ x GP♀♀ were observed to be 961.75 ± 7.450(g), 689.521±7.227(g) and 599.365± 7.387(g) respectively. At 12th week of age the average body weight in GP♂♂ x GP♀♀

ere obtained as 824.68 ± 4.75 (g), 877.5 ± 5.52 (g), and 80.12 ± 10.36 (g) by Jha and Prasad (2013), Nishant Patel 2013) and Ali wafa (2014) respectively which are lower than he findings of the present study in GP♂♂ x GP♀♀ but higher han the MZFP♂♂ x GP♀♀ and GAYA♂♂ x GP♀♀. Sharma (2014) bserved 12th week body weight in GP♂♂ x MZFP♀♀ and GP♂♂ x GAYA♀♀ to be 853.49±13.50 (g) and 892.0± 9.69(g) which are higher than the estimates obtained for MZFP♂♂ x GP♀♀ and GAYA♂♂ x GP♀♀ in this study. Variations in managemental and environmental factors might be responsible for this.

Malik et al.(2009) in CARI Shyama (F) and Daida et al. 2012) in Rajasree (F) chickens obtained 725.59 ± 27.09 (g) and 697.8(g) at 12th week body weight which are in close proximity with the findings obtained in MZFP♂♂ x GP♀♀. Jha et al. (2013) reported 614.83 ± 5.39 (g) 12th week body weight in Hajra chicken which are very close to the findings obtained for GAYA♂♂ x GP♀♀ in this study.

AVERAGE 16th WEEK BODY WEIGHT:

Least squares means of 16th week body weight in GP♂♂ x GP♀♀, MZFP♂♂xGP♀♀ and GAYA♂♂xGP♀♀ were observed to be 1125.30± 11.555 (g), 981.068±11.323 (g) and 853.133 ± 11.454 (g) respectively in this study. Ali wafa (2014) obtained

1153±5.33 (g) 16th week body weight of GP♂♂ x GP♀♀ which is in close proximity with the findings of the present study. However, Jha and Prasad (2013) and Nishant Patel (2013) reported the 16th week body weight in GP♂♂ x GP♀♀ to be 1263.46± 5.90 (g) and 1310.54±6.36 (g) respectively which are higher than the findings of this investigation. Variations in managemental and environmental conditions might be responsible for these differences. Daida et al.(2012) in male Rajasree chicks and Jha et al.(2013) in Hajra chicken reported 16th week body weights to be 1050.70 (g) and 1056.82 (g) which are close to the 16th week body weight of MZFP♂♂ x GP♀♀. However, no information could be made available in literature for comparison of body weights at 16th week of age in GAYA♂♂ x GP♀♀.

AVERAGE 20th WEEK BODY WEIGHT:

Least squares means of 20th week body weight in GP♂♂ x GP♀♀, MZFP♂♂ x GP♀♀ and GAYA ♂♂ x GP♀♀ were obtained as 1538.975 ± 12.115 (g), 1278.805±11.863 (g) and 1116.511 ± 11.863 (g) respectively. Jha and Prasad (2013) reported 20th week body weight in GP♂♂ x GP♀♀ to be 1574.31±6.87 (g) which is in close proximity with the findings of the present study in this genetic group.

Nishant Patel (2013) and Ali wafa observed 20th week dy weight in GP♂♂ x GP♀♀ to be 1730.46± 14.20 (g) and 38.59±9.46 (g) respectively which are higher than the body ight obtained in this experiment for this genetic group which ght be, probably, due to better managemental factors ovided to those chickens.

Jha et al. (2013) observed 20th week body weight in Hajra icken to be 1294.38±7.35 (g) which is very close to the 20th eek body weight of MZFP♂♂ x GP♀♀ obtained in this study. esides, Jayalaxmi et al.(2011) in White leghorn (WLH) and aida et al.(2012) in male Rajasree chickens reported 1155.56 and 1160.60 (g) 20th week body weight respectively which e in close proximity with 20th week body weight of GAYA♂♂ x P♀♀ obtained in this investigation. However, Sharma (2014) eported 1405.46±23.06 (g) and 1084.82 ± 49.78 (g) in GP♂♂ x IZFP♀♀ and GPP♂♂ x GAYA♀♀ respectively which are higher an the estimates obtained for MZFP♂♂ x GP♀♀ and GAYA♂♂ x P♀♀ respectively. Variations in the body weight at different ges might be attributed to various genetic and non-genetic actors.

ct of sex on body weight at different weeks of age:

Mean squares from analysis of variance to study the effect ex on body weight at different weeks of age in GP♂♂ x GP♀♀, FP♂♂ x GP♀♀ and GAYA ♂♂ x GP♀♀ have been presented in le-9, 10 and 11 respectively. It was observed that sex had ıly significant (P<0.01) effect at all ages in all the three etic groups except at 8th and 12th week body weight in FP♂♂ x GP♀♀ and at 4th week body weight in GAYA♂♂ x ♀♀.

Critical analysis of table-12 revealed that males had ıificantly (P<0.01) higher body weights than their female ınterparts by 4.834(g), 36.155(g), 78.030(g), 126.062(g),).955(g) and 148.467(g) at zero, 4th, 8th, 12th,16th and 20th ek of age respectively in GP♂♂ x GP♀♀ genetic group.

Males of MZFP♂♂ x GP♀♀ were significantly (P<0.01) avier by 3.672(g),14.678(g), 49.485(g) and 112.473(g) at zero y, 4th week, 16th and 20th week of age respectively. Similarly was observed that male of GAYA♂♂ x GP♀♀ were significantly :0.01) heavier by 5.182(g),32.489(g), 48.610(g), 183.50(g) and 9.473(g) at zero day, 8th week, 12th,16th and 20th week of age spectively.

Literature revealed heavier body weight of males at ·rent weeks of age in various genetic groups of chicken. na et al.(1981) in White Rock x RIR, Gupta et al.1983) in te Rock, Padhi et al.(1999b) in Black and white Nicobari, gh et al.(2000) in Red Cornish, Padhi et al.(2012) in araja, Singh et al.(2012) in PB-2 lines and Ali wafa (2014) 'R♂♂ x VR♀♀, GP♂♂ x GP♀♀, VR♂♂ x GP♀♀ and GP♂♂ x VR♀♀ etic groups reported significantly (P<0.01) heavier body ghts in males than their female counterparts which are in formity with the findings of the present study. Further, it ; also observed that sex differences between male and ale chickens for body weight increased with the ancement of age. This might be, possibly, attributed to erential rate of growth of chicken of either sex to the given ironment. Apart from this, various other physiological tors might also be responsible for differential rate of growth per suggestion given by Buckner et al.(1949) Gillbreath and p (1952) and Roberts (1964).

Table-07: Mean squares from analysis of variance to test the effect of genetic groups on body weight at various ages

ts	Source of variation	D.F.	M.S.	F
ek	Between genetic group	2	3180.146	258.633**
	Error	687	12.295	
k	Between genetic group	2	429786.295	429.524**
	Error	597	1000.611	
k	Between genetic group	2	4818711.760	1121.511**
	Error	553	4296.624	
ek	Between genetic group	2	6281131.454	646.527**
	Error	536	9715.187	
ek	Between genetic group	2	3160027.154	140.036**
	Error	514	22565.892	
eek	Between genetic group	2	7537183.430	315.006**
	Error	500	23927.077	

*Significant at P<0.01

weeks of age in various genetic groups of chicken (sexes pooled)

WEEKS		GP ♂♂X GP ♀♀	MZFP♂♂ X GP ♀♀	GAYA ♂♂X GP ♀♀
Zero day	Mean ± S.E	35.558[a] ± 0.234	32.947[b] ± 0.231	28.237[c] ± 0.228
	C V %	9.203	10.93	13.332
4th week	Mean ± S.E	281.907[a] ± 2.271	225.600[b] ± 2.193	188.893[c] ± 2.248
	C V %	9.689	12.242	20.509
8th week	Mean ± S.E	666.318[a] ± 4.858	414.194[b] ± 4.755	363.516[c] ± 4.832
	C V %	5.548	15.481	16.952
12th week	Mean ± S.E	961.725[a] ± 7.450	689.521[b] ± 7.227	599.365[c] ± 7.387
	C V %	13.433	12.439	12.265
16th week	Mean ± S.E	1125.301[a] ± 11.555	981.068[b] ± 11.323	853.133[c] ± 11.454
	C V %	16.420	11.623	17.004
20th week	Mean ± S.E	1538.975[a] ± 12.115	1278.805[b] ± 11.863	1116.511[c] ± 11.863
	C V %	10.646	11.512	13.695

Means (row wise) with different superscripts differ significantly ($P<0.01$)

ıle-9: Mean squares from analysis of variance to test the :ct of sex on body weight at different weeks of age in .mapriya ♂♂ x Gramapriya ♀♀

'raits	Source of variation	D.F.	M.S.	F
o day	Between sexes	1	1308.150	368.963**
	Error	222	3.545	
week	Between sexes	1	63374.538	151.008**
	Error	192	419.675	
week	Between sexes	1	276899.183	79.516**
	Error	179	3482.301	
:h week	Between sexes	1	695053.607	54.796**
	Error	173	12684.469	
,th week	Between sexes	1	3575525.697	276.335**
	Error	167	12939.089	
ıth week	Between sexes	1	897920.327	41.890**
	Error	161	21435.376	

Significant at P<0.01

Table-10 : Mean squares from analysis of variance to test the effect of sex on body weight at different weeks of age in Muzaffarpur ♂♂ X Gramapriya ♀♀

Traits	Source of variation	D.F.	M.S.	F
Zero day	Between sexes Error	1 228	773.827	78.500**
4^{th} week	Between sexes Error	1 206	11177.558 711.088	15.719**
8^{th} week	Between sexes Error	1 188	7137.912 4096.510	1.742^{NS}
12^{th} week	Between sexes Error	1 184	26149.516 7255.874	3.604^{NS}
16^{th} week	Between sexes Error	1 174	107400.805 12390.737	8.668**
20^{th} week	Between sexes Error	1 168	535764.738 18615.737	28.780**

****Significant at P<0.01**

NS= Non-significant

ıle-11: Mean squares from analysis of variance to test effect of sex on body weight at different weeks of age in ɟa ♂♂ X Gramapriya ♀♀

