Indian J Anim Health (2025), 64(1): 80 - 86
DOI: https://doi.org/10.36062/ijah.2025.02225

Research Article

Growth performance, carcass characteristic, biochemical profile and immunological status of Narmada Nidhi chicken reared as broiler in response to concentrations of dietary energy and protein

K. K. Pandey[1], S. Koley[2*], N. Kurechiya[3], B. K. Ojha[4] and A. Singh[4]

[1]Veterinary Officer, Veterinary Hospital Manikwar, Raipur Karchuliyan, Rewa - 486 123, Madhya Pradesh, India; [2]Department of Animal Nutrition, Bihar Veterinary College, Bihar Animal Sciences University, Patna - 800 014, Bihar, India; [3]Department of Animal Nutrition, College of Veterinary Science and Animal Husbandry, Mhow - 453 446, Madhya Pradesh, India; [4]Department of Animal Nutrition, College of Veterinary Science and Animal Husbandry, Rewa - 486 001, Madhya Pradesh, India

Abstract

The effect of different dietary concentrations of energy and protein suggested for broilers was evaluated on the growth performance, carcass characteristic, biochemical profile and immunological status of Narmada Nidhi chicken. An experiment was conducted for 42 days, with 140 unsexed day old chicks under four dietary treatments with different energy (kcal/kg) and protein (%) concentrations -T_1 (3200 kcal/kg, 23% and 3200 kcal/kg, 20%), T_2 (3000 kcal/kg, 23%; 31000 kcal/kg, 22% and 3200 kcal/kg, 20%), T_3 (3000 kcal/kg, 22%; 3050 kcal/kg, 21.5% and 3100 kcal/kg, 19.5%) and T_4 (2950 kcal/kg, 21.5% and 3050 kcal/kg, 20%). Each treatment had five replicates with seven birds in each replicate. Feed intake, body weight gain, feed conversion ratio, carcass characteristics, serum parameters and haemagglutination inhibition titre were estimated. From the experiment it was elucidated that significantly higher (P<0.05) average daily feed intake (g) for T_3 (2nd and 4th week), T_4 (3rd week) and T_1 (6th week) were observed. Overall average daily feed intake was higher (P<0.05) for T_1 and T_4. T_1 had the highest (P<0.05) average daily gain (g) and final average body weight (g). Best (P<0.05) feed conversion ratio was observed for T_1. Relative weight (g) of most of the cut-up parts and organs was significantly higher (P<0.05) for T_1 treatment. Levels (mg/dL) of triglyceride and total cholesterol were significantly increased (P<0.05) for T_4 and T_2, respectively. There were no significant differences in haemagglutination inhibition titre among the treatments. Variable concentrations of dietary energy and protein influenced the performance of Narmada Nidhi chicken and T_1 diet was found best for the performances of Narmada Nidhi chicken reared as broiler.

Keywords: Broiler, Dietary concentration, Energy, Narmada Nidhi chicken, Protein

Highlights

- Energy and protein of 3200 kcal/kg, 23% and 3200 kcal/kg, 20% in diet produced higher average daily feed intake, daily gain and body weight in chicken
- Best feed conversion ratio, higher cut-up part and organ weight and lower level of triglyceride and total cholesterol for birds fed with energy and protein of 3200 kcal/kg, 23% and 3200 kcal/kg, and 20%, respectively
- No significant differences in haemagglutination inhibition titre among the dietary treatments

INTRODUCTION

The policy of 'Current Strategy for Unorganized Sector under the National Action Plan for Egg and Poultry-2022' encompasses that how the backyard poultry system can be improved to a new commercial and economic type (DAHDF, GOI, 2019). It is proposed to move incrementally from the current subsistence model of backyard poultry farming to a scaled-up entrepreneur model, upscaling incrementally up to 400-1,000 birds (DAHDF, GOI, 2019). In the case of Low-input technology (LIT) birds, these would help in the transition and upscaling later to 1,000-2,000 birds for larger commercial-scale poultry farming. It also focuses to develop the different breeds as well as low input technology birds for improved household system of poultry rearing (DAHDF, GOI, 2019).

