*Mysore J. Agric. Sci.,* 51 (4) : 850-855, 2017

# Effect of Varied Levels of Dietary Crude Protein and Metabolizable Energy on Carcass Characteristics and Immune Status in Giriraja Chicken

H. N. Rajeswara, Jaya Naik, T. Munegowda, R. Gideon Glori Doss,
Y. B. Rajeshwari and G. Ananda Manegar
Department of Poultry Science, KVAFSU, Veterinary College, Hebbal, Bengaluru - 560 024

## Abstract

A study was conducted to observe the effect of varied levels of dietary crude protein and metabolizable energy on carcass characteristics and immune status (antibody titre against Newcastle Disease and Infectious Bursal Disease Virus) in Giriraja chicks, with three levels of energy 2700, 2800 and 2900 kcal metabolizable energy (ME/kg), each with three levels of protein (CP), *viz.,* 19, 20 and 21 per cent, respectively. Results showed that varied levels of dietary crude protein and energy had no significant effect on both the carcass characteristics and immune status of Giriraja birds. Hence, other growth parameters such as body weight gain and FCR might be considered to determine the diets for optimal profit in Giriraja birds.

*Keywords* : Dietary crude protein, metabolizable energy, immune status

Backyard poultry farming by and large was a low input venture. Besides income generation, backyard poultry farming helps in alleviation of malnutrition of the rural people through the production of valuable animal protein and empowers rural women (Besbes *et al.,* 2012). The University of Agricultural Sciences, Bengaluru released the first improved coloured bird suitable for backyard rearing 'Giriraja' in 1989. Giriraja is a pioneer bird and blazed to strengthen the economy of the rural poor by producing good number of eggs (75-180/yr) as well as good quantity/quality meat (3-6 kg body weight) under rural conditions (Reddy and Rajendiran, 2002). Though it is widely accepted by poultry farmers all over the state for rural poultry farming, scientific studies on different aspects of production in these birds are scanty especially with respect to nutrients, Genetic selection and cross breeding programmes were effectively used to produce cross-bred chickens for small holding farmers in India which would be able to withstand village production conditions with better production capacity, meat yield and immune competence. Poultry nutritionists in India are adopting BIS or NRC recommendations in formulating rations for different age group of chicken. These recommendations may not be optimum for scavenging birds such as Giriraja, Swarnadhara, Vanaraja etc. Since, these birds differ in their growth rate compared to commercial broilers / layers. Hence, an experiment is designed to study the effect of varied levels of dietary crude protein and metabolizable energy on carcass characteristics and immune status (ND and IBD) of Giriraja birds.

## Material and Methods

The experiment was conducted to investigate the effect of varied levels of dietary crude protein and metabolizable energy on carcass characteristics and immune status (ND and IBD) of Giriraja birds at the Department of Poultry Science, Veterinary College, KVAFSU, Hebbal, Bengaluru. Feed ingredients were procured and proximate analysis was determined before compounding experimental diets, and feed formulation was done as per BIS (2007).

A total of 720 one day-old chicks of Giriraja breed were procured from the Poultry Department which were individually weighed and distributed into nine groups having 80 birds in each. Each group was further subdivided into four replicates having 20 birds in each. Nine different experimental diets ($T_1$ to $T_9$) were formulated with three levels of energy 2700, 2800, and 2900 kcal metabolizable energy (kcal/kg), each with three levels of protein, *viz.,* 19, 20 and 21 per cent, respectively (Table I). Group $T_5$ served as control fed with 20 per cent protein and 2800 kcal energy as per BIS (2007) requirements. Nutrient composition of these diets is presented in Table II.

TABLE I

*Ingredients composition of different experimental diets*

| Ingredients (%) | $T_1$ | $T_2$ | $T_3$ | $T_4$ | $T_5$ | $T_6$ | $T_7$ | $T_8$ | $T_9$ |
|---|---|---|---|---|---|---|---|---|---|
| Yellow maize | 46.50 | 40.00 | 45.50 | 55.40 | 54.00 | 54.00 | 64.00 | 63.50 | 60.70 |
| Soya bean meal | 28.00 | 30.50 | 33.50 | 28.20 | 31.40 | 34.50 | 29.50 | 32.50 | 35.30 |
| Rice bran | 23.00 | 25.00 | 17.00 | 12.40 | 10.60 | 7.50 | 2.50 | 0.00 | 0.00 |
| Mineral-Mixture | 2.50 | 2.50 | 2.00 | 2.00 | 2.00 | 2.00 | 1.00 | 1.00 | 1.00 |
| DCP | - | - | - | 1.00 | 1.00 | 1.00 | 2.00 | 2.00 | 2.00 |
| VitaminAB2D3K | 0.20 | 0.20 | 0.20 | 0.20 | 0.20 | 0.20 | 0.20 | 0.20 | 0.20 |
| Vitamin-B-com | 0.20 | 0.20 | 0.20 | 0.20 | 0.20 | 0.20 | 0.20 | 0.20 | 0.20 |
| Salt | 0.30 | 0.30 | 0.30 | 0.30 | 0.30 | 0.30 | 0.30 | 0.30 | 0.30 |
| Methionine | 0.10 | 0.10 | 0.10 | 0.10 | 0.10 | 0.10 | 0.10 | 0.10 | 0.10 |
| Liver tonic | 0.10 | 0.10 | 0.10 | 0.10 | 0.10 | 0.10 | 0.10 | 0.10 | 0.10 |
| Toxin binder | 0.10 | 0.10 | 0.10 | 0.10 | 0.10 | 0.10 | 0.10 | 0.10 | 0.10 |