:aits	Source of variation	D.F.	M.S.	F
:o day	Between sexes Error	1 234	1581.462 7.4754	211.555**
ı week	Between sexes Error	1 196	486.785 1506.448	0.323NS
ı week	Between sexes Error	1 182	48411.316 3552.893	13.626**
th week	Between sexes Error	1 176	104819.392 4839.908	21.657**
;th week	Between sexes Error	1 170	1443137.352 12682.285	113.792**
)th week	Between sexes Error	1 168	823870.620 18615.737	44.257**

· Significant at P<0.01

S= Non-significant

Table-12: Least squares means along with C.V % of body weight (g) at different weeks of age in male and female of various genetic groups of chickens

Weeks		GP ♂♂X GP ♀♀		MZFP♂♂ X GP ♀♀		GAYA ♂♂X GP ♀♀	
		Male	Female	Male	Female	Male	Female
Zero day	Mean ± S.E.	38.018[a] ± 0.179	33.184[b] ± 0.176	34.863[a] ± 0.299	31.191[b] ± 0.286	30.938[a] ± 0.257	25.756[b] ± 0.246
	C.V%	6.016	3.735	10.109	9.048	10.109	9.048
4th week	Mean ± S.E.	300.357[a] ± 2.101	264.2020[b] ± 2.058	233.292[a] ± 2.680	218.614[b] ± 2.554	187.244[a] ± 4.003	190.384[b] ± 3.805
	C.V%	7.094	7.439	21.953	19.227	21.953	19.227
8th week	Mean ± S.E.	706.191[a] ± 6.255	628.161[b] ± 6.119	420.655[a] ± 6.746	408.380[b] ± 6.400	380.643[a] ± 6.390	348.154[b] ± 6.052
	C.V%	9.388	8.174	14.398	18.267	14.398	18.267
12th week	Mean ± S.E.	1025.837[a] ± 12.144	899.775[b] ± 11.938	702.034[a] ± 9.080	678.285[b] ± 8.604	625.035[a] ± 7.590	576.425[b] ± 7.175
	C.V%	13.559	8.784	12.258	10.861	12.258	10.861

16th week	Mean ± S.E.	1273.361^{a} ± 12.485	982.406^{b} ± 12.265	1007.216^{a} ± 12.218	957.731^{b} ± 11.542	950.222^{a} ± 12.512	766.714^{b} ± 11.805
	C.V%	8.505	12.089	12.097	14.411	12.097	14.411
20th week	Mean ± S.E.	1614.575^{a} ± 16.368	1466.108^{b} ± 16.070	1338.350^{a} ± 15.254	1225.877^{b} ± 14.381	1190.350^{a} 15.254	1050.877^{b} 14.381
	C.V%	10.595	8.039	13.186	10.961	13.186	10.961

Means (row wise) with different superscripts under each group taken separately differ significantly($P<0.01$)

EFFECT OF GENOTYPES ON BODY WEIGHT:

Mean squares from analysis of variance to study the effect of genetic groups on body weight at various ages have been depicted in table-7. An appraisal of table-7 clearly reflects that genetic groups played highly significant (P<0.01) role on body weight at all the ages. Least squares means along with C.V.% of body weight(g) at different weeks of age in various genetic groups of chicken (sexes pooled) have been depicted in table -8.

It was observed that GP♂♂X GP♀♀ had heaviest body weight followed by MZFP♂♂ X GP♀♀ and GAYA♂♂ X GP♀♀ at zero day body weight. GP♂♂X GP♀♀ had significantly (P<0.01) 2.611(g) and 7.321(g) heavier body weights at zero day body weight than MZFP♂♂ X GP♀♀ and GAYA♂♂ X GP♀♀ respectively. Besides, MZFP♂♂ X GP♀♀ had also significantly (P<0.01) 4.710(g) heavier body weights than GAYA♂♂ X GP♀♀.

At 4th week of age the trend of growth also remained consistent in all the three genetic groups where GP♂♂X GP♀♀ had heaviest body weight followed by MZFP♂♂ X GP♀♀ and GAYA♂♂ X GP♀♀. The 4th week body weight of GP♂♂X GP♀♀ was observed to be significantly (P<0.01) heavier by 56.307(g) and 93.014(g) than MZFP♂♂ X GP♀♀ and GAYA♂♂ X GP♀♀

ɔectively. Besides, the 4th week body weight of MZFP♂♂ X ♀♀ was also observed to be heavier by 36.70(g) than GAYA♂♂ P♀♀.

The trend of growth among all three groups at 8th week of was similar to those of zero day and 4th week body weight. ♂♂X GP♀♀ although, basically dual type chicken developed PDP, Hyderabad, had heaviest body weight among all the ee genetic groups followed by MZFP♂♂ X GP♀♀ and GAYA♂♂ GP♀♀. GP♂♂X GP♀♀ had significantly (P<0.01) 252.14(g) and 2.802(g) heavier body weights than MZFP♂♂ X GP♀♀ and YA♂♂ X GP♀♀ respectively. Apart from this MZFP♂♂ X GP♀♀ d also significantly (P<0.01) 50.678(g) heavier 8th week body ights than GAYA♂♂ X GP♀♀.

Like zero day, 4th and 8th week body weight GP♂♂X GP♀♀ d again heaviest body weight at 12th week of age which was gnificantly (P<0.01) heavier by 272.204(g) and 362.360(g) an MZFP♂♂ X GP♀♀ and GAYA♂♂ X GP♀♀ genetic groups spectively. MZFP♂♂XGP♀♀ genetic group ranked second hich was also significantly (P<0.01) heavier by 90.156(g) than AYA♂♂ X GP♀♀ crosses.

The trend of growth among 16th week of age as depicted in ble-8 revealed similar trend obtained at zero day, 4th,8th and week of age. GP♂♂X GP♀♀ had again heaviest body weight is age also whereas MZFP♂♂ X GP♀♀ and GAYA♂♂ X GP♀♀ ed 2nd and 3rd respectively. Further, it was observed in this stigation that at 16th week of age GP♂♂X GP♀♀ had ficantly (P<0.01) 144.233(g) and 272.168(g) heavier body hts than MZFP♂♂ X GP♀♀ and GAYA♂♂ X GP♀♀ ectively. Over and above MZFP♂♂ X GP♀♀ had also ficantly (P<0.01) 127.935(g) heavier body weight than A♂♂ X GP♀♀.

The trend of growth at 20th week of age remained sistent with body weights at all the ages from zero day body ht to 16th week body weight mentioned earlier. The viest body weight at 20th week of age was found to be in ♂X GP♀♀ followed by MZFP♂♂ X GP♀♀ and GAYA♂♂ X ♀. GP♂♂X GP♀♀ although a dual type chicken, had ificantly (P<0.01) heavier body weights by 260.170(g) and .464(g) than MZFP♂♂ X GP♀♀ and GAYA♂♂ X GP♀♀ genetic ups respectively. Besides, MZFP♂♂ X GP♀♀ genetic group ch ranked second had also significantly (P<0.01)162.294(g) vier body weight than GAYA♂♂ X GP♀♀.

The critical analysis of table-8 clearly indicated that ong all the three genetic groups studied in this investigation

;X GP♀♀ had the heaviest body weight at all the ages, eas MZFP♂♂ X GP♀♀ and GAYA♂♂ X GP♀♀ ranked 2nd and ɜspectively.

It is to be pointed out here that Gramapriya chicken has developed by crossing Desi male and Dahlem Red female ›roject Directorate of Poultry, Hyderabad. Males of ıapriya have moderate body weight and best suited for aration of tandoori type desi chicken dishes, whereas the ıles lay more number of eggs than the native chickens. des, Gramapriya have better adaptability to adverse litions and also better immunocompetence which gives the ıgth for maximum survivability of these birds under rural .try farming conditions. Muzaffarpur and Gaya are local kens reared in Muzaffarpur and Gaya districts of Bihar ɔh have been crossed with Gramapriya females to take antage of its higher egg production as well as heavier male y weights and also better adaptability of local chickens in backyard poultry farming of Bihar.

AVERAGE SHANK LENGTHS AT VARIOUS WEEKS OF AGE IN DIFFERENT GENETIC GROUPS:

Least squares means along with C.V.% of shank length at different weeks of age in various genetic groups of chicken have been presented in table -14. The average shank length in GP♂♂X GP♀♀, MZFP♂♂ X GP♀♀ and GAYA♂♂ X GP♀♀ were obtained as 6.970±0.028cm, 6.413±0.027cm and 6.113±0.028cm respectively at 4th week of age. C.V.% in the genetic group were also very low ranging from 5.548 in GP♂♂X GP♀♀ to 6.790 in Gaya♂♂ X GP♀♀.

The average shank lengths at 8th week of age were observed to be 8.770±0.058cm, 7.906±0.057cm and 7.203±0.058cm in GP♂♂X GP♀♀, MZFP♂♂ X GP♀♀ and GAYA♂♂ X GP♀♀ respectively whereas the corresponding values at 12th week of age were obtained as 9.254±0.080cm, 8.265±0.078cm and 7.552±0.080cm respectively. The corresponding shank lengths at 16th week of age were observed to be 9.398±0.135cm, 8.722±0.132cm and 7.817±0.134cm respectively whereas the corresponding values at 20th week of age were found to be 9.658±0.104cm, 8.824±0.102cm and 8.115±0.102cm respectively.

Jha and Prasad (2012) observed 7.986cm average shank length in Gramapriya at 40th week of age, the trend of which is similar to the findings of present study. Ali wafa (2014) observed mean shank length of GP♂♂X GP♀♀ at 4th, 8th, 12th, 16th and 20th week of age to be 7.04cm, 8.70cm,9.03cm,9.37cm and 9.48 cm spectively which are in close proximity with the findings of the esent study.

However, no information could be made available in the erature for comparison of shank length of MZFP♂♂X GP♀♀ and AYA♂♂X GP♀♀ genetic groups.

fect of sex on shank lengths at different weeks of age:

Mean squares from analysis of variance to test the effect of sex shank length at different weeks of age in GP♂♂X GP♀♀, MZFP♂♂ GP♀♀ and GAYA♂♂ X GP♀♀ have been presented in table 15, 16 d 17 respectively. These tables very clearly indicate highly gnificant (P<0.01) effect of sex on shank length in all the genetic oups at all the ages except at 4th week in GP♂♂X GP♀♀, 16th week MZFP♂♂X GP♀♀ and also at 16th week in GAYA♂♂X GP♀♀.