Indian Council of Agriculture Research (ICAR) and the Government of India (GOI) have been working on such LIT birds that look like native chickens and suit the rural production systems. If given good feed, they can grow faster. These birds can be raised in the intensive production system of poultry (DAHDF, GOI, 2019). Narmada Nidhi is such a dual purpose coloured and improved breed of chicken developed by the

*Corresponding Author, E-mail: skoley2008@gmail.com

Table 1. Experimental design with dietary treatments

	T_1		T_2			T_3			T_4	
Age of the birds (day)	0-21	22-42	0-7	8-21	22-42	0-14	14-21	21-42	0-21	21-42
ME (kcal/kg)	3200	3200	3000	3100	3200	3000	3050	3100	2950	3050
CP (%)	23	20	23	22	20	22	21.5	19.5	21.5	20

College of Veterinary Science and Animal Husbandry, Nanaji Deshmukh Pashu Chikitsa Vigyan Vishwa Vidyalaya (or Nanaji Deshmukh Veterinary Science University), Jabalpur (ICAR-DPR, 2019).

Optimal levels and proportions of nutrients particularly major nutrients including energy and protein are necessary for optimum performances of the chicken. Optimal energy and protein requirements of chickens are specific to their breeds and production traits (NRC, 1994; BIS, 2007; ICAR, 2013). However, the energy and protein requirements of Narmada Nidhi chicken reared as broilers are not available. There are some recommendations of nutrient requirements for broiler chicken, such as NRC (1994), BIS (2007), and ICAR (2013). These recommendations need to be tested on Narmada Nidhi chicken to know how Narmada Nidhi chicken respond to different concentrations of dietary energy and protein suggested for broiler chicken. In view of the above discussion, an experiment was conducted to evaluate the effect of different levels of energy as well as protein in diets suggested for broilers on Narmada Nidhi chicken.

MATERIALS AND METHODS

The trial was carried out at the trial farm, College of Veterinary Science and Animal Husbandry, Rewa. Duration of work was 42 days (6 weeks). The shed was prepared following standard practice before the arrival of the birds. The day old 140 unsexed Narmada Nidhi chicks were procured from the lines developed in Nanaji Deshmukh Veterinary Science University (NDVSU), Jabalpur, and maintained at the poultry farm, College of Veterinary Science and Animal Husbandry, Rewa. Day old chicks produced in a single hatch were weighed post-hatching and allocated randomly in all the replicates of the groups. Chicks were housed in deep litter system and provided with artificial light from the evening to morning. Chicks were subjected to standard vaccination schedule in the duration of investigation: 0 day- Marek's disease vaccine, 7 day- New Castle disease vaccine (B_1 strain), 15 day- infectious bursal disease vaccine and 28 day- New Castle disease vaccine (Lasota strain).

Experimental design and diets: The trial was made with a form of complete randomization. Total four groups were made. Every group was made of five replicates. Every replicate had seven chicks each. Treatment groups were prepared with the metabolizable energy (ME) as well as crude protein (CP) concentrations in the feeds following the guidelines of NRC (1994) (T_1), BIS (2007) (T_2), ICAR (2013) for white broilers (T_3) and ICAR (2013) for coloured broilers (T_4) (Table 1).

The experimental diets were composed of maize and soybean meal as the major ingredients (Table 2).

Table 2. Composition of experimental diets

Attributes	T_1		T_2			T_3			T_4	
Age of the birds (day)	0-21	22-42	0-7	8-21	22-42	0-14	14-21	21-42	0-21	21-42
Ingredient composition (%)										
Maize	54	59.5	55.5	56.5	59	58	59.5	65.8	61	66.5
Soybean oil	3.5	4	1.5	2.5	4	1.5	1.5	1.5	0	0.5
Soybean meal	38	32.5	38.5	36.4	32.5	36	34.5	28.5	34.5	28.5
DL-methionine	0.25	0.18	0.25	0.25	0.25	0.25	0.25	0.18	0.25	0.25
L-lysine hydrochloride	0.3	0.2	0.3	0.29	0.3	0.3	0.3	0.2	0.3	0.3
L-threonine	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07
Dicalcium phosphate	1.2	1	1.2	1.3	1.2	1.2	1.2	1.2	1.2	1.2
Limestone powder	1.57	1.44	1.57	1.58	1.57	1.57	1.57	1.44	1.57	1.57
Common salt	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3
Sodium bicarbonate	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3

Cont. Table 2.

