

Full Length Research Paper

Effect of calorie protein ratio on the growth performance and haematology of two strains of pullet chicks

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In a 56 days experiment, 432-day old chicks were used to determine the influence of varying levels of calorie:protein ratio on the growth performance and haematology of two strains of commercial pullet chicks. Each of the strains, (i)Nera Black (NB) and (ii)Isa Brown (IB) were randomly allocated to three dietary levels of calorie:protein ratio designed to contain normal calorie:protein ratio (NC:P), high calorie:protein ratio (HC:P) and low calorie:protein ratio (LC:P). This gave a total of six treatments, replicated thrice to give 18 replicates comprised 24 birds each. Results showed that strain effect was significantly ($p<0.05$) higher in NB for average daily feed intake (ADFI) 27.81g and average daily weight gain (ADWG) 9.20g and lower ($p<0.05$) feed conversion ratio (FCR) 2.99 than corresponding values for IB. Strain effect also influenced ($p<0.05$) all haematology indices except haemoglobin, red blood cell and basophils. It also affected the serum indices at higher ($p<0.05$) values for glucose, calcium, and phosphorus in NB chicks. Calorie:Protein ratio effect was significantly higher ($p<0.05$) in ADFI (29.64g) for birds fed HC:P while those on NC:P recorded ADWG (9.32g) and FCR (2.72). All the haematological and serum indices values were influenced ($p<0.05$) by the calorie protein ratio effect whereas other determined parameters were not. Strain x Calorie Protein effect on the growth performance showed NB chicks fed HC:P recorded highest ($p<0.05$) ADFI (30.52g), while those on LC:P had highest ADWG (9.61g). Best FCR ($p<0.05$) was observed among chicks fed LC:P (2.74) while NB chicks on HC:P showed the best PER (1.51). All the haematology parameters except basophils and serum indices albumin and total protein were significantly influenced ($p<0.05$) by the strain x calorie:protein ratio. The study showed that Nera Black strain performed optimally than Isa Brown in the tropical zone where the trial was conducted.

Key words: Commercial pullet, high calorie: protein ration: Low Calorie:protein ratio. Normal Calorie:protein ratio.

INTRODUCTION

Feed utilization by the different classes of farm animals is predicated on the availability of the nutrients content of

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which two namely, energy and protein appear to be the major determinants for their evaluation for variables such as cost, suitability, quantity and quality of products (Dawood and Mohammed, 2015; Dairo et al., 2010; Li et al., 2013). The sources of these two nutrients are also very important for optimal growth of the animals.

Research have shown that a good understanding of the precise manipulation of the calorie and protein in the feed improved the growth and production performances of the local *Desi* breed of poultry birds in Pakistan through the genetic constitution of the birds using selective inbreeding and cross breeding (Sahota et al., 2003; Anjum et al., 2012).

Olomu and Offiong (1980) reported a requirement of 23% crude protein (CP) with 2800 kcal/kg metabolizable energy (ME) for broiler chicken, while Onwudike (1983) suggested a CP of 22% and 2900 kcal/kg ME. Ojewola and Longe (1999) established the regime of 27% crude protein in the diets of broiler chicken at starter phase with a decrease to a maximum of 24% during the finisher phase. Most of the requirements recommended for broiler chicks were adapted for the pullet chicks in addition to the values suggested by NRC (1994).

The environmental variations no doubt have impacted the feeding and performance of the various classes of farm animals. Therefore, the manipulation of the calorie and protein contents of the feed was exploited as a way out of the effect of heat overload as a result of calorie intake through the feed. Reports have shown that adequate provision of calorie and protein in the feed of these animals particularly, poultry is not just enough. The values often time recorded are at best called ideal data. However, the interaction between the nutrients especially ME and CP in proportion to one another have been used to ameliorate the heat load and hence help in the management of heat stress for a better performance (Balnave and Brake, 2005; Syafwan et al., 2011).