Least squares means along with C.V.% of shank length(cm) at ifferent weeks of age in all the three genetic groups of chicken have een presented in table-18.Table-18 very clearly reflects that males ave significantly (P<0.01) lengthier shanks than their female ounterparts in all the genetic groups at all the ages except at 4th eek in GP♂♂X GP♀♀, at 16th week in both MZFP♂♂X GP♀♀ and AYA♂♂X GP♀♀.

It was observed that at 4th week shank length of males of ZFP♂♂X GP♀♀ and GAYA♂♂X GP♀♀ were significantly (P<0.01) ngthier by 0.300cm and 0.300cm than their female counterparts spectively. Although, males of GP♂♂X GP♀♀ had 0.109cm hier shank than their female counterparts, yet this difference ›bserved to be statistically non-significant.

Males of GP♂♂X GP♀♀, MZFP♂♂X GP♀♀and GAYA♂♂X GP♀♀ significantly (P<0.01) lengthier shanks by 0.688cm, 0.289cm 0.616cm than their female counterparts respectively at 8th : of age. The corresponding increments in male shanks at 12th : of age were observed to be 0.797cm, 0.575cm and 0.485cm ›ctively.

At 16th week of age males of GP♂♂X GP♀♀ had significantly .01) 0.633cm lengthier shank than their female counterparts. ›ugh males of MZFP♂♂X GP♀♀and GAYA♂♂X GP♀♀had 0.418cm 0.238cm lengthier shanks than their female counterparts, yet › differences were observed to be statistically non-significant.

It was further observed that at 20th week of age males of ♂X GP♀♀, MZFP♂♂ X GP♀♀ and GAYA♂♂ X GP♀♀ had ificantly (P<0.01) lengthier shanks than their respective females '.799cm, 0.760cm and 0.380cm respectively.

Various authors (Sharma (1984),Malik et al.(1997), Padhi et 000), Padhi et al.(1999b), Singh et al.(2000), Padhi et al.(2012), ;h et al.(2012) and Ali Wafa (2014) have also reported that males significantly (P<0.01) lengthier shank than their female ıterparts in various genetic groups of chickens at different ages.

ble-13 : Mean squares from analysis of variance to test the 'ect of genetic group on Shank length (cm) at various ages

raits	Source of variation	D.F.	M.S.	F
ı week	Between genetic group Error	2 597	37.080 0.162	228.336**
ı week	Between genetic group Error	2 553	102.589 0.626	163.797**
th week	Between genetic group Error	2 536	128.912 1.143	112.719**
th week	Between genetic group Error	2 514	107.425 3.106	34.577**
)th week	Between genetic group Error	2 500	99.178 1.792	55.336**

Significant at P<0.01

weeks of age in various genetic groups of chicken (sexes pooled)

WEEKS		GP♂♂X GP♀♀	MZF♂♂ X GP♀♀	GAYA♂♂ XGP♀♀
4th week	Mean ± S.E	$6.970^{a} \pm 0.028$	$6.413^{b} \pm 0.027$	$6.113^{c} \pm 0.028$
	C.V. %	5.548	6.335	6.790
8th week	Mean ± S.E	$8.700^{a} \pm 0.058$	$7.906^{b} \pm 0.057$	$7.203^{c} \pm 0.058$
	C.V. %	9.954	9.138	10.883
12th week	Mean ± S.E	$9.254^{a} \pm 0.080$	$8.265^{b} \pm 0.078$	$7.552^{c} \pm .080$
	C.V. %	13.433	12.190	13.460
16th week	Mean ± S.E	$9.398^{a} \pm 0.135$	$8.722^{b} \pm 0.132$	$7.817^{c} \pm 0.134$
	C.V. %	18.613	20.272	22.705
20th week	Mean ± S.E	$9.658^{a} \pm 0.104$	$8.824^{b} \pm 0.102$	$8.115^{c} \pm 0.102$
	C.V. %	16.380	13.907	14.567

Means(row wise) with different superscripts differ significantly($P<0.01$)

le-15: Mean squares from analysis of variance to test the ct of sex on shank length (cm) at different weeks of age in mapriya ♂♂ X Gramapriya ♀♀

Traits	Source of variation	D.F.	M.S.	F
th week	Between sexes Error	1 192	0.570 0.147	3.874^{NS}
th week	Between sexes Error	1 179	21.508 0.631	34.052**
2th week	Between sexes Error	1 173	52.573 1.096	47.956**
6th week	Between sexes Error	1 167	16.933 2.977	5.687*
0th week	Between sexes Error	1 161	25.988 2.356	11.026**

Significant at P<0.01

Significant at P<0.05

S= Non-significant

le-16: Mean squares from analysis of variance to test the ct of sex on shank length (cm) at different weeks of age in zaffarpur ♂♂ X Gramapriya ♀♀

Traits	Source of variation	D.F.	M.S.	F
4th week	Between sexes Error	1 206	4.662 0.143	32.544**
8th week	Between sexes Error	1 188	3.965 0.503	7.873**
12th week	Between sexes Error	1 184	15.372 0.937	16.400**
16th week	Between sexes Error	1 174	7.659 3.082	2.485NS
20th week	Between sexes Error	1 168	24.436 1.369	17.843**

'Significant at P<0.01

S= Non significant

ble-17: Mean squares from analysis of variance to test the ect of sex on shank length (cm) at different weeks of age in ya ♂♂ X Gramapriya ♀♀

Traits	Source of variation	D.F.	M.S.	F
th week	Between sexes Error	1 196	4.437 0.150	29.467**
3th week	Between sexes Error	1 182	17.398 0.522	33.297**
2th week	Between sexes Error	1 176	10.461 0.979	10.675**
6th week	Between sexes Error	1 170	2.429 3.154	0.770NS
0th week	Between sexes Error	1 168	6.102 1.369	4.456*

Significant at P<0.01

ignificant at P<0.05

S= Non significant

ble-18: Least squares means along with C.V % of shank ıgth (cm) at different weeks of age in male and female of rious genetic groups of chicken

eks		GP ♂♂X GP ♀♀		MZFP♂♂ X GP ♀♀		GAYA ♂♂X GP ♀♀	
		Male	Female	Male	Female	Male	Female
₄th eek	Mean ± S.E	7.026 ± 0.039	6.917 ± 0.038	6.570 [a] ± 0.038	6.270 [b] ± 0.036	6.270 [a] ± 0.040	5.970 [b] ± 0.038
	C.V%	5.197	5.790	5.664	6.126	6.092	6.588
ȝth eek	Mean±S.E	9.051[a] ± 0.084	8.363 [b] ± 0.082	8.058 [a] ± .074	7.769 [b] ± 0.070	7.528 [a] ± 0.077	6.912 [b] ± 0.073
	C.V%	8.641	9.695	8.709	9.225	9.484	10.570
2th eek	Mean±S.E	9.512[a] ± 0.112	8.715 [b] ± 0.110	8.568 [a] ± 0.103	7.993 [b] ± 0.097	7.808 [a] ± 0.108	7.323 [b] ± 0.102
	C.V%	9.206	13.414	10.972	12.190	12.327	13.841
6th eek	Mean±S.E	9.721[a] ± 0.189	9.088 [b] ± 0.186	8.943 [a] ± 0.192	8.525 [a] ± 0.182	7.943 [a] ± 0.197	7.705[a] ± 0.186
	C.V%	17.763	18.972	19.588	20.739	22.196	23.199
:0th eek	Mean±S.E	10.065[a] ± 0.171	9.266 [b] ± 0.168	9.226 [a] ± 0.130	8.466 [b] ± 0.123	8.316 [a] ± 0.130	7.936 [b] ± 0.123
	C.V%	15.848	15.919	14.058	13.907	15.626	13.130

ans(row wise) with different superscripts under each group taken separately fer significantly(P<0.01)

Wafa (2014) reported that males had significantly (P<0.01) 4cm, 0.70cm, 1.16cm,0.76cm and 0.69cm lengthier shanks than ir female counterparts in GP♂♂X GP♀♀ at 4th, 8th, 12th, 16th and h weeks of ages respectively which are in close proximity with the dings of the present study.

Besides, Padhi and Chatterjee (2012) in VR♂♂X VR♀♀ and Ali fa (2014) in GP♂♂X GP♀♀ have reported as long as 10.65cm and 3cm shank lengths at 20th week of age which are in close ximity with the findings of the present study.

Differences in shank length of males and females in all the netic groups under studied might be attributed to differential rate growth of chicks of both the sexes to the given common vironment along with other physiological factors such as rmones etc.

fect of genetic groups on shank length:

Analysis of variance as reflected in table-13 clearly reflected at genetic group played highly significant (P<0.01) role on shank ngth at all the ages understudied. Least squares means along with V.% at different weeks of age in various genetic groups have been picted in table-14.

It was observed that the GP♂♂X GP♀♀ had lengthiest shank llowed by MZFP♂♂X GP♀♀ and GAYA♂♂X GP♀♀. GP♂♂X GP♀♀ had gnificantly (P<0.01) 0.557cm and 0.857cm lengthier shanks than ZFP♂♂X GP♀♀ and GAYA♂♂X GP♀♀ genetic groups respectively.

ɪides, MZFP♂♂X GP♀♀ genetic group had also significantly 0.01) 0.300cm lengthier shank than GAYA♂♂X GP♀♀ genetic up.

The trend of growth of shank at 8th week of age was also found ɔe similar to the trend obtained at 4th week of age. GP♂♂X GP♀♀ ıetic group had lengthiest shank whereas MZFP♂♂X GP♀♀ and YA♂♂X GP♀♀ ranked 2nd and 3rd respectively. GP♂♂X GP♀♀ ıetic group had significantly (P<0.01) 0.94cm and 1.497cm gthier shank than MZFP♂♂X GP♀♀ and GAYA♂♂X GP♀♀ genetic ɔups respectively. Besides, MZFP♂♂X GP♀♀ genetic group had o significantly (P<0.01) 0.703cm lengthier shank than GAYA♂♂X ♀♀ genetic group.

At 12th week of age also the pattern of growth of shank in all e three genetic groups remained the same where GP♂♂X GP♀♀, ZFP♂♂X GP♀♀ and GAYA♂♂X GP♀♀ ranked 1st,2nd and 3rd spectively. GP♂♂X GP♀♀ had significantly (P<0.01) 0.989cm and 702 cm lengthier shank than MZFP♂♂X GP♀♀ and GAYA♂♂X GP♀♀ spectively. Apart from these MZFP♂♂X GP♀♀ had also gnificantly (P<0.01) 0.713cm lengthier shank than GAYA♂♂X P♀♀ genetic group.