Table 2., Cont. ...

Attributes	T_1			T_2			T_3			T_4	
Mineral premix[a]	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	
Vitamin premix[b]	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	
Choline chloride	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	
Antioxidant	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	
Toxin binder	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	
Maduramycin	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	
BMD	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	
Nutrient composition											
ME (kcal/kg)	3186	3202	2997	3084	3205	3005	3044	3104	2957	3048	
Crude protein (%)	22.98	20.05	22.84	22.07	20.05	22.02	21.45	19.48	21.64	20.02	
Crude fibre (%)	3.92	3.74	3.84	3.9	3.74	3.91	3.86	3.7	3.91	3.72	
Lysine (%)	1.57	1.31	1.56	1.52	1.31	1.52	1.47	1.21	1.48	1.32	
Methionine (%)	0.61	0.52	0.62	0.61	0.52	0.61	0.6	0.56	0.6	0.58	
Calcium (%)	0.95	0.85	0.95	0.94	0.85	0.97	0.96	0.85	0.97	0.95	
Available phosphorus (%)	0.45	0.40	0.45	0.46	0.40	0.46	0.45	0.39	0.46	0.44	

[a]Supplied per kg diet (as organic minerals): Manganese- 25 mg, zinc- 20 mg, iron- 10 mg, copper- 5 mg, iodine- 1 mg, chromium- 0.05 mg, selenium- 0.05 mg

[b]Supplied per kg diet: Vitamin A- 12500 IU, vitamin D_3- 5000 IU, vitamin E- 150 mg, vitamin K_3 (menadione)- 4 mg, vitamin B_1 (thiamin)- 3 mg, vitamin B_2 (riboflavin)- 8 mg, vitamin B_3 (niacin)- 80 mg, vitamin B_5 (d-pantothenic acid)- 15 mg, vitamin B_6 (pyridoxine)- 6 mg, vitamin B_{12} (cyanocobalamin)- 0.03 mg, biotin- 0.40 mg, folic acid- 2.5 mg, choline- 600 mg, vitamin C (ascorbic acid)- 200 mg

Each experimental diet was offered *ad libitum* to the respective birds for six weeks. The chicks were given drinking water during the experimental period.

Growth performance: The amount of feed was weighed with the digital weighing balance and offered to the birds for *ad libitum* feeding daily in the morning for each replicate. The residual feeds were weighed after every week for each replicate. Weekly average daily feed intake/bird/replicate was calculated by dividing weekly total feed intake for each bird with total number of days (7) in a week. Weekly average daily gain/bird/replicate was calculated by dividing weekly total gain/bird/replicate with total number of days (7) in a week. Weekly feed conversion ratio/bird/replicate was determined by division of weekly average daily feed intake (g)/bird/replicate with weekly average daily gain (g)/bird/replicate.

Carcass characteristic: Upon termination of the trial, two birds from each of the replicate of a treatment group was randomly chosen and ethically slaughtered and eviscerated for studying various carcass parameters. Carcass weight was recorded with the digital weighing balance after de-feathering and eviscerating the slaughtered birds. Dressing percentage was calculated as the percent carcass weight of the live weight. Different cut-up parts of the birds such as, neck, wings, back, breast, thighs as well as drumsticks were separated. Weight of cut-up parts was measured. Cut-up parts were expressed in percentage of live weight. Weight of liver, heart and gizzard was recorded and expressed in percentage of live weight.

Biochemical profile: Blood was collected after completion of 6 weeks. Five milliliters of blood was collected aseptically from each bird by venipuncture of the brachial vein using vacutainer tube and needle. After collection of the blood into the test tubes, it was kept in a slanting position and left at room temperature, for 2-3 hours to separate serum from blood cells. The serum samples were then transferred to serum vials properly marked and stored at -20ºC for biochemical analysis and determination of haemagglutination inhibition (HI) titre. Serum glucose, triglyceride, total cholesterol, total protein, albumin and globulin were estimated in biochemistry auto analyzer (Star 21 Plus, Aspen Diagnostics Pvt. Ltd., Delhi, India) using Erba® kits and following the analytical guidelines in kits.