In Nigeria, most of the pullets on commercial poultry farms are imported from the temperate zones of the world with sharp contrast in weather conditions; therefore, it becomes very necessary to investigate the responses of the pullet chicks to different calorie and protein values which often come with strict instruction in their breeders manuals. It becomes very necessary therefore to investigate the calorie protein regime for some of the common breeds imported as egg type chicken in Nigeria.

MATERIALS AND METHODS

Location of experimental site

The study was carried out at the Teaching and Research Farm of the Ekiti State University, Ado-Ekiti. The town is located on latitude $7^{\circ} 31'$ and $7^{\circ} 49'$ North of the equator and longitude $5^{\circ} 71'$ and $5^{\circ} 27'$ East of the Greenwich meridian. The town has two distinct seasons which are (i) the rainy seasons from May to October and (ii) the dry season that starts from November to April of every year.

Experimental design, preparation of diets, birds and management

The experimental diets for the chicks were formulated to have three regimes of calorie protein ratios indicating 3 factors of Calorie: Protein ratios and designated as (i) Normal Calorie: Protein ratio (NCP) of 165:1; High calorie Protein ratio (HCP) of 167:1 and Low Calorie Protein ratio (LCP) of 160:1. The metabolizable energy (ME) in the diets of the pullet chicks should be about 2850 kcal/kg ME with a crude protein (CP) of about 17% was taken as the standard for a guide. Diets in which the standards were used for these two nutrients gave the normal calorie protein ratio (NCP) of 165:1 (Table 1). The ME was then reduced a bit lower to about 2,700 Kcal/kg with protein of about 16.17% to give high calorie protein ratio (HCP) of 167:1 while the low calorie protein ratio (LCP) diet was obtained by increasing the protein slightly above the standard to about 18% and ME of about 2900kcal/kg to give 160:1 The protein and energy contents of the diets were manipulated to obtain the different categories of the Calorie Protein ratios using the recommended ideal data (NRC,1994). Diet 1 that represented Treatment 1 contained 17.03% CP and 2808kcal/kg ME, the HCP contained 16.17% and 2702 kcal/kg which represented the diet for treatment 2 and LCP while diet three contained 18.04% and 2906 kcal/kg. The above arrangement was done for each of the strains to give six treatments groups (Table 1).

A total of 432 day old chicks that comprised 216 Isa Brown and Nera Black strains each were procured from a reputable hatchery in Ibadan, South west Nigeria and were divided into six treatment groups of 72 day old chicks. The treatment groups were replicated thrice in a 2 x 3 x 3 factorial manner that translate into 18 replicates in all. The factors are 3 calorie protein ratio, 2 strains of birds namely Isa Brown and Nera Black and 3 replicates. Each of the replicate contained 24 day old chicks. Before the arrival of the day old chicks, the brooding house was washed and well fumigated with a mixture of 1 part of $KMNO_4$ to 3 parts of formalin and rested for one week. The pens were allocated to the treatment replicates randomly and well labelled. On arrival, the day old chicks were weighed with initial average weight of 30.00 g/day old chicks and randomly distributed to the replicates as labelled. Routine medications and vaccination were given to the chicks according to the schedule followed by the Poultry Unit of the Teaching and Research Farm. The birds were fed ad libitum for a period of 56 days and data collected as indicated below. The average pen temperature was about 31.5°C at the initial stage and later reduced to about 29.4°C

Data collection

Data were collected on the growth performance, such as feed intake and body weight gained from which the feed conversion ratio and protein efficiency ratio were derived. Mortality of the birds was also recorded.

Blood collection

At the last day of the 8th week of the experiment, 2 ml of blood samples was collected from the pullet chicks' wing veins using sterilized syringe with 22 gauge needles into 18 vacutainer tubes that contained ethylene diamine tetra acetate (EDTA) as anticoagulant while the second set of the blood samples did not contain speck of EDTA. The first set was used to evaluate haematology indices of the experimental pullet chicks such as packed cell volume (PCV), haemoglobin (Hb), red blood cell count (RBC), white blood Cell count (WBC) and the non-differential; while the other set of 18 was used to determine the serum samples namely, total protein, albumin, creatinine, and urea. The two sets of

Table 1. Composition of chick's experimental diets with three calorie: protein ratio (%).