The mean shank length at 16th week of age was observed to be ngthiest in GP♂♂X GP♀♀ genetic group followed by MZFP♂♂X GP♀♀ ıd GAYA♂♂X GP♀♀, a similar trend obtained at 4th,8th and 12th eek of age. The mean shank length at 16th week of age of GP♂♂X P♀♀ was observed to be significantly (P<0.01) lengthier by 0.676cm

1.581cm than MZFP♂♂X GP♀♀ and GAYA♂♂X GP♀♀ genetic ps respectively. Besides, MZFP♂♂X GP♀♀ genetic group had significantly (P<0.01) 0.905cm lengthier shank than GAYA♂♂X ♀ genetic group.

At 20th week of age also the growth pattern of shank remained lar to the pattern obtained at 4th,8th,12th and 16th weeks of age. ♂X GP♀♀ had again lengthiest shank followed by MZFP♂♂X ♀ and GAYA♂♂X GP♀♀. The genetic group GP♂♂X GP♀♀ had ificantly (P<0.01) 0.834cm and 1.543cm lengthier shanks than 'P♂♂X GP♀♀ and GAYA♂♂X GP♀♀ genetic group respectively. ides, MZFP♂♂X GP♀♀ had also significantly (P<0.01) 0.709 cm thier shank than GAYA♂♂X GP♀♀ genetic group.

Differences in shank length in various genetic groups of :ken at different ages have also been reported by various ɿors (Chhabra et al. (1972), Agarwal et al. (1979), Verma et al. 79) Mahapatra et al. (1983), Sharma (1984), Padhi et al.)9a), Singh et al. (2000), Khurana et al. (2006), Kalita et al. l1), Padhi and Chatterjee (2012), Jha and Prasad (2013) and Ali a (2014) which are in conformity with the findings of the present dy. Ali wafa (2014) at 4th,8th, 12th, 16th and 20th weeks of age orted shank lengths to be 7.04±0.01cm, 8.70±0.04cm, 3±0.07cm, 9.37±0.08cm and 9.48±0.14cm respectively in ♂♂X GP♀♀ genetic group which are in close proximity with the lings of present study. However, no information could be made ilable in literature to compare the average shank lengths of sses of MZFP♂♂X GP♀♀ and GAYA♂♂X GP♀♀ genetic groups. iations in shank length in different genetic groups in similar ironment and at similar age might be, possibly, attributed to erences in gene combinations of different genotypes suggesting hly significant (P<0.01) effect of genotypes on shank length.

ERAGE KEEL LENGTH AT VARIOUS WEEKS OF AGE IN 'FERENT GENETIC GROUPS:

Least squares means along with C.V.% of keel length (cm) at 'erent weeks of ages in all the three genetic groups of chicken ve been presented in table -20.

The mean keel lengths in GP♂♂X GP♀♀ genetic group (sexes oled) were observed as 4.687cm, 6.177cm, 6.469cm, 6.721cm d 6.850cm at 4th, 8th, 12th, 16th and 20th week of age respectively. e corresponding values in MZFP♂♂X GP♀♀ genetic group were tained as 4.54cm, 5.808cm, 6.084cm, 6.252cm and 6.396cm spectively, whereas the corresponding values in Gaya♂♂ X GP♀♀ netic group were estimated to be 4.453cm, 5.504cm, 5.678cm, 392cm and 6.016cm respectively.

Ali Wafa (2014) reported the keel length at 4th, 8th, 12th, 16th d 20th weeks of ages to be 4.74cm, 6.04cm, 6.18cm, 6.35cm and 40cm respectively in GP♂♂X GP♀♀ genetic group which are in ose proximity with the findings of the present investigation. sides, Kalita et al. (2011) observed mean keel length at 40th week age in Vanaraja to be 7.258cm. The trend of result obtained in is study for keel length appears to be similar to that of Kalita et

(2011). However, no information in literature could be made ilable to compare the findings of the present study at different s in various genetic groups under studied.

ect of sex on keel length at different weeks of age:

Analysis of variance to study the effect of sex on keel length at erent weeks of age in GP♂♂X GP♀♀, MZFP♂♂ X GP♀♀ and 'A♂♂ X GP♀♀ have been depicted in table 21,22 and 23 pectively. It was observed that sex had significant (P<0.05) effect keel length at all the ages except at 4th week in GP♂♂X GP♀♀. : males had significantly (P<0.05) lengthier keels than their ale counterparts by 0.381cm, 0.386cm, 0.503cm and 0.471cm 3th 12th 16th and 20th weeks of age respectively. Although, the les of GP♂♂X GP♀♀ had 0.029cm lengthier keel over their female interparts at 4th week of age, yet the difference was found to be tistically non-significant.

The males of MZFP♂♂X GP♀♀ had significantly (P<0.01) gthier keels at 4th, 8th, and 20th week of age. However, sex did t play significant role at 12th and 16th week of age in MZFP♂♂X '♀♀ genetic group (Table-22).

The males of MZFP♂♂XGP♀♀ genetic group had significantly <0.01) 0.123cm,0.321cm and 0.417cm lengthier keels than their nale counterparts at 4th,8th and 20th week of age respectively. The rement of keel length of males over their female counterparts by

.9cm and 0.305cm at 12th and 16th week of age in this genetic ıp was observed to be statistically non-significant.

Analysis of variance presented in table-23 reflected that sex ed significant ($P<0.05$ or 0.01) role on keel length at all the ages pt 16th week in GAYA♂♂X GP♀♀ genetic group. It was observed (Table-23) males had significantly ($P<0.05$ or 0.01) lengthier s by 0.303cm,0.461cm,0.419cm and 0.417cm at 4th,8th,12th and weeks of age respectively in GAYA♂♂X GP♀♀ genetic group. vever, the increment of 0.305cm of male keel length over their ale counterparts at 16th week of age was observed to be istically non-significant.

Sharma (1984), Venkatesh (1985), Malik et al.(1997), Singh et (2000) and Ali Wafa (2014) have also observed lengthier keels in les than their female counterparts in different genetic groups of ckens at various ages which are in conformity with the results ained in this experiment.

Ali wafa (2014) reported increment of male keel lengths over eir female counterparts by 0.36cm, 0.31cm, 0.53cm, 0.82cm and 35cm at 4th, 8th, 12th, 16th and 20th weeks of age in GP♂♂X GP♀♀ netic group which are in close proximity with the findings of the esent study.

Differences in keel lengths of both the sexes might be, ssibly, attributed to differential rate of growth of both the sexes ıd various other physiological factors too.

e-19: Mean squares from analysis of variance to test the ct of genetic group on keel length (cm) at various ages

aits	Source of variation	D.F.	M.S.	F
week	Between genetic group Error	2 597	2.721547 .069432	39.197**
week	Between genetic group Error	2 553	20.825168 .164000	126.983**
week	Between genetic group Error	2 536	27.574825 0.985854	27.970**
week	Between genetic group Error	2 514	29.469357 1.498440	19.667**
week	Between genetic group Error	2 500	28.990371 1.599482	18.125**

gnificant at P<0.01

le-20: Least squares means along with C.V. % of Keel length) at different weeks of age in various genetic groups of cken (sexes pooled)

WEEKS		GP♂♂ X GP♀♀	MZF♂♂ X GP♀♀	GAYA♂♂ X GP♀♀
	Mean ± S.E	4.687 [a] ± 0.018	4.547 [b] ± 0.018	4.453 [c] ± 0.018
k	C V %	4.911	5.665	6.691
	Mean ± S.E	6.177 [a] ± 0.030	5.808 [b] ± 0.029	5.504 [c] ± 0.029
k	C V %	6.323	6.762	7.833
n	Mean ± S.E	6.469 [a] ± 0.075	6.084 [b] ± 0.072	5.678 [c] ± 0.074
k	C V %	15.689	15.862	17.653
h	Mean ± S.E	6.721 [a] ± 0.094	6.252 [b] ± 0.092	5.892 [c] ± 0.093
k	C V %	19.414	18.867	20.188
h	Mean ± S.E	6.850 [a] ± 0.099	6.396 [b] ± 0.096	6.016 [c] ± 0.096
k	C V %	18.377	19.814	21.066

ans(row wise) with different superscripts differ significantly (P<0.01)

e-21 : Mean squares from analysis of variance to test the ct of sex on keel length (cm) at different weeks of age in napriya ♂♂ X Gramapriya♀♀

Traits	Source of variation	D.F.	M.S.	F
4th week	Between sexes	1	0.039	0.745NS
	Error	192	0 .053	
8th week	Between sexes	1	6.577	56.551**
	Error	179	0 .116	
12th week	Between sexes	1	6.509	6.560*
	Error	173	0.992	
16th week	Between sexes	1	10.688	6.481*
	Error	167	1.649	
20th week	Between sexes	1	9.026	5.866*
	Error	161	1.538	

***Significant at P<0.01**

****Significant at P<0.05**

NS= Non-significant

le-22 : Mean squares from analysis of variance to test the ct of sex on keel length (cm) at different weeks of age in ;affarpur ♂♂ X Gramapriya ♀♀

[raits	Source of variation	D.F.	M.S.	F
h week	Between sexes Error	1 196	0.778 0.062	12.372**
h week	Between sexes Error	1 182	4.869 0.129	37.688**
th week	Between sexes Error	1 176	2.223 0.924	2.405NS
th week	Between sexes Error	1 170	4.071 1.367	2.977NS
)th week	Between sexes Error	1 168	7.382 1.572	4.696*

ignificant at P<0.01

gnificant at P<0.05

= Non-significant

ıle-23: Mean squares from analysis of variance to test the ɛct of sex on keel length (cm) at different weeks of age in ɣa ♂♂ X Gramapriya ♀♀

ſraits	Source of variation	D.F.	M.S.	F
th week	Between sexes Error	1 196	4.521 0.066	68.387**
th week	Between sexes Error	1 182	9.731 0.133	72.917**
2th week	Between sexes Error	1 176	7.785 0.966	8.055**
6th week	Between sexes Error	1 170	3.981 1.400	2.844NS
0th week	Between sexes Error	1 168	7.382 1.572	4.696*

ignificant at P<0.01

ignificant at P<0.05

= Non-significant

le-24 : Least squares means along with C.V % of keel length) at different weeks of age in male and female of various etic groups of chicken