Immunological status: Haemagglutination inhibition (HI) titre of the birds against the Newcastle disease (ND) vaccine was determined to evaluate humoral immune response. The micro test method (Allan and Gough, 1974) was applied for the detection of HI titres in serum samples. The titre was determined as the

Table 3. Growth performance of Narmada Nidhi chicken reared as broiler in response to concentrations of dietary energy and protein

Attributes	T_1	T_2	T_3	T_4	SEM	*P*-value
Average daily feed intake (g)						
0-7 days	6.14	6.14	6.98	6.78	0.31	0.161
8-14 days	15.52^{ab}	14.00^{a}	15.94^{b}	14.58^{ab}	0.43	0.025
15-21 days	31.50^{ab}	33.52^{b}	27.20^{a}	35.28^{b}	1.20	0.001
22-28 days	39.02^{a}	36.58^{a}	49.62^{b}	38.14^{a}	1.06	0.000
29-35 days	49.98	51.26	52.70	54.10	1.20	0.130
36-42 days	134.06^{c}	118.52^{ab}	113.88^{a}	127.54^{bc}	3.57	0.003
0-42 days	46.04^{b}	43.32^{a}	44.42^{ab}	46.06^{b}	0.69	0.034
Average daily gain (g)						
0-7 days	3.21	2.97	3.74	3.27	0.18	0.061
8-14 days	6.98^{c}	5.28^{a}	6.24^{bc}	5.72^{ab}	0.22	0.000
15-21 days	13.20^{b}	11.98^{b}	9.42^{a}	11.86^{b}	0.45	0.000
22-28 days	15.02^{b}	12.62^{a}	17.22^{c}	12.62^{a}	0.46	0.000
29-35 days	16.20	15.80	17.32	17.80	0.61	0.116
36-42 days	42.66^{c}	34.90^{ab}	30.14^{a}	39.10^{bc}	1.38	0.000
0-42 days	16.21^{b}	13.93^{a}	14.01^{a}	15.05^{ab}	0.32	0.000
Average body weight (g)						
0 day	33.07	35.10	32.41	33.37	0.95	0.264
42^{nd} day	714.16^{b}	620.36^{a}	621.04^{a}	665.82^{ab}	14.08	0.001
Feed conversion ratio						
0-7 days	1.90^{ab}	2.08^{b}	1.86^{a}	2.08^{b}	0.04	0.007
8-14 days	2.22^{a}	2.66^{b}	2.56^{b}	2.56^{b}	0.06	0.001
15-21 days	2.40^{a}	2.80^{b}	2.88^{bc}	2.98^{c}	0.04	0.000
22-28 days	2.60^{a}	2.90^{b}	2.90^{b}	3.00^{b}	0.05	0.001
29-35 days	3.10	3.22	3.00	3.04	0.06	0.159
36-42 days	3.14^{a}	3.42^{a}	3.78^{b}	3.30^{a}	0.07	0.000
0-42 days	2.86^{a}	3.12^{b}	3.16^{b}	3.06^{b}	0.03	0.000

Means not sharing same superscript in a row are significantly different ($P<0.05$).

reciprocal of the highest dilution of serum showing the haemagglutination inhibition or button formation and expressed in log value (log of the reciprocal value).

Statistical analysis: The trial was of completely randomized design with replicate as the experimental unit. Growth, carcass and blood parameters were the response variables. The experimental data were subjected to the ANOVA (one way) following the method of SPSS Statistics (V22.0) (IBM, New York, USA). Statistical means were compared by using Tukey's test and regarded as significantly different at $P<0.05$.

RESULTS

Growth performance: The data on the average daily feed intake, average daily gain as well as feed conversion ratio of experimental chicks influenced by different types of feed for six weeks are presented in Table 3.

The average daily feed intake (ADFI) on 1st and 5th weeks in all four experimental diets showed no variation. On 2nd week significantly higher ($P<0.05$) ADFI was recorded in chicks fed T_3 diet compared to T_2 diet. On 3rd week significantly higher ($P<0.05$) ADFI was recorded in chicks fed T_2 and T_4 diet compared to T_3 diet. On 4th week the highest ADFI was recorded in chicks fed T_3 diet having significant difference ($P<0.05$) with all other diets. The highest ADFI on the 6th week was estimated for the group fed T_1 diet which was significantly different ($P<0.05$) with T_2 and T_3 while T_4 also had significant ($P<0.05$) difference from T_3. Overall (0-42 days) ADFI was significantly higher ($P<0.05$) in T_1 and T_4 compared to T_2.