Mineral mixture composition : Calcium (30%), Phosphorous (9%), Manganese (0.40%), Zinc (0.40%), Iron (2000ppm), Copper (500ppm), Iodine (100ppm), Selenium (23ppm) and Fluorine (0.05%). DCP : Dicalcium Phosphate

TABLE II

*Nutrient composition of different experimental diets*

| Nutrients | $T_1$ | $T_2$ | $T_3$ | $T_4$ | $T_5$ | $T_6$ | $T_7$ | $T_8$ | $T_9$ |
|---|---|---|---|---|---|---|---|---|---|
| CP (%) | 19.01 | 20.27 | 21.13 | 19.00 | 20.05 | 21.02 | 19.07 | 20.02 | 20.99 |
| ME(kcal/kg) | 2716 | 2719 | 2718 | 2806 | 2800 | 2810 | 2905 | 2908 | 2886 |
| Ca(%) | 1.04 | 1.05 | 1.05 | 1.11 | 1.11 | 1.11 | 1.02 | 1.02 | 1.02 |
| P(%) | 0.83 | 0.87 | 0.77 | 0.80 | 0.78 | 0.75 | 0.74 | 0.71 | 0.72 |
| Lysine (%) | 1.13 | 1.25 | 1.30 | 1.11 | 1.19 | 1.27 | 1.09 | 1.17 | 1.25 |
| Methionine (%) | 0.43 | 0.45 | 0.46 | 0.43 | 0.44 | 0.45 | 0.42 | 0.43 | 0.45 |
| Fat (%) | 2.52 | 2.33 | 2.44 | 2.71 | 2.65 | 2.63 | 2.90 | 2.87 | 2.78 |
| Crude Fibre (%) | 5.77 | 6.13 | 5.43 | 4.54 | 4.45 | 4.20 | 3.40 | 3.22 | 3.33 |
| Linoleic acid (%) | 1.77 | 1.74 | 1.59 | 1.56 | 1.48 | 1.38 | 1.36 | 1.28 | 1.23 |

CP: Crude Protein, ME: Metabolizable Energy, Ca: Calcium, P: Total Phosphorous

**Carcass Parameters**

At the end of the trial, eight birds from each treatment (two birds from each replicate) were sacrificed to study the carcass characteristics such as dressing percentage, breast meat yield (%), organs weight (% of live weight) and abdominal fat percentage.

The birds were fasted for 12 hours with access to ad-libitum drinking water. Live weight of the birds was recorded, birds were slaughtered by humane method and bled for 90 seconds by severing jugular vein and carotid artery, scalded at 60 °C for two minutes, defeathered mechanically and the eviscerated carcass weights and after evisceration weights of breast meat, giblets *viz.,* heart without pericardium, liver without gall bladder and gizzard without inner mucous membrane of the bird and abdominal fat were recorded.

**Immune Status**

The antibody titre against New Castle Disease Virus (NDV) and Infectious Bursal Disease Virus (IBDV) was carried out by using HA followed by HI (Allan and Gough, 1974) and using indirect ELISA Kit, respectively.

**Newcastle Disease**

The antibody titre against Newcastle Disease was carried out by using HA followed by HI test. The micro-test method described by Allan and Gouch (1974) was used for detection of HI titres from serum samples collected on 56th day to assess the antibody titres and their relation with the different diets. The HI test was done manually by â- procedure in 'U' bottom micro-plates using diluters, droppers and 4 HA units of ND viral antigen. Serial two fold dilution of serum in normal saline was taken and 25 µl/well 4 HA unit of antigen was added. Plates were incubated for 45 minutes at room temperature. Fifty µl of 0.8 per cent chicken erythrocytes were added to each well and the plates were incubated for one hour at room temperature before reading the results. The titres ($\log_{10}$ values) were expressed as the reciprocal of highest dilution of serum showing the haemag glutination inhibition or button formation.

**Infectious Bursal Diesease**

The serum antibodies against IBDV were titered by using Poultry Diagnostic and Research Centre (PDRC) indirect ELISA Kit.