:s		GP ♂♂X GP ♀♀		MZFP♂♂ X GP ♀♀		GAYA ♂♂X GP ♀♀	
		Male	Female	Male	Female	Male	Female
eek	Mean±S.E	4.702^{a} ± 0.023	4.673^{b} ± 0.023	4.612^{a} ± 0.025	4.489^{b} ± 0.024	4.612^{a} ± 0.026	4.309^{b} ± 0.025
	C.V%	4.532	5.260	5.072	5.905	5.207	6.300
eek	Mean ±	6.372^{a} ± 0.036	5.991^{b} ± 0.035	5.977^{a} ± 0.037	5.656^{b} ± 0.035	5.747^{a} ± 0.039	5.286^{b} ± 0.037
	C.V%	5.289	5.785	5.996	6.370	6.344	6.922
:	Mean±S.E	6.665^{a} ± 0.107	6.279^{b} ± 0.105	6.200^{a} ± 0.102	5.981^{a} ± 0.097	5.900^{a} ± 0.107	5.481^{b} ± 0.101
	C.V%	14.441	16.364	15.381	15.682	16.548	18.046
:	Mean±S.E	6.977^{a} ± 0.140	6.474^{b} ± 0.138	6.413^{a} ± 0.128	6.108^{b} ± 0.121	6.053^{a} ± 0.131	5.748^{b} ± 0.124
	C.V%	16.550	21.587	18.889	18.627	20.138	20.010
:	Mean±S.E	7.090^{a} ± 0.138	6.619^{b} ± 0.136	6.617^{a} ± 0.140	6.200^{b} ± 0.132	6.237^{a} ± 0.140	5.820^{b} ± 0.132
	C.V%	17.131	19.108	20.669	19.814	21.928	19.641

ıns(row wise) with different superscripts under each group taken arately differ significantly(P<0.01)

t of genetic groups on keel length:

ınalysis of variance as depicted in table-19 indicated that c group had highly significant (P<0.01) influence on keel at all the ages under studied.

east squares means along with C.V.% as mentioned in table-lected that at all the ages GP♂♂X GP♀♀ genetic group had ıiest keel followed by MZFP♂♂X GP♀♀ and GAYA♂♂X GP♀♀ c groups.

The average keel lengths of GP♂♂X GP♀♀ was significantly)1) lengthier by 0.557cm and 0.857cm than MZFP♂♂X GP♀♀ ;AYA♂♂X GP♀♀ genetic groups respectively at 4th week of age. es, MZFP♂♂X GP♀♀ genetic group had also icantly(P<0.01) 0.300cm lengthier keel than GAYA♂♂X GP♀♀ ic group.

At 8th week of age also GP♂♂X GP♀♀, MZFP♂♂X GP♀♀ and ♂♂X GP♀♀ genetic groups ranked 1st, 2nd and 3rd respectively. X GP♀♀ genetic group had significantly (P<0.01) 0.794cm and 'cm lengthier keels than MZFP♂♂X GP♀♀ and GAYA♂♂X GP♀♀ ic groups respectively. Besides, MZFP♂♂X GP♀♀ genetic group also significantly (P<0.01) 0.703cm lengthier keel than ♂♂X GP♀♀ genetic group.

The trend of growth pattern of keel at 12th week of age was ar to those of 4th and 8th week of age. GP♂♂X GP♀♀ genetic ɔ had significantly (P<0.01) 0.989cm and 1.702cm lengthier els than MZFP♂♂X GP♀♀ and GAYA♂♂X GP♀♀ genetic groups spectively. Apart from these MZFP♂♂X GP♀♀ genetic group had o significantly (P<0.01) 0.713cm lengthier keel than GAYA♂♂X P♀♀ genetic group.

At 16th week of age growth pattern of keel was found to be nilar to those obtained at all the previous ages. GP♂♂X GP♀♀ had gnificantly (P<0.01) 0.676cm and 1.581cm lengthier keels than ZFP♂♂X GP♀♀ and GAYA♂♂X GP♀♀ genetic groups. Besides, ZFP♂♂X GP♀♀ genetic group had also significantly (P<0.01) 905cm lengthier keel than GAYA♂♂X GP♀♀ genetic group.

The trend of growth at 20th week of age was found to be similar the trend mentioned at 4th, 8th,12th and 16th weeks of ages. Like evious results again GP♂♂X GP♀♀ had lengthiest keel among the tire genetic group. GP♂♂X GP♀♀ had significantly (P<0.01) 834cm and 1.543cm lengthier keels than MZFP♂♂X GP♀♀ and AYA♂♂X GP♀♀ genetic group respectively. MZFP♂♂X GP♀♀ and AYA♂♂X GP♀♀ genetic groups ranked 2nd and 3rd respectively. esides, MZFP♂♂X GP♀♀ had also significantly (P<0.01) 0.709 cm ngthier keel than GAYA♂♂X GP♀♀ genetic group respectively.

Mahapatra et al. (1983), Sharma et al. (1984),Venkatesh 985), Singh et al. (1999a), Singh et al. (2000), Kalita et al. (2011), nd Ali wafa (2014) have also reported differences in keel length in rious genetic groups at different ages of chicken which are in nformity with the findings of the present study.

Differences in keel length of various genetic groups might be)uted to differential gene combinations.

It is to be pointed out here that GP♂♂X GP♀♀ genetic group heaviest body weight and lengthiest keel length among all the tic groups at different ages. Positive and significant correlations ıg body weight, shank length and keel length might have ɜd important role on it.

HAEMATOBIOCHEMICAL PARAMETERS

[AEMOGLOBIN:

Least squares mean along with CV% of Hb (g%) at 20 week of in various genetic groups of chicken have been depicted in le- 28. The mean Hb (g%) level in GP♂♂X GP♀♀, MZFP♂♂ X GP♀♀ 1 GAYA♂♂ X GP♀♀ were observed to be 12.163 g%,11.513 g% 1 10.813 g% respectively. Literature reveals the range of Hb (g%) ɔe from 6.20± 0.71 g% in Shaver Star Bro strain of broilers at 55 /s of age (Kamruzzaman et al. 2005) to 20.66 g% in Large Beladi ›type of Sudan in indigenous adult chickens. The findings of the ːsent study in all the three genetic groups fall in the range ntioned above.

Peters et al.(2011) reported the Hb(g%) of Normal feathered, ked neck and Frizzled bird of Nigerian native chickens at 20 week age to be 11.98 ± 0.12(g%), 11.55±0.41(g%) and 11.42±0.31(g%) ;pectively which are in close agreement with the finding of the ɜsent study. Prahsanth et al. (2012) reported the Hb (g%) at 25 ·ek of age in females of domestic birds in PB-1 and PB-2 strains be 13.49±0.37(g%) and 12.96 ± 0.23(g%) respectively which are nilar to the findings of the present study. Pandian et al. (2012) ported Hb(g%) in Kadaknath, Nicobari and Aseel adult chicken to : 11.10±0.38(g%), 12.50±0.43(g%) and12.90 ±0.69 (g%) spectively which are in close proximity with the findings of the ·esent study.

Bhatti et al. (2002) observed Hb(g%) in crossbred, desi, umi and Nick chick laying hens to be 11.80±0.76(g%),)±0.55(g%), 13.08±0.87(g%) and 10.80±0.84(g%) ectively, the findings of which are similar to the findings of present study. However, Islam et al. (2004), Kamruzzaman al. (2005), Ahmed et al. (2007), Jayabarathi and amudha. (2010), Prameela Rani et al. (2011) and Kanduri .(2013) have reported lower Hb(g%) at different weeks of n different genetic groups of chicken, whereas Elagib and ed (2011) and Kundu et al. (2013) have found the higher es of Hb(g%) than the findings of the present study.

Variations in the Hb(g%) in chickens may be attributed to sex, breed, climate, geographical locations, season, day h, time of day, nutritional status, present status of idual and various other physiological factors which might esponsible for variations in Hb(g%) mentioned in the ature.

ct of sex:

Analysis of variance (Table-25) manifested that sex had ly significant (P<0.01) effect in all the three genetic groups respect to Hb(g%). Least squares means along with C.V.% b(g%) at 20 week of age in both the sexes among all the e genetic groups have been depicted in table-26. It was erved that males had significantly (P<0.01) '3(g%),6.373(g%) and 6.373(g%) higher Hb(g%) in

Traits	Source of variation	D.F.	M.S.	F
Gramapriya ♂♂ x Gramapriya ♀♀	Between sexes Error	1 64	818.706 23.009	35.581**
Muzaffarpur ♂♂ X Gramapriya ♀♀.	Between sexes Error	1 64	639.926 4.201	152.327**
Gaya ♂♂ X Gramapriya ♀♀.	Between sexes Error	1 64	639.926 4.201	152.327**

**** Significant at P<0.01**

week of age in male and female of various genetic groups of ...

Weeks		GP ♂♂X GP ♀♀		MZFP♂♂ X GP ♀♀		GAYA ♂♂X GP ♀♀	
		Male	Female	Male	Female	Male	Female
20 week age	Mean ± S.E.	$16.026^{a} \pm 0.401$	$9.653^{b} \pm 0.324$	$15.376^{a} \pm 0.401$	$9.003^{b} \pm 0.324$	$14.676^{a} \pm 0.401$	$8.303^{b} \pm 0.324$
	C.V%	14.544	19.131	15.159	20.512	15.882	22.241

Means(Row wise) with different superscripts for each genetic group taken separately differ significantly($P<0.01$)

-27: Mean squares from analysis of variance to test the of genetic groups on different haematobiochemical neters at twenty week of age