The average daily gain (ADG) on 1st and 5th week in all four experimental diets showed no variation. On

2nd week significantly higher (P<0.05) ADG was estimated for the chicks fed T_1 diet compared T_4 and T_2 diets. On 3rd week compared to T_3 group significantly higher (P<0.05) ADG was determined for the chicks fed T_1, T_2 and T_4 diets. On 4th week significantly higher (P<0.05) ADG was observed for T_3 group than T_1, T_2 as well as T_4. On 6th week significantly higher (P<0.05) ADG was recorded in chicks fed T_1 compared to T_2 and T_3. Overall ADG of T_1 was significantly higher (P<0.01) than that of T_3 and T_2. Average body weight (ABW) of newborn (zero-day old) chicks had no significant variation among the groups. Final ABW of the chicks was significantly higher (P<0.05) in the group fed T_1 diet than the groups fed T_3 and T_2 diets.

The feed conversion ratio (FCR) in 1st week of age was significantly better (P<0.05) for T_3 than T_2 as well as T_4 but comparable with T_1. Non-significant variation was observed among T_1, T_2 and T_4. On 2nd week T_1 showed significantly better (P<0.05) FCR than T_3, T_2, and T_4. Significantly better (P<0.05) FCR was recorded on 3rd week in chicks fed T_1 diet in comparison with other groups. T_2 showed significantly better (P<0.05) FCR than T_4 but similar with T_3. On 4th week T_1 showed significantly better (P<0.05) FCR than T_2, T_3 as well as T_4. There was no difference in FCR on 5th week. On 6th week, significantly better (P<0.05) FCR was found for T_1, T_2 as well as T_4 than T_3. Overall FCR was the best (P<0.01) for T_1 group compared with other treatments.

Table 4. Carcass characteristic (percentage of live weight) of Narmada Nidhi chicken reared as broiler in response to concentrations of dietary energy and protein

Attributes	T_1	T_2	T_3	T_4	SEM	P-value
Dressing percentage	50.08	50.09	49.83	49.69	0.52	0.938
Neck	2.73^a	3.45^b	3.17^b	3.05^a	0.08	0.000
Wings	5.97	5.87	5.94	6.04	0.16	0.899
Back	12.89^b	10.51^a	11.76^{ab}	10.95^a	0.43	0.007
Breast	13.06	13.09	12.64	12.25	0.40	0.441
Thighs	6.83	7.57	7.77	7.90	0.28	0.073
Drumsticks	8.64^b	8.62^b	7.84^a	8.85^b	0.15	0.002
Liver	3.05^b	2.44^a	2.62^a	2.39^a	0.07	0.000
Heart	1.09^b	0.86^a	0.81^a	0.76^a	0.02	0.000
Gizzard	2.50	2.86	3.13	3.24	0.19	0.063

Means not sharing same superscript in a row are significantly different (P<0.01).

Carcass characteristic: Dressing percentage and wings, breast, thighs and gizzard (%) in relation to percentage of live weight showed non-significant variation among the experimental groups (Table 4). Relative weight of the neck was significantly higher (P<0.01) for T_2 as well as T_3 compared to T_4 and T_1. The relative weight of back was significantly higher (P<0.01) in T_1 compared to T_4 and T_2. Drumsticks' relative weight was significantly higher (P<0.01) in T_4, T_1 and T_2 compared to T_3. The relative weight of liver and heart was significantly higher (P<0.01) for T_1 treatment compared to other treatments.