Feed Ingredients	NC:P (165:1)	HC:P (167:1)	LC:P (160:1)
Maize	53.50	48.00	56.00
Groundnut Cake	4.00	3.00	8.00
Soya Bean Meal	12.00	8.00	12.00
Palm Kernel Cake	8.00	9.00	12.00
Wheat Offal	18.80	28.30	8.30
Bone Meal	2.00	2.00	2.00
Oyster Shell	1.00	1.00	1.00
Salt	0.30	0.30	0.30
Chicks' Premix	0.20	0.20	0.20
DL-Methionine	0.10	0.10	0.10
L-Lysine	0.10	0.10	0.10
Total	100	100.	100.
Determined/Analyses			
Dry matter (%)	91.70	92.60	91.50
Crude Protein (%)	17.01	16.17	18.04
Crude Fiber (%)	1.10	5.30	4.00
Ash(%)			
NFE(%)			
Ether extract (%)	17.20	17.90	17.20
ME(Kcal/kg) Calculated	2808	2702	2906

NC:P (Normal Calorie:Protein) HCP (High Calorie Protein) LC:P (Low Calorie:Protein).

Table 2. Effect of calorie protein ratio on the growth performance of pullet chicks.

Parameter	Calorie protein ratio			SEM	p-value
	NC:P (C)	HC:P	LC:P		
Initial live weight (g/bird)	30.10	30.10	29.90	-	-
Final live weight (g/bird)	526.77 ^b	514.70 ^c	551.77 ^a	0.63	0.0001
Average daily weight gain (g/bird)	8.87 ^b	8.65 ^b	9.32 ^a	0.01	0.0001
Total feed intake(g/bird)	508.00 ^b	569.00 ^a	486.00 ^c	0.049	0.0001
Average daily feed intake (g/bird)	26.43 ^b	29.62 ^a	24.97 ^c	0.34	0.0001
Feed conversion ratio (FCR)	2.98 ^b	3.42 ^a	2.68 ^c	0.01	0.0001
Protein efficiency ratio (PER)	1.56 ^b	1.52 ^c	1.60 ^a	0.01	0.0001
Mortality (%)	0.17	0.50	0.17	0.23	0.49

a ,b ,c Means in the same row with the different superscript are significantly different at (p<0.05).

the blood samples were immediately taken to the laboratory of the Department of Animal Production and Health Sciences. The serum in the set of blood without anticoagulants was separated using laboratory centrifuge at 2500 revolution per min in a bench top Harris Centrifuge (Model C2473/2) and stored in a refrigerator at 4°C and later analysed for parameters as indicated for serum above

Chemical and statistical analyses

The experimental feeds was analysed for proximate using techniques described by AOAC (2005) while the metabolizable energy (ME) was calculated using the prediction equation described by Pauzenga (1985) as indicated below,

$$ME=37 \times \%CP + 81.8 \times \%EE + 35.5 \times \%NFE$$

The haematology and serum indices of the blood sample as indicated above were determined according to Sastri (2004). All the data were subjected to statistical analysis using SAS (1987) computer software for ANOVA and means separated by Duncan Multiple Range Test at 5% level of probability. The variables analysed were growth performance, haematology and serum indices.

RESULTS

The effects of calorie protein ratio on the growth

Table 3. Strain effect on growth performance of pullet chicks.