	Source of variation	D.F.	M.S.	F
oglobin g%)	Between genetic group Error	2 195	30.085 13.981	2.152^{NS}
V (%)	Between genetic group Error	2 195	1151.119 35.251	32.655**
RBC $)^6$/mm^3)	Between genetic group Error	2 195	11.411 0.790	14.433**
BC (X /mm^3)	Between genetic group Error	2 195	135.220 18.472	7.320**
OT (IU)	Between genetic group Error	2 195	15906.000 3029.776	5.250**
PT (IU)	Between genetic group Error	2 195	3.570 0.194	18.377**
blesterol ng/dl)	Between genetic group Error	2 195	7520.156 518.764	14.496**
lucose ng/dl)	Between genetic group Error	2 195	9112.338 528.081	17.256**

gnificant at P<0.01

Non-significant

**-28 : Least squares means along with C.V. % of different haemato-
iemical parameters at twenty week of age in various genetic groups
icken (sexes pooled)**

raits		GP ♂♂X GP ♀♀	MZFP♂♂ X GP ♀♀	GAYA ♂♂X GP ♀♀
noglobin (g%)	Mean ± S.E.	12.163[a] ± 0.460	11.513[a] ± 0.460	10.813[a] ± 0.460
	C.V%	0.307	0.324	0.345
CV (%)	Mean ± S.E.	35.774[a] ± 0.730	27.474[b] ± 0.730	32.434[c] ± 0.730
	C.V%	0.166	0.216	0.183
RBC (10^6/mm^3)	Mean ± S.E.	3.584[a] ± 0.109	3.124[b] ± 0.109	2.754[c] ± 0.109
	C.V%	0.248	0.284	0.322
WBC (10^3/mm^3)	Mean ± S.E.	25.905[a] ± 0.529	24.716 [a] ± * 0.529	23.055 [c] ± * 0.529
	C.V%	0.178	0.183	0.158
GOT (IU)	Mean ± S.E.	266.090[a] ± 6.775	249.090[ab] ± 6.775	235.090[b] ± 6.775
	C.V%	0.207	0220	0.234
GPT (IU)	Mean ± S.E.	4.589[a] ± 0.054	4.299[b] ± * 0.054	4.129 [c] ± * .0542
	C.V%	0.096	0.109	0.106
iolesterol (mg/dl)	Mean ± S.E.	131.136[a] ± 2.803	120.545[b] ± 2.803	109.787[c] ± 2.803
	C.V%	0.174	0.188	0.207
Glucose (mg/dl)	Mean ± S.E.	219.045[a] ± 2.828	208.348[b] ± 2.828	195.575[c] ± 2.828
	C.V%	0.103	0.109	0.116

**ns(Row wise) with different superscripts for each haematobiochemical trait
n separately differ significantly(P<0.01)**

Ieans differ significantly(P<0.05)

♂X GP♀♀, MZFP♂♂ X GP♀♀ and GAYA♂♂ X GP♀♀ genetic ps respectively than their female counterparts. Peters et 011) in Normal feathered, Frizzled and Naked neck genotypes gerian native chickens at 20 week of age also observed higher %) than their female counterparts which are similar to the ings of the present study. Elagib and Ahmed (2011) in genous chicken of Sudan, Prahsanth et al. (2012) in estic birds at 25 week of age and Kundu et al.(2013) in araja, white Nicobari, Black Nicobari, and Brown Nicobari ken also reported significantly (P<0.01) higher Hb(g%) in es than their female counterparts, which are in conformity the findings of the present study.

The higher mean value of Hb(g%) in males as compared to r female counterparts may be attributed mainly to siological status of the chickens along with various other ors.

ct of genetic groups:

Analysis of variance (Table-27) presented non-significant ct of genetic groups on Hb(g%).Least squares means ± S.E g with C.V.% of Hb(g%) in all the three genetic groups have n depicted in table -28. Hb(g%) of GP♂♂X GP♀♀ was observed e higher by 0.65 g% and 1.35 g% than MZFP♂♂ X GP♀♀ and A♂♂ X GP♀♀ respectively. However, these increased values e found to be statistically non-significant. Besides, Hb(g%) IZFP♂♂ X GP♀♀ was also observed to be higher by 0.70 g% than A♂♂ X GP♀♀ which was also found to be statistically non-ficant. Prahsanth et al. (2012) also reported non-ficant effect of strain with respect to Hb(g%) at 25 week of which is similar to the findings of the present study. ɜver, contrary to the findings of the present study, Peters l.(2011), Pandian et al. (2012) and Kundu et al.(2013) rted significant (P<0.01) effect of genetic group on Hb(g%).

ɿCKED CELL VOLUME:

Least squares means along with C.V.% of PCV% in all the ɜ genetic groups have been presented in table-28 which observed to be 35.774 ± 0.730(%), 27.474 ± 0.730(%) and 34 ±0.730(%) in GP♂♂X GP♀♀, MZFP♂♂ X GP♀♀ and GAYA♂♂ '♀♀ genotypes respectively. Literature reveals that PCV% in rent genetic groups of adult chicken ranged from 24.83% hode Island Red (Pandian et al. 2012) to 49.20% in Large di (Elagib and Ahmed 2011) in which the findings of present study also stood.

Bhatti et al.(2002) in Nick chick, Islam et al.(2004) in umi, Assil and local chickens of Bangladesh, Peters et 011), Prameela et al.(2011) in broiler chickens, Pandian et 012) in Nicobari and Adeyemo and Sani (2013) in broiler kens at different weeks of age obtained PCV% very close to findings of the present study.

Pandian et al. (2012) reported PCV% to be 24.83%in de Island Red which is lower than findings of the present ly, whereas Bhatti et al. (2002) in laying hens of Desi and oumi chickens, Elagib and Ahmed (2011) in Betwil, Bare k and Large Beladi, Pandian et al.(2012) in Aseel, hsanth et al. (2012) in domestic birds and Abdi-Hachesoo et 2013) in indigenous chicken of Iran have reported higher V value than findings of the present value.

Various genetic and non-genetic factors such as breed, age, hormones, climate, geographical locations, season etc might be ponsible for variations in PCV% of chickens.

ect of sex:

Mean squares from analysis of variance reflected highly nificant (P<0.01) effect of sex on PCV% at 20 week of age in all three genetic groups (Table-29). Least squares means ± S.E ng with C.V.% of PCV% at 20 week of age in both the sexes ong all three genetic groups have been shown in table-30. Males significantly (P<0.01) higher PCV% by 7.208,7.208 and 7.208 n their female counterparts in GP♂♂X GP♀♀, MZFP♂♂ X GP♀♀ GAYA♂♂ X GP♀♀ genetic groups respectively. Elagib and ned (2011) in indigenous matured chicken of Sudan, Peters et 2011) in Normal feathered, Frizzled and Naked neck genotypes Nigerian native chickens at 20 week of age, Prahsanth et al. 12) in domestic birds (*Gallus gallus domesticus*) at 25 week age and Abdi-Hachesoo et al. (2013) in adult indigenous ckens of Iran reported significantly (P<0.01) higher PCV% in les than females which are in conformity with the findings of the sent experiment. Differences in physiological status between two

Table-29 : Mean squares from analysis of variance to test the effect of sex on PCV level (%) at twenty week of age in different genetic groups

Traits	Source of variation	D.F.	M.S.	F
Gramapriya ♂♂ x Gramapriya ♀♀	Between sexes	1	818.706	35.581**
	Error	64	23.009	
Muzaffarpur ♂♂ X Gramapriya ♀♀.	Between sexes	1	818.706	35.581**
	Error	64	23.009	
Gaya ♂♂ X Gramapriya ♀♀.	Between sexes	1	818.706	35.581**
	Error	64	23.009	

** **Significant at P<0.01**

Weeks		**GP ♂♂X GP ♀♀**		**MZFP♂♂ X GP ♀♀**		**GAYA ♂♂X GP ♀♀**	
		Male	**Female**	**Male**	**Female**	**Male**	**Female**
20 week age	Mean ± S.E.	$40.143^{a} \pm 0.940$	$32.935^{b} \pm 0.758$	$31.843^{a} \pm 0.940$	$24.635^{b} \pm 0.758$	$36.803^{a} \pm 0.940$	$29.595^{b} \pm 0.758$
	C.V%	12.103	14.442	15.258	19.308	13.202	16.072

Means(Row wise) with different superscripts for each genetic group taken separately differ significantly($P<0.01$)

; might be mainly responsible for differences in PCV% of both
;.

:ts of genetic groups:

Analysis of variance (Table-27) presented highly significant .01) effect of genetic group on PCV%. Least squares means ; with C.V.% of PCV% at 20 week of age in all the three genetic ps under study have been depicted in table-28.

It was observed that GP♂♂X GP♀♀ had significantly .01)8.30% and 3.34% higher PCV% than MZFP♂♂ X GP♀♀ and A♂♂ X GP♀♀ genetic groups respectively. Besides, GAYA♂♂ X ♀ had also significantly (P<0.01) 4.96% higher PCV% than P♂♂ X GP♀♀.

Peters et al.(2011) in Normal feathered, Frizzled and ed neck genotypes of Nigerian native chickens and Pandian . (2012) in Aseel, Nicobari, White Leghorn, Kadakanath and de Island Red have also reported significant (P<0.01) effect genotypes on PCV% which are in agreement with the ings of the present study.

ED BLOOD CORPUSCLES (RBC):

Least squares means ± S.E. along with C.V.% of RBC /mm^3) at 20 week age in various genetic groups have been cted in table-28. It ranged from 2.754 X 10^6/mm^3 in GAYA♂♂ X ♀ to 3.584 X 10^6/mm^3 in GP♂♂X GP♀♀ at this age. Literature als the range of R.B.C. to be 0.84 X10^6/mm^3 in adult Vanaraja ndu et al.2013) to 4.46 X 10^6/mm^3 in Naked neck chickens at eek of age (Peters et al. 2011) in which the findings of the nt study also fell.

Prameela Rani et al. (2011), Pandian et al. (2012), Kanduri et 013) have also reported the estimates of RBC similar to the ngs of the present study. However, Islam et al.(2004), uzzaman et al.(2005), Ahmed et al. (2007), Elagib and Ahmed), Kundu et al. (2013) and Adeyemo and Sani (2013) have ved the estimates of RBC to be lower than the estimates ned in the present investigation. Besides, Peters et al.(2011) Prahsanth et al. (2012) have obtained the estimates of RBC r than the findings of the present study.

Variations in the estimates of erythrocytes may be attributed enetic and various non-genetic factors like age, sex, ological status, climate etc.

t of sex:

Least squares analysis of variance (Table-31) reveals highly ficant (P<0.01) effect of sex on RBC level. Least squares means g with C.V.% of RBC at 20 week of age in male and females of nree genetic groups of chicken have been depicted in table-32 n reflected that males had significantly (P<0.01) higher RBC their female counterparts. Twenty week males of GP♂♂X , MZFP♂♂ X GP♀♀ and GAYA♂♂ X GP♀♀ had significantly 01) 1.174 X10^6/mm^3,1.175 X10^6/mm^3 and 1.174 X10^6/mm^3 er estimates of RBC respectively than their female terparts.