Table 5. Biochemical profile of Narmada Nidhi chicken reared as broiler in response to concentrations of dietary energy and protein

Attributes	T_1	T_2	T_3	T_4	SEM	P-value
Glucose (mg/dL)	151.40	171.00	160.00	208.00	16.57	0.151
Triglyceride (mg/dL)	54.40^a	51.40^a	46.40^a	69.00^b	3.02	0.001
Total cholesterol (mg/dL)	110.40^a	155.98^b	133.10^{ab}	133.46^{ab}	6.07	0.001
Total protein (g/dL)	4.16	4.96	4.13	4.19	0.29	0.187
Albumin (g/dL)	1.58	1.66	1.59	1.58	0.06	0.802
Globulin (g/dL)	2.46	3.10	2.65	2.87	0.30	0.496
Albumin: globulin	0.66	0.57	0.60	0.57	0.06	0.706

Means not sharing same superscript in a row are significantly different (P<0.01).

Biochemical profile: Significant changes in serum concentrations of glucose (mg/dL), total protein (g/dL), albumin (g/dL), globulin (g/dL) and albumin to globulin ratio among the treatments were not observed (Table 5). Serum triglyceride (mg/dL) for T_4 group was significantly higher (P<0.01) than that for other treatments. Serum total cholesterol level (mg/dL) was significantly higher (P<0.01) for T_2 compared to T_1.

Table 6. Haemagglutination inhibition (HI) titre of Narmada Nidhi chicken reared as broiler in response to concentrations of dietary energy and protein

Dietary treatments	T_1	T_2	T_3	T_4	SEM	P-value
HI titre (log_2 of the value)	4.60	4.60	4.60	4.40	0.29	0.948

Immunological status: No significant variation in haemagglutination inhibition (HI) titre (log_2 of the value) was observed among the groups (Table 6).

DISCUSSION

The experimental results of this study follow the findings of Perween *et al*. (2016) who reported the sig-nificant effects ($P<0.05$) of different dietary levels of protein and energy on feed intake at the weekly interval and 8th week of age in Vanaraja chicken. While Magala *et al*. (2012) observed that the cockerels' feed intake did not change significantly due to different dietary regimen which included different protein (18 and 20% CP) and three energy levels (2800, 2900, and 3000 kcal/kg ME), similarly, Nguyen *et al*. (2010) stated that the feed intake did not change significantly due to four dietary protein levels (15, 17, 19, and 21% CP) and two energy levels (3000 and 3200 ME kcal/kg) in Betong chicken. The results also varied with that of Kingori *et al*. (2003) who observed that indigenous chicken fed with 160 or 180 g crude protein/kg diet did not have any significant variation in feed intake. Elangovan *et al*. (2004) also reported non-significant effects on feed intake of Naked Neck x CARI Red chicks by dietary treatments with crude protein of 18, 16, 14 and 12%. However, in our experiments significant changes in feed intake were observed for Narmada Nidhi chicken fed with different energy and protein levels at different age.

The results on weight gain of this investigation are in accordance with Perween *et al*. (2016) who reported that the body weight as well as body weight gain were significantly higher ($P<0.05$) in Vanaraja birds on diets having 19% and 21% CP with 3000 kcal ME/kg compared to that on diet having 17% CP and 2600 kcal ME/kg. Haunshi *et al*. (2013) also reported that altered dietary concentrations of ME significantly affected the body weight gain in chicken. Our results are also in line with that of Miah *et al*. (2014) who observed that body weight was significantly ($P<0.01$) improved in starter phase with high energy density diet (ME- 3000 kcal/kg, CP- 23%) and moderate energy density diet (ME- 2800 kcal/kg, CP- 23%) compared to low energy density diets (ME- 2400 kcal/kg, CP- 23% and ME- 2600 kcal/kg, CP- 23%) during 3-14 weeks of age in indigenous (Desi) chicken.

FCR was significantly influenced by various experimental diets with different levels of protein and energy in our experiments and the present findings are in agreement with that of Karomy *et al*. (2019) who concluded that with an adequate balance of dietary calorie and protein such as, 3120 kcal/kg and 24% CP at starter phase and 3204 kcal/kg and 20% CP at finisher phase improved the performance of Ross broiler chicken at Basrah region. Our feeding standard-based approach consisted of various levels of ME and CP at different phases. Results indicate that balance of calorie and protein such as, 3200 kcal/kg and 23% CP at the starter phase (0-21 day) and 3200 kcal/kg and 20% CP diet at finisher phase (22-42 day) might be adequate to give best FCR for T_1 treatment. Our study is also in consonance with Perween *et al*. (2016) who showed feed efficiency improved with increased dietary energy and protein. However, it was not in agreement with other report (Nguyen *et al*., 2010).