Parameter	Strain s			P-value
	ISA brown	NERA black	SEM	
Initial live weight (g/bird)	30.10	29.90		
Final Live weight (g/bird)	516.94 ^b	545.21 ^a	0.52	<0.0001
Average daily weight gain (g/bird)	8.69 ^b	9.20 ^a	0.01	<0.0001
Average daily feed intake (g/bird)	26.50 ^b	27.51 ^a	0.28	<0.0001
Feed conversion ratio (FCR)	3.05 ^b	2.99 ^a	0.01	<0.0001
Protein efficiency ratio (PER)	1.54 ^b	1.56 ^a	0.01	<0.0001
Mortality (%)	0.11	0.44	0.19	0.57

^{a,b}Means in the same row with the different superscript are significantly different ($p < 0.05$).

Table 4. Strains X Calorie:protein ratio effects on growth performance of pullet chicks.

Parameter	ISA BROWN			NERA BLACK			SEM	p-value
	NC:P	HC:P	LC:P	NC:P	HC:P	LC:P		
Initial live weight (g/bird)	29.90	30.20	30.10	30.20	30.00	29.60	-	-
Final live weight (g/bird)	510.40 ^e	504.55 ^f	535.88 ^c	543.13 ^b	524.86 ^d	567.65 ^a	0.89	<0.0001
Average daily weight gain (g/bird)	8.58 ^e	8.47 ^f	9.03 ^c	9.16 ^b	8.84 ^d	9.61 ^a	0.02	<0.0001
Average daily feed intake (g/bird)	26.08 ^c	28.73 ^b	24.70 ^d	26.79 ^c	30.50 ^a	25.23 ^c	0.48	<0.0001
Feed conversion ratio	3.04 ^b	3.39 ^a	2.74 ^c	2.92 ^b	3.45 ^a	2.63 ^c	0.46	<0.0001
Protein efficiency ratio (PER)	1.53 ^d	1.53 ^d	1.56 ^c	1.59 ^b	1.51 ^e	1.63 ^a	0.041	<0.0001
Mortality (%)	0.00	0.00	0.33	0.33	1.00	0.00	0.33	0.0012

^{a,b,c}Means in the same row with the different superscript are significantly different at ($p < 0.05$).

performance are shown in Table 2. The final live weight (FLW), average daily weight gain (ADWG), feed conversion ratio (FCR) and protein efficiency ratio (PER) were all significantly better ($p < 0.05$) for the pullet chicks fed low calorie protein ratio (LCP) with recorded values of 551.77g, 9.32g, 2.68 and 1.60 respectively. However, this group of chicks showed the lowest ($p < 0.05$) average daily feed intake of 24.97 g (ADFI). Pullet chicks fed diets containing high calorie protein (HCP) ratio recorded significantly higher ($p < 0.05$) average daily feed intake (ADFI) of 29.62g but showed the lowest ($p < 0.05$) feed conversion ratio (FCR) of 3.42 and protein efficiency ratio (PER) of 1.52. Birds fed normal calorie protein ratio (NCP) recorded the next best values of the growth indices after the LCP groups. Mortality of the chicks was not affected at all ($p > 0.05$).

The strain effects on the growth performance are presented in Table 3. The strain effect increased significantly ($p < 0.05$) the ADFI (27.51 g), FLW (545.21 g) and ADWG (9.20g) with better FCR (2.99) and PER (1.56) of NB over the values recorded for IB. The mortality was not significantly ($p > 0.05$) affected at all. Strain x calorie protein ratio interaction on growth performance is shown in Table 4. It significantly increased ($p < 0.05$) the values of FLW (567.65 g), ADWG (9.61 g) and best FCR (2.63) and PER (1.63) for NB pullet chicks

fed LCP diet. The IB strains on HCP diet showed the lowest FLW (504.55g). The ADWG, FCR and PER followed the same trend of having the highest values recorded for pullet NB chicks fed LCP diet. The ADFI was significantly highest ($p < 0.05$) for NB chicks fed HCP diet (30.50 g) while the lowest values were recorded by IB chicks on LCP diet (26.79g). Strain x Calorie protein ratio interaction did not influence ($p > 0.05$) mortality of the strains of birds.