Traits	Source of variation	D.F.	M.S.	F
Gramapriya ♂♂ x Gramapriya ♀♀	Between sexes	1	21.719	46.845**
	Error	64	0.463	
Muzaffarpur ♂♂ X Gramapriya ♀♀.	Between sexes	1	21.719	46.845**
	Error	64	0.463	
Gaya ♂♂ X Gramapriya ♀♀.	Between sexes	1	21.719	46.845**
	Error	64	0.463	

**** Significant at $P<0.01$**

Weeks		GP ♂♂X GP ♀♀		MZFP♂♂ X GP ♀♀		GAYA ♂♂X GP ♀♀	
		Male	Female	Male	Female	Male	Female
20 week age	Mean ± S.E.	$4.295^{a} \pm 0.133$	$3.121^{b} \pm 0.107$	$3.835^{a} \pm 0.133$	$2.66^{b} \pm 0.107$	$3.465^{a} \pm 0.133$	$2.291^{b} \pm 0.107$
	C.V%	16.452	21.263	18.425	24.938	20.392	28.964

Means (Row wise) with different superscripts for each genetic group taken separately differ significantly($P<0.01$)

Peters et al.(2011) at 20 week of age in Normal feathered, rizzled and Naked neck genotypes of Nigerian native chickens nd Elagib and Ahmed (2011) in Sudanese indigenous chicken have lso reported higher estimates of RBC in males than their female ounterparts which are in close agreement with the findings of the resent study. However, contrary to the findings of the present tudy Prahsanth et al. (2012) could not find significant effect of sex t 25 week of age in domestic chickens with respect to RBC.

Differences in physiological status of the birds might be ttributed to variations in estimates of RBC ($10^6/mm^3$) in both the exes. Gonadal and spermio-genetic development which occurs uring the period of sexual maturation and at the onset of eproductive activity in breeding cocks may be attributed for higher stimates of erythrocytes in male birds as per Kral and Suchy 2000).

ffect of genetic groups:

Mean squares from analysis of variance (Table-27) reflected ighly significant (P<0.01) effect of genotypes on RBC. Least quares means ± S.E. along with C.V.% of RBC at 20 week of age in hicken have been presented in table-28.

The highest RBC ($X10^6/mm^3$) was observed to be in GP♂♂X GP♀♀ genetic group followed by MZFP♂♂ X GP♀♀ and GAYA♂♂ X GP♀♀. GP♂♂X GP♀♀ had significantly (P<0.01) 0.46 X $10^6/mm^3$ and 0.83 X $10^6/mm^3$ higher RBC than MZFP♂♂ X GP♀♀ and GAYA♂♂ X respectively. Besides, MZFP♂♂ X GP♀♀ had also significantly)1) 0.37 X 10^6/mm^3 higher RBC than GAYA♂♂ X GP♀♀.

Islam et al.(2004) in Fayoumi, Assil and Local chickens of ladesh, Pandian et al.(2012) in Kadakanath, Nicobari, Aseel, e Island Red (RIR) and White Leghorn (WLH) chicken and u et al. (2013) in Vanaraja, Nicobari fowl and their various F_1 es have also reported significant (P<0.01) effect of genotypes BC which are in conformity with the findings of the present r. However, Prahsanth et al.(2012) could not find significant : of strain on RBC (10^6/mm^3) at 25 week of age in domestic :ens.

HITE BLOOD CORPUSCLE (WBC):

Least squares means ± S.E. along with C.V.% of WBC mm³) at 20 week age in various genetic groups have been :ted in table-28.It ranged from 23.055 X 10^6/mm^3 in GAYA♂♂ P♀♀ to 25.905 X 10^3/mm^3 in GP♂♂X GP♀♀ at this age. ature reveals the range of WBC to be 2.19 X10^3/mm^3 in les of indigenous chickens of Large Beladi ecotypes(Elagib and ed 2011) to 28.70 X 10^3/mm^3 in broiler chickens (Prameela et al. 2011) in which the findings of the present study also fell.

Prahsanth et al. (2011), Kanduri et al. (2013) have also :ted the estimates of WBC similar to the findings of the present y. However, Bhatti et al.(2004) Jayabarathi and Mohamudha)), Elagib and Ahmed (2011) and Peters et al. (2011) have also rved the estimates of WBC to be lower than the estimates btained in the present study. Besides, Prameela Rani et al. (2011) btained the estimates of WBC higher than the findings of the resent study.

Variations in the estimates of WBC may be attributed to iurnal fluctuations or changes in daily physical and metabolic ctivities (Sanni et al., 2000; Piccione et al., 2001, 2005) apart from arious genetic and non-genetic factors.

ffect of sex:

Least squares analysis of variance (Table-33) reveals non-ignificant effect of sex on WBC ($10^3/mm^3$) level. Least squares ieans along with C.V.% of WBC ($10^3/mm^3$) at 20 week of age in iale and females of all three genetic groups of chicken have been epicted in table-34, which reflected that there was no significant ifference between WBC of males and females in all the three enetic groups.

Peters et al.(2011) in Normal feathered, Frizzled and Iaked neck genotypes of Nigerian native chickens at 20 week f age and Prahsanth et al. (2012) in domestic birds (*Gallus iallus domesticus*) at 25 week of age also reported non-significant ffect of sex on WBC which are in conformity with the findings of he present study.

Effect of genetic groups:

Least squares analysis of variance (Table-27) reflected highly significant ($P<0.01$) effect of genotypes on WBC. Least squares

Traits	Source of variation	D.F.	M.S.	F
Gramapriya ♂♂ x Gramapriya ♀♀	Between sexes	1	2.419	0.111^{NS}
	Error	64	21.773	
Muzaffarpur ♂♂ X Gramapriya ♀♀.	Between sexes	1	54.402	2.721^{NS}
	Error	64	19.991	
Gaya ♂♂ X Gramapriya ♀♀.	Between sexes	1	34.530	2.638^{NS}
	Error	64	13.090	

NS= Non-significant

week of age in male and female of various

Weeks		GP ♂♂X GP ♀♀		MZFP♂♂ X GP ♀♀		GAYA ♂♂X GP ♀♀	
		Male	Female	Male	Female	Male	Female
20 week age	Mean ± S.E.	$26.143^{a} \pm 0.915$	$25.751^{a} \pm 0.737$	$25.843^{b} \pm 0.876$	$23.985^{b} \pm 0.706$	$23.953^{c} \pm 0.709$	$22.472^{c} \pm 0.572$
	C.V%	18.585	17.624	18.800	17.527	20.284	11.212

Means(Row wise) with different superscripts for each genetic group taken separately differ significantly($P<0.01$)

ns ± S.E along with C.V.% of WBC at 20 week of age in all the e genetic groups under studied have been presented in e-28. The highest WBC was observed to be in GP♂♂X GP♀♀ etic group followed by MZFP♂♂ X GP♀♀ and GAYA♂♂ X GP♀♀. ♂X GP♀♀ genetic group had significantly ($P<0.05$) 1.189 X mm³ and 2.85 X $10^3/mm^3$ higher WBC than MZFP♂♂ X GP♀♀ GAYA♂♂ X GP♀♀ genetic groups respectively. Besides, MZFP♂♂ P♀♀ had also significantly ($P<0.05$) 1.661 X $10^3/mm^3$ higher C than GAYA♂♂ X GP♀♀.

However, contrary to the findings of the present study, Peters l. (2011) in Normal feathered, Frizzled and Naked neck otypes of Nigerian native chickens at 20 week of age and isanth et al. (2012) in domestic birds (*Gallus gallus esticus*) at 25 week of age observed non-significant effect of otypes on WBC.

GOT/AST:

Least squares means along with C.V.% of SGOT (IU) at 20 k of age in all three genetic groups have been depicted in le-28. The mean SGOT (IU) values were observed to be hest in GP♂♂X GP♀♀ followed by MZFP♂♂ X GP♀♀ and GAYA♂♂ GP♀♀. The estimates were obtained as 266.090 ± 6.775(IU), .090 ±6.775 (IU) and 235.090±6.775 (IU) in GP♂♂X GP♀♀, FP♂♂ X GP♀♀ and GAYA♂♂ X GP♀♀ respectively. Literature eals that SGOT (IU) ranged from 56..10 ±2.10 (IU) in broiler cken at 06 week of age (Biswas et al. 2012) to 341.0 ± 3.18(IU) in ilers at 06 week of age (Ahmed et al. 2007) in which the findings he present experiment also fell. However, the estimates of SGOT at 20 week of age could not be obtained in literature for ıparison.

ect of sex:

Analysis of variance revealed highly significant (P<0.01) effect ex on SGOT at 20 week of age in all the three genetic groups. wise estimates of SGOT (IU) in all the three genetic groups have n depicted in table-36. Males had significantly (P<0.01) higher OT values by 88.95 (IU), 88.95 (IU) and 88.95 (IU) in GP♂♂X ♀♀, MZFP♂♂ X GP♀♀ and GAYA♂♂ X GP♀♀ genetic groups pectively.

Abdi-Hachesoo et al. (2013) also reported significantly (P<0.05) ıer estimates of AST (IU) in male adult indigenous chicken of ı than their female counterparts which is in agreement with the lings of the present study.

ect of genetic groups:

Least squares analysis of variance presented in table-27 icated highly significant (P<0.01) effect of genetic group on SGOT in this experiment. It was observed that the mean estimates of OT (IU) of GP♂♂X GP♀♀ was significantly (P<0.01) higher by 31.0 than GAYA♂♂ X GP♀♀ (Table-28). However, the mean estimates GP♂♂X GP♀♀, although higher by 17.01 (IU) than MZFP♂♂X ♀♀, yet it did not differ significantly statistically. Besides, the an value of SGOT (IU) of MZFP♂♂X GP♀♀ which was higher

level at twenty week of age in different genetic groups

Traits	Source of variation	D.F.	M.S.	F
Gramapriya ♂♂ x Gramapriya ♀♀	Between sexes Error	1 64	124675.554 1129.060	110.424**
Muzaffarpur ♂♂ X Gramapriya ♀♀.	Between sexes Error	1 64	124675.554 1129.060	110.424**
Gaya ♂♂ X Gramapriya ♀♀.	Between sexes Error	1 64	124675.554 1129.060	110.424**

**** Significant at P<0.01**

Weeks		GP ♂♂X GP ♀♀		MZFP♂♂ X GP ♀♀		GAYA ♂♂X GP ♀♀	
		Male	Female	Male	Female	Male	Female
20 week age	Mean ± S.E.	320.000[a] ± 6.589	231.050[b] ±5.312	303.000[a] ±6.589	214.050[b] ±5.312	289.000[a] ±6.589	200.050[b] ±5.312
	C.V%	12.814	12.047	13.517	12.982	14.189	13.914

Means(Row wise) with different superscripts for each genetic group taken separately differ significantly($P<0.01$)

4.0 IU than GAYA♂♂X GP♀♀ also did not differ ly. However, Prahsanth et al.(2012) observed non- effect of strains with respect to SGOT (IU) in domestic *us gallus domesticus)* at 25 week of age.