The present study showed improved back, drumstick, liver and heart parameters for T_1 treatment. There was no such available earlier report that could be correlated with these findings. On the other hand, Jahan *et al*. (2024) reported that in Sonali chicken varying energy and protein levels did not influence the above parameters, though, dressing percentage, breast meat and thigh meat were also not affected, as found in this investigation. Improved carcass parameters observed in our experiment might be attributed to improved body weight gain for the group.

Regarding biochemical profile, the results align with the study of Behera *et al*. (2016) who reported that protein content was not significantly different among various treatments in desi ducks of 8 weeks age. The concentration of cholesterol of the white maize fed male birds at 18 week was above the normal range (87-192 mg/mL) (Meluzzi *et al*., 1992) of cholesterol in birds. Triglyceride is formed in the liver from fatty acids, glucose and protein - once these nutrients become higher than the body's current requirements – and stored in adipose tissue (Esubonteng, 2011). The triglyceride level at 21 weeks of age of female birds fed with the white maize was greater than the normal range (45.7-172 mg/mL) (Meluzzi *et al*., 1992) and had positive correlation with the feed quality (Etuk *et al*., 2014). Maize (yellow) level in our experimental diets was in ascending order from T_1 to T_4 treatments which might be a cause for increasing cholesterol and triglyceride concentrations in serum of the birds.

The present results suggest that varying experimental diets had no effect on the immune response of Narmada Nidhi chicken to Newcastle disease virus. The present study matches with Reddy (2011) and Rathod *et al*. (2018) who observed no significant changes among treatments by different levels of energy and protein in feeds in Kadaknath chicken but varies with that of Perween *et al*. (2016) who found gradual increase in antibody titre against Newcastle disease virus when the concentrations of protein and energy increased in Vanaraja chicken.

In the present investigation Narmada Nidhi chicken responded to different dietary concentrations of energy and protein suggested for broilers. Narmada Nidhi chicken reared as broiler exhibited the best performance when fed T_1 diet (NRC, 1994).

Conflict of interest: There is no conflict of interest among the authors.

Author's contribution: KKP: Investigation, data generation and preparation of the original draft; SK: Conception and design, the acquisition of data and critically revising the manuscript; NK: Contribution to data analysis and critically revising the manuscript; BKO: Critically revising the manuscript; AS: Critically revising the manuscript.

Data availability statement: Data of research will be made available with the corresponding author on demand.

Ethical statement: The procedures in this study were approved by the Institutional Animal Ethical Committee, College of Veterinary Science and Animal Husbandry, Rewa, Madhya Pradesh.

REFERENCES

Allan WH and Gough RE, 1974. A standard haemagglutination inhibition test for Newcastle disease. (1). A comparison of macro and micro methods. Vet Record, 95(6): 120-123, doi: 10.1136/vr.95.6.120

Behera NK, Babu LK, Sahoo SK, Giri SC, Pati PK *et al.*, 2016. Effect of feeding different levels of protein on mortality, carcass characteristics, biochemical parameter, time motion study and economics of desi ducks under intensive system of rearing. Asian J Anim Sci, 10(1): 106-112, doi: 10.3923/ajas.2016.106.112

BIS, 2007. India Standard Poultry Feeds - Specification, 5th Review of Bureau of Indian Standards, Manak Bhavan, New Delhi, India

DAHDF, GOI, 2019. National Action Plan for Egg & Poultry-2022 for Doubling Farmers' Income by 2022, Department of Animal Husbandry, Dairying & Fisheries, Ministry of Agriculture & Farmers Welfare, Government of India. Available in: http://www.dahd.nic.in/sites/default / filess / Seeking % 20 Comments % 20 on % 20 National % 20 Action % 20 Plan - %20Poultry - % 202022 % 20 by % 2012-2017.pdf. [20 Dec, 2019]

Elangovan AY, Deo C, Mandal AB, Singh DP and Shrivastava HP, 2004. Protein requirements of growing (12-20 weeks) Naked neck x CARl-Red (Hitcari) and Frizzle x CARI-Red (Upcari) pullets. Ind J Poult Sci, 39(1): 61-65