Each of the wells of antigen pre-coated plate provided in the kit was used for the test. 100 µL each of the positive control serum and the negative control serum were added in duplicates to the respective control wells. Then, 100 µL of each test serum sample diluted in the sample buffer were added in duplicates to corresponding wells of the plate (apart from the control wells) and incubated at 37 $^0$C for one hr. The plate was washed using the wash buffer provided in the kit. One hundred µL of mouse anti-chicken IgG conjugated with Horse Raddish Peroxidase (HRP) in wash buffer was added to each of the wells and incubated at 37 $^0$C for one hr. The plate was washed as afore mentioned. One hundred µL of freshly prepared chromogen-substrate solution containing OPD and 3 per cent $H_2O_2$ as substrate (4 L / ml of chromogen) were added to each of the wells and the plate was kept at room temperature for 15 min. Finally, 50 µL of 2.5 N HCl was added to each of the wells to stop enzyme-substrate reaction. Absorbance values were read using the ELISA reader (Bio Rad) with an interference filter at 492 nm. Readings were taken after the wells with only substrate-chromogen and HCl were blanked to 'zero' at 492 nm.

Data pertaining to carcass characteristics and immune status (Antibody titre against ND and IBD virus) in Giriraja chicks were analyzed statistically by ANOVA using SPSS 20 statistical software as per standard procedures described by Snedecor and Cochran (1994). Differences between the means were tested using Tukey's Range Test at $P<0.05$.

## Results and Discussion

**Carcass characteristics**

*Dressing percentage, breast meat yield andvisceral organs weight (giblets)* : The results (Table III) of the present study showed that there was no significant effect of varied levels of protein and energy on dressing percentage and breast meat yield of Giriraja birds which might be due to adequate levels of essential amino acids, particularly Lysine and

TABLE III

*Effect of varied levels of dietary crude protein and metabolizable energy on dressing percentage, breast meat yield , organs weight and abdominal fat percentage at 8th week in giriraja birds*

| Nutrients | $T_1$ | $T_2$ | $T_3$ | $T_4$ | $T_5$ | $T_6$ | $T_7$ | $T_8$ | $T_9$ |
|---|---|---|---|---|---|---|---|---|---|
| CP% | 19 | 20 | 21 | 19 | 20 | 21 | 19 | 20 | 21 |
| ME (Kcal/kg) | 2700 | 2700 | 2700 | 2800 | 2800 | 2800 | 2900 | 2900 | 2900 |
| Dressing percentage | 69.53 ± 1.92 | 70.12 ± 0.97 | 69.06 ± 1.37 | 69.06 ± 1.37 | 70.99 ± 0.95 | 69.79 ± 1.15 | 70.93 ± 0.90 | 71.92 ± 1.54 | 71.94 ± 1.54 |
| Breast meat yield % | 13.53 ± 0.68 | 13.37 ± 0.74 | 13.81 ± 0.50 | 12.74 ± 0.38 | 15.19 ± 0.46 | 12.69 ± 0.42 | 12.90 ± 0.47 | 13.90 ± 0.61 | 12.81 ± 2.46 |
| *Organs weight (% to live weight)* | | | | | | | | | |
| Liver | 2.84 ± 0.26 | 2.90 ± 0.22 | 2.63 ± 0.19 | 2.71 ± 0.15 | 2.57 ± 0.43 | 2.70 ± 0.21 | 2.55 ± 0.08 | 2.65 ± 0.22 | 2.59 ± 0.21 |
| Gizzard | 3.15 ± 0.14 | 3.21 ± 0.25 | 2.95 ± 0.29 | 2.96 ± 0.20 | 2.49 ± 0.38 | 2.72 ± 0.18 | 2.51 ± 0.14 | 2.96 ± 0.20 | 2.73 ± 0.15 |
| Heart | 0.78 ± 0.07 | 0.85 ± 0.12 | 0.78 ± 0.12 | 0.83 ± 0.09 | 0.66 ± 0.13 | 0.70 ± 0.08 | 0.75 ± 0.56 | 0.91 ± 0.13 | 0.69 ± 0.08 |
| Abdominal Fat percentage | 0.93 ± 0.11 | 0.98 ± 0.15 | 1.07 ± 0.18 | 1.09 ± 0.17 | 0.89 ± 0.17 | 0.98 ± 0.08 | 1.00 ± 0.10 | 1.33 ± 0.15 | 1.17 ± 0.90 |

Methionine used for protein accretion in the body (Si *et al.,* 2001). The findings of the present study are in agreement with the findings of Dehury *et al.* (2007) in Vanaraja birds and kamran *et al.* (2008) in Hubbard broiler chicken. The results of the present study revealed that there was no significant difference in weight of giblets (liver, heart and gizzard). The results are in agreement with the findings of Nguyen and Bunchasak (2005), kamran *et al.*(2007) and Dairo *et al*. (2010) who reported no significant differences for heart, liver and gizzard weights of broilers fed with different energy and protein levels.

*Abdominal fat percentage*