Calorie protein ratio effect on haematology is shown in Table 5. The packed cell volume (PCV) was significantly ($p < 0.05$) influenced with highest value recorded by pullet chicks fed the LCP diet (27.50%) while birds on HCP and NCP had similar values (25.83 and 25.33% respectively) but significantly ($p < 0.05$) the lowest. The differentials such as lymphocytes neutrophils and eosinophil were significantly influenced ($p < 0.05$) while other haematology indices such as red blood cell (RBC), white blood cell (WBC) and basophils were not significant ($p < 0.05$).

Table 6 shows the Strain x Calorie protein ratio interaction on haematology. PCV was significantly ($p < 0.05$) higher and similar generally for NB chicks fed with NCP, HCP and LCP diets and IB pullet chicks on LCP diet (27.67, 26.33, 26.33 and 27.33% respectively) while IB on NCP had the lowest value (24.33%). The haemoglobin concentration (Hbc) almost followed the

Table 5. Effects of calorie-protein ratio on haematology of pullet chicks.

Parameter	Calorie:Protein ratio			SEM	p-value	Range
	NC:P	HC:P	LC:P			
PCV (%)	25.33 ^b	25.83 ^b	27.50 ^a	0.30	0.18	22.9-40.7
Hbc (g/dl)	8.22	8.41	8.85	0.21	0.54	7.40-12.2
RBC (x10 ⁶ µl)	3.53	3.30	3.58	0.16	0.81	1.58-3.82
WBC (x10 ³ µl)	15780.0	15941.7	15975.0	236.12	0.69	9.20-28.6
Lymphocytes (%)	63.67 ^a	63.67 ^a	47.00 ^b	1.36	0.36	5.91-18.4
Neutrophils (%)	29.67 ^b	25.17 ^c	50.50 ^a	1.26	<0.0001	2.23-6.92
Monocytes (%)	3.67	3.33	4.00	0.26	0.67	0.04-0.12
Eosinophils (%)	2.83 ^a	3.00 ^a	1.67 ^b	0.33	0.0019	0.67 – 2.07
Basophils (%)	0.17	0.17	0.50	0.21	0.55	0.36-1.12

^{a, b, c}Means in the same row with the different superscript are significantly different at (p<0.05).

Table 6. Interaction Effect of Strain and Calorie-Protein ratio on haematology.

Parameter	ISA brown			NERA black			SEM	p-value	Range
	NC:P	HC:P	LC:P	NC:P	HC:P	LC:P			
PVC (%)	24.33 ^c	25.33 ^{bc}	27.33 ^a	26.33 ^{ab}	26.33 ^{ab}	27.67 ^a	0.42	0.18	22.9-40.7
HBc (g/dl)	8.11 ^b	8.45 ^{ab}	9.18 ^a	8.32 ^{ab}	8.38 ^{ab}	8.52 ^{ab}	0.30	0.36	7.40-12.2
Rbc (x10 ⁶ µl)	3.54	3.45	3.31	3.51	3.15	3.85	0.23	0.74	1.58-3.82
Wbc (x10 ³ µl)	15683.3 ^{ab}	15700.0 ^{ab}	15266.7 ^b	15876.7 ^{ab}	16183.3 ^{ab}	16683.3 ^a	333.92	0.21	9.20-28.6
Lymphocyte (%)	67.00 ^a	63.33 ^{ab}	69.00 ^a	60.33 ^b	64.00 ^{ab}	55.00 ^c	1.92	<0.0001	5.91-18.4
Neutrophil (%)	30.33 ^{bc}	25.33 ^c	33.33 ^b	29.00 ^{bc}	25.00 ^c	67.67 ^a	1.79	<0.0001	2.23-6.92
Monocyte (%)	3.33 ^{ab}	2.33 ^b	4.33 ^a	4.00 ^a	4.33 ^a	3.67	0.37	<0.0001	0.04-0.12
Eosinophil (%)	4.33 ^a	3.67 ^{ab}	1.33 ^c	1.33 ^c	2.33 ^{bc}	2.00 ^c	0.46	0.009	0.67-2.07
Basophil (%)	0.33	0.33	0.33	0.00	0.00	0.67	0.29	0.56	0.36-1.12