Esubonteng PKA, 2011. An assessment of the effect of *Moringa olifera* leaf powder as a nutritional supplement in the diet. Doctoral dissertation, Kwame Nkrumah University of Science and Technology, Kumasi, Ghana

Etuk EB, Ugwu CC, Inyama E and Ugorji C, 2014. Blood chemistry, haematology, carcass characteristics and organ weight of finisher broilers fed breadfruit (*Treculia africana*) hull (BFH) in their diet. Comp Clin Patho, 23(5): 1153-1158, doi: 10.1007/s00580-013-1756-y

Haunshi S, Sunitha R, Shanmugam M, Padhi MK and Niranjan M, 2013. Carcass characteristics and chemical composition of breast and thigh muscles of native chicken breeds. Indian J Poult Sci, 48(2): 219-222

ICAR, 2013. Nutrient Requirements of Animal- Poultry, (ICAR-NIANP), Indian Council of Agricultural Research, New Delhi, India

ICAR-DPR, 2019. Narmada Nidhi: dual purpose coloured bird suitable for rural and tribal areas poultry farming in Madhya Pradesh, online: http://www.pdonpoultry.org/pdpnew/ index. php? option = com_content&view = article&id =101&Itemid =47 & limitstart = 3

Jahan MS, Hossain A, Ahammed M and Hossain ME, 2024. Effect of different energy and protein levels on growth performances and carcass yields of Sonali chicken. Bangladesh J Anim Sci, 53(3): 101-110, doi: 10.3329/bjas.v53i3.76545

Karomy AS, Habib HN and Kasim SA, 2019. Influence of different levels of crude protein and metabolizable energy on production performance of Ross broiler. J Biol Agric Healthc, 9(18): 20-24, doi: 10.7176/jbah

Kingori AM, Tuitoek JK, Muiruri HK and Wachira AM, 2003. Protein requirements of growing indigenous chickens during the 14-21 weeks growing period. S Afr J Anim Sci, 33(2): 78-82, doi: 10.4314/sajas.v33i2.3759

Magala H, Kugonza DR, Kwizera H and Kyarisiim CC, 2012. Influence of varying dietary energy and protein on growth and carcass characteristics of Ugandan local chickens. J Anim Prod Adv, 2(7): 316-324

Meluzzi A, Primiceri G, Giordani R and Fabris G, 1992. Determination of blood constituents reference values in broilers. Poult Sci, 71(2): 337-345, doi: 10.3382/ps.0710337

Miah MY, Chowdhury SD, Bhuiyan AKFH and Ali MS, 2014. Effect of different levels of dietary energy on growth performance of indigenous desi chicks reared in confinement up to target weight of 950 g. Livest Res Rural Dev, 26(7): 124

Nguyen TV, Bunchasak C and Chantsavang S, 2010. Effects of dietary protein and energy on growth performance and carcass characteristics of Betong chicken (*Gallus domesticus*) during growing period. Int J Poult Sci, 9(5): 468-472, doi: 10.3923/ijps.2010.468.472

NRC, 1994. Nutrient Requirements of Poultry, National Research Council, National Academy Press, Washington, DC, USA, doi: 10.17226/2114

Perween S, Kumar K, Chandramoni, Kumar S and Singh PK *et al.*, 2016. Effect of feeding different dietary levels of energy and protein on growth performance and immune status of Vanaraja chicken in the tropic. Vet World, 9(8): 893-899, doi: 10.14202/vetworld. 2016. 893-899

Rathod P, Kadam MM, Khose KK, Patil AR and Kamble PC, 2018. Nutrient requirement of Kadaknath chicken during the finisher phase to optimize the growth and economic performance. J Entomol Zool Stud, 6(6): 31-35

Reddy JK, 2011. Studies on the optimum requirement of energy and protein for commercial Giriraja chicks. Doctoral dissertation, Karnataka Veterinary, Animal and Fisheries Sciences University, Bidar

Received - 21.02.2025, Accepted - 14.04.2025, Published - 21.05.2025 (Online), 01.06.2025 (Print)
Section Editor: Dr. A. K. Patra, Associate Editor