LT:

t squares means of SGPT (IU) at 20 week of age in enetic groups have been presented in table-28. It was to be 4.589± 0.054, 4.299± 0.054 and 4.129± 0.0542 ♂X GP♀♀, MZFP♂♂ X GP♀♀ and GAYA♂♂ X GP♀♀ genetic spectively. Literature revealed the range of SGPT (IU) to U in control groups of growing hens (Jayabarathi and ha 2010) to 20.97 IU in six week old broiler chickens et al. 2013). The findings of the present study fell a little range mentioned in the literature.

natobiochemical parameters are influenced by various nd non-genetic factors such as age, sex, hormones, eason, nutritional status, physiological factors etc which responsible for variations in estimates of SGPT.

sex:

ysis of variance to show the effect of sex on SGPT(IU) in genetic groups have been presented in table-37. Sex did nce the level of SGPT in all three genetic groups in this

Traits	Source of variation	D.F.	M.S.	F
Gramapriya ♂♂ x Gramapriya ♀♀	Between sexes Error	1 64	0.709 0.186	3.810^{NS}
Muzaffarpur ♂♂ X Gramapriya ♀♀.	Between sexes Error	1 64	0.709 0.186	3.810^{NS}
Gaya ♂♂ X Gramapriya ♀♀.	Between sexes Error	1 64	0.709 0.186	3.810^{NS}

NS= Non-significant

Weeks		**GP ♂♂X GP ♀♀**		**MZFP♂♂ X GP ♀♀**		**GAYA ♂♂X GP ♀♀**	
		Male	**Female**	**Male**	**Female**	**Male**	**Female**
20 week age	Mean ± S.E.	4.718 [a] ±0.0846	4.506 [a] ± 0.068	4.428 [b] ±0.084	4.216 [b] ±0.068	4.258 [c] ±0.084	4.046 [c] ±0.068
	C.V%	5.254	11.450	5.598	12.237	5.821	12.752

Means (Row wise) with different superscripts for each genetic group taken separately differ significantly($P<0.01$)

vise least squares means along with C.V.% of SGPT (IU) hree genetic groups have been presented in table-38. :t al. (2012) also could not find the effect of sex in PB-1 :rains of domestic birds (*Gallus gallus domesticus*) at 25 which is in agreement with the findings of the present ever, contrary to findings of present study Abdi- et al. (2013) reported that cocks had significantly gher estimates of SGPT than hens in indigenous chicken

enetic groups:

ses of variance to show the effect of genetic groups on have been depicted in table-27. Genetic groups had ficant (P<0.01) effect on SGPT (IU). Least squares means C.V.% of SGPT (IU) at 20 week of age have been shown in Highest SGPT (IU) was observed to be in GP♂♂X GP♀♀ MZFP♂♂ X GP♀♀ and GAYA♂♂ X GP♀♀ genetic groups. ♀♀ had significantly (P<0.01) 0.29 IU and 0.45 IU higher than MZFP♂♂ X GP♀♀ and GAYA♂♂ X GP♀♀ respectively. IZFP♂♂XGP♀♀ had also significantly (P<0.01) 0.17 IU 'T (IU) than GAYA♂♂ X GP♀♀.

ver, no information could be made available in literature the findings of this experiment at this age.

EROL:

squares means along with C.V.% of cholesterol
0 week of age in all the three genetic groups have
d in table-28. The estimates of cholesterol (mg/dl)
d as 131.36 ± 2.833,120.545 ± 2.803 and 109.787
mg/dl in GP♂♂X GP♀♀, MZFP♂♂ X GP♀♀ and
♀♀ genetic groups respectively.

re revealed the range of estimates of cholesterol
be 95.28mg/dl in domestic birds (*Gallus gallus*
(Prahsanth et al. 2012) to 183.1 mg/dl in Naked neck
2011) In which the findings of the present study also
al. (2004) in Shaver Star Bro strain of broilers,
and Mohamudha (2010) in growing hens,
et al. (2012) in domestic birds (*Gallus gallus*
and Khawaja et al. (2013) in crossbred chickens
estimates of cholesterol very close to the findings of
study, whereas Bhatti et al. (2002) in laying hens, Das
) in Vencob broiler chickens, Peters et al. (2011) in
thered, Frizzled and Naked neck genotypes of
ative chickens, Abdi-Hachesoo et al. (2013) in
chicken of Iran and Kanduri et al. (2013) in broiler
ken observed the estimates of cholesterol at different
igher than the present findings. Variations in level of
night be attributed to age, sex, breed, nutritional
ological factors etc.

:t of sex:

yses of variance to assess the effect of sex on cholesterol vel at 20 week of age in different genetic groups have been in table-39, which revealed highly significant (P<0.01) ex on cholesterol (mg/dl) level. Least squares means along % in both the sexes in different genetic groups have been in table-40. Males had significantly (P<0.01) higher of cholesterol (mg/dl) than their female counterparts by g/dl,22.453 mg/dl and 22.434 mg/dl in GP♂♂X GP♀♀, (GP♀♀ and GAYA♂♂ X GP♀♀ genetic groups respectively.

:s et al. (2011) in Normal feathered, Frizzled and Naked otypes of Nigerian native chickens at 20 week of age isanth et al. (2012) in domestic birds (*Gallus gallus ıs*) also reported that males had significantly (P<0.01) estimates of cholesterol (mg/dl) than their female arts which are in conformity with the findings of the tudy.

Groups:

n squares analysis of variance revealed highly significant effect of genetic group on cholesterol (mg/dl) (Table-27). ıares means of cholesterol (mg/dl) in different genetic t 20 week of age have been shown in table-28.It was that GP♂♂X GP♀♀ had significantly (P<0.01) 10.591mg/dl

Traits	Source of variation	D.F.	M.S.	F
Gramapriya ♂♂ x Gramapriya ♀♀	Between sexes	1	8018.234	19.820**
	Error	64	404.555	
Muzaffarpur ♂♂ X Gramapriya ♀♀.	Between sexes	1	7944.579	19.817**
	Error	64	400.902	
Gaya ♂♂ X Gramapriya ♀♀.	Between sexes	1	7930.976	19.738**
	Error	64	401.813	

**** Significant at P<0.01**

		Male	Female	Male	Female	Male	Female
20 week age	Mean ± S.E.	$144.807^{a} \pm 3.944$	$122.250^{b} \pm 3.180$	$134.153^{a} \pm 3.926$	$111.700^{b} \pm 3.165$	$123.384^{a} \pm 3.931$	$100.950^{b} \pm 3.169$
	C.V%	14.441	15.963	15.563	17.452	16.922	19.315

Means(Row wise) with different superscripts for each genetic group taken separately differ significantly($P<0.01$)

ɘ mg/dl higher estimates of cholesterol (mg/dl) than : GP♀♀ and GAYA♂♂ X GP♀♀ respectively. Besides, : GP♀♀ had also significantly (P<0.01) 10.758 mg/dl esterol (mg/dl) than GAYA♂♂ X GP♀♀ genetic group.

Hachesoo et al. (2011) in adult indigenous chicken and broiler breeds and Peters et al. (2011) in Normal Frizzled and Naked neck genotypes of Nigerian :kens at 20 week of age also reported highly significant fect of genotypes on cholesterol (mg/dl) which are in with the findings of the present study.

SE:

squares means of glucose (mg/dl) at 20 week of age in ıetic groups have been presented in table-28.These were ɔe 219.045 ± 2.828 mg/dl, 208.348 ± 2.848 mg/dl and : 2.828 mg/dl in GP♂♂X GP♀♀, MZFP♂♂ X GP♀♀ and GP♀♀ genetic groups respectively.

minimum and maximum estimates of glucose (mg/dl) d to be 54.60 ± 1.33 mg/dl in females of Naked neck al.2011) and 274.50±33.22 mg/dl in females of Ross-308 ıesoo et al. 2011) respectively in available literature in findings of the present study also fell. Bhatti et al. (2002) hens of different genetic groups, Prameela Rani et al. broiler chicken and Prahsanth et al. (2012) in ɔirds (*Gallus gallus domesticus*) obtained the estimates of ıg/dl) very close to the findings of present study. However, hesoo et al.(2011), Abdi-Hachesoo et al.(2013) and et al.(2013) reported higher estimates of glucose (mg/dl) the findings of present study, whereas Peters et al. (2011) lower estimates of glucose (mg/dl) than the result in this investigation.

ations in estimates of glucose, like other iochemical parameters, may be attributed to genetic and on-genetic factors including age, sex, nutritional status iological factors etc.

sex:

n squares from analysis of variance to test the effect of sex se level (mg/dl) in different genetic groups have been table-41, which revealed that sex did not play significant lucose (mg/dl) level in all the three genetic groups. Least means of glucose (mg/dl) level in both the sexes in all e genetic groups have been presented in table-42.

ihsanth et al.(2012) in *Gallus gallus domesticus* chicken, chesoo et al. (2013) in indigenous chickens of Iran and et al. (2013) in crossbred chickens reported non-nt effect of sex on blood glucose level (mg/dl) which are in ty with the findings of the present study. However, to findings of this investigation Peters et al. (2011) reported gnificant ($P<0.01$) effect of sex on glucose (mg/dl) in Normal d, Frizzled and Naked neck genotypes of Nigerian native s.

f genotypes:

alysis of variance to show the effect of genetic groups on (mg/dl) have been depicted in table – 27. Least squares of glucose (mg/dl) at 20 week of age in all the three genetic have been presented in table-28. It was observed that GP♀♀ genetic group had highest glucose (mg/dl) value by MZFP♂♂ X GP♀♀ and GAYA♂♂ X GP♀♀ genetic groups vely. GP♂♂X GP♀♀ had significantly (P<0.01) 10.697mg/dl 47mg/dl higher estimates of glucose (mg/dl) than MZFP♂♂ and GAYA♂♂ X GP♀♀ genetic groups respectively. Besides, ♂ X GP♀♀ genetic group had also 12.773 mg/dl higher e of glucose (mg/dl) than GAYA♂♂ X GP♀♀.

eters et al. (2011) in Normal feathered, Frizzled and Naked genotypes of Nigerian native chickens at 20 week of age lso reported highly significant (P<0.01) effect of genetic group cose (mg/dl) which are in conformity with the findings of t study.