^{a, b, c}Means in the same row with the different superscript are significantly different at (p>0.05).

same trend as the PCV. The WBC highest (p<0.05) value was recorded by NB chicks fed LCP diet (16683.3x10³µl) and similar to all other groups of chicks of both strains except for IB fed LCP diet that recorded the lowest value of 15266.7 × 10³µl. The lymphocytes (67.00%) and eosinophils (4.33%) values were highest in IB fed with NCP diet while NB on LCP diet showed the lowest (55.00 and 2.00% respectively). Significantly highest (p<0.05) value of monocytes was observed in IB chicks on LCP diet (4.33%) and similar in values recorded by NB chicks on NCP (4.00%) HCP (4.33%) and LCP (3.67); the lowest value was noted in IB chicks fed HCP diet (2.33%). However, the RBC values were not significantly (p>0.05) influenced by the Strain x calorie protein ratio interaction. Strain effect on haematology is shown in Table 7. The PCV, WBC, neutrophils and monocytes in NB pullet chicks have significantly higher (p<0.05) values than the IB whereas the lymphocytes and eosinophils values were higher in IB chicks. However, the haemoglobin concentration (Hbc), RBC, monocytes and basophils values were not affected (p>0.05)

Calorie protein ratio effect did not significantly influence (p>0.05) all the serum indices analysed (Table 8) except

aspartate enzyme which was highest for pullet chicks fed HCP ratio diet (68.77 µl). Birds fed diets containing NCP and LCP diets had similar but lower values (61.52µl and 57.97 µl respectively). Strain effect on the serum indices were not significant at all (p>0.05). The strain x calorie protein interaction (Table 9) significantly influence (p<0.05) the serum indices such as creatinine, aspartate and urea values. Isa Brown and Nera Black pullet chicks fed HCP and LCP diets respectively indicated similar but highest (p<0.05) serum aspartate concentrations of 88.15µl and 80.87 µl while IB chicks on LCP ratio had the lowest value (42.17 µl). Highest (p<0.05) creatinine value of 0.83 g/dl was observed in NB pullet chicks fed NCP ratio diet while the IB chicks on same diet NCP ratio recorded the lowest (0.62 g/dl). The urea values followed the same trend as obtained for creatinine. Strain effects on serum indices were not significant among the strains (Table 10).

DISCUSSION

The effect of calorie protein ratio in the diet of the two

Table 7. Strains effect on haematology of pullet chicks.

Parameter	Strains		SEM	p-value	Range
	ISA brown	NERA black			
PCV (%)	25.67 ^b	26.78 ^a	0.24	<0.0001	22.9-40.7
HBc (g/dl)	8.58	8.41	0.17	0.56	7.49-12.2
RBC (x10 ⁶ µl)	3.43	3.51	0.13	0.71	1.58-3.82
WBC (x10 ³ µl)	15550.0 ^b	16247.8 ^a	192.79	<0.0001	9.20-28.6
Lymphocytes (%)	66.44 ^a	49.78 ^b	1.11	<0.0001	5.91-18.4
Neutrophils (%)	29.67 ^b	40.56 ^a	1.03	<0.0001	2.23-6.92
Monocyte (%)	3.33 ^b	4.00 ^a	0.21	<0.0001	0.04-0.12
Eosinophils (%)	3.11 ^a	1.89 ^b	0.27	0.0001	0.67-2.07
Basophils (%)	0.33	0.22	0.17	0.94	0.36-1.12

^{a,b,c}Means in the same row with the different superscripts are significantly different at (p<0.05).

Table 8. Effect of calorie-protein ratio on serum.

Parameter	Calorie: protein ratio			SEM	p-value	Range
	NC:P	HC:P	LC:P			
Glucose (mg/dl)	211.73 ^b	178.00 ^c	313.45 ^a	5.30	0.008	152-182
Calcium (mg/dl)	21.98 ^a	19.05 ^b	17.93 ^c	0.84	0.0034	9.00-23.7
Phosphorus (mg/dl)	6.78 ^b	9.65 ^a	6.15 ^b	0.55	0.009	6.20-7.90
Cholesterol (mg/dl)	134.74 ^a	132.61 ^b	126.15 ^b	1.41	<0.0001	52.0-148
Albumin (g/dl)	3.01	3.06	3.01	0.17	0.72	3.50-5.50
Total protein g/dl)	4.53	4.19	4.56	0.27	0.61	6.20-8.00
Creatinine (mg/dl)	0.73	0.73	0.68	0.03	0.51	0.90-1.85
Aspartate (LU/L)	57.97 ^b	68.77 ^a	61.52 ^{ab}	2.55	<0.0001	88.0-208
Urea (mg/dl)	5.34	4.86	4.90	0.44	0.71	1.50-6.30

^{a,b,c}Means in the same row with the different superscript are significantly different at (p>0.05).

Table 9. Interaction effect of strains and calorie-protein ratio on Serum.

Parameter	ISA brown			NERA black			SEM	p-value	Range
	NC:P	HC:P	LC:P	NC:P	HC:P	LC:P			
Glucose (mg/dl)	198.81 ^d	160.68 ^e	272.34 ^b	224.66 ^c	195.32 ^d	354.35 ^a	7.49	0.008	152-182
Calcium (mg/dl)	18.27 ^b	12.44 ^c	16.78 ^b	25.69 ^a	25.67 ^a	19.08 ^b	1.19	0.0034	9.0-23.7
Phosphorus (mg/dl)	6.20 ^b	7.31 ^b	5.30 ^b	7.35 ^b	12.00 ^a	7.00 ^b	0.78	0.009	6.20-7.90
Cholesterol (mg/dl)	128.69 ^d	159.67 ^a	103.43 ^e	140.79 ^c	105.55 ^e	148.78 ^b	1.99	<0.0001	52.0-148
Albumin (g/dl)	3.09	2.97	2.83	2.93	3.16	2.72	0.23	0.73	3.50-5.50
Total Protein (g/dl)	4.72	4.22	4.37	4.33	4.16	4.75	0.38	0.61	6.20-8.00
Creatinine (mg/dl)	0.62 ^b	0.72 ^{ab}	0.71 ^{ab}	0.83 ^a	0.74 ^{ab}	0.66 ^b	0.05	0.04	0.90-1.85
Aspartate (LU/L)	61.90 ^b	88.15 ^a	42.17 ^c	54.05 ^b	56.38 ^b	80.87 ^a	3.61	<0.0001	88.0-208
Urea (mg/dl)	3.71 ^c	5.01 ^{abc}	5.96 ^{ab}	6.95 ^a	4.70 ^{bc}	3.85 ^c	0.29 ()	0.005	1.50-6.30

^{a,b,c}Means in the same row with the different superscript are significantly different at (p>0.05).

strains of pullet chicks showed that low calorie protein ratio diet (LCP) supported lower feed intake and better body weight gain whereas high calorie protein ratio diet (HCP) showed poor body weight and higher feed intake.

This implies that lower calorie protein ratio diet was better utilized by the pullet chicks than the high calorie protein ratio (HCP) and the normal calorie protein ratio (NCP) diets (Dairo et al., 2010). This finding is also consistent

Table 10. Strains effect on serum.

Parameter	Strains		SEM	p-value	Range
	ISA Brown	NERA Black			
Glucose (mg/dl)	210.61 ^b	258.11 ^a	4.33	<0.0001	152-182
Calcium (mg/dl)	15.83 ^b	23.48 ^a	0.69	<0.0001	9.0-23.7
Phosphorus (mg/dl)	6.27 ^b	8.78 ^a	0.45	<0.0001	6.20-7.90
Cholesterol mg/dl)	130.60	131.71	1.15	0.52	52.0-148
Albumin (g/dl)	2.96	2.93	0.14	0.72	3.5-5.5
Total protein (g/dl)	4.43	4.42	0.22	0.61	6.2-8.0
Creatinine (mg/dl)	0.68	0.74	0.03	0.51	0.90-1.85
Aspartate (LU/L)	61.74	63.77	2.08	0.66	88.0-208
Urea (mg/dl)	4.90	5.17	0.36	0.77	1.50-6.30

^{a, b, c}Means in the same row with the different superscript are significantly different at (p>0.05).

with the reports of Aftab et al. (2006), and Khan et al. (2011) who investigated the feeding of low calorie protein ratio diets with adequate lysine and methionine supplementation to broiler chickens. The energy in the LCP diets supported adequate consumption of the needed energy for body growth with efficient utilization of the protein. The birds consumed less to produce better body gain whereas pullet chicks on the HCP consumed more to meet energy needs which agreed with earlier report of previous workers that birds eat to meet their energy need (Golian and Moaurice, 1992; Leeson et al., 1993). It should be noted as well that increasing the energy of the diets did not profoundly support body weight gained of pullet chicks in this study which is contrary to the findings of Jafarnejad and Sadegh (2011) who reported an increased in body weight gain of broilers having access to feed with unlimited fat than those that did not have in their diet. Though the component of the experimental diets did not contain vegetable oil, energy increase in the diet of the chicks could be sourced from other feed ingredients. It is also contrary to the report of other workers who found that dietary energy did not influence the body weight gain (Summers et al., 1992; Leeson et al., 1996). This trend was also observed in the poor values of the feed conversion and protein efficiency ratio recorded as the energy in the diets increased for the different groups of chicks fed HC:P and NC:P.

Strains have significant effect on the performance of the chicks. In this study, Nera Black (NB) was observed to respond with better performance indices as the calorie protein ratio in the diet fluctuates. This might have been genetic which tend to agree with the reports of Sahota et al. (2003) and Anjum et al. (2012) that breed improvement could actually affect production performance of local breed of Dessi chicken in Pakistan. Nera Black used in this study may have been developed over years to effectively adjust to variation in dietary energy and protein contents in the tropical conditions.

Strain x Calorie protein ratio interaction had profound effect on the growth performance of the two strains

investigated in this work. There appeared to be an inverse relationship of the effect on the average feed intake and the average daily body weight gain. Nera Black pullet chicks had significantly better impact of the interaction than the Isa Brown strain it might not be unconnected to some physiological changes which perhaps help the NB to respond positively than IB. Nera Black strain may have developed some physiological responses through some biochemical processes that may have enhanced their basal metabolic rate, physical activity or regulation of thermogenesis with overall consequential better performance (Gabarrou et al., 1997; Decuyper and Buyse, 2006). Research has further supported this view though the physiological uncoupling protein that regulates energy balance and thermogenesis in breeds of chicken with genetic difference might be responsible for the observation in this study (Raimbault et al., 2001; Li et al., 2013)

The various effects have been noted to have the same trend on the observations recorded for haematology and serum parameters. It is noted that Nera Black pullet chicks across the indices evaluated demonstrated better responses to the various interactive effects which agreed with reports from other investigators (Dairo et al., 2010) In conclusion, low calorie protein ratio diets of pullet chicks appear to be a better option for optimum performance of pullet chicks. There is also strain effect on the utilization of the diet. In this study, Nera Black performed optimally than Isa Brown. Therefore adequate consideration must be given to the energy and protein content to obtain a good calorie protein ratio in the pullet chicks' diet to promote the desired objective in production.

CONFLICT OF INTERESTS

The study was carried out without any conflict of interest as approved by the Departmental and University Ethics Committee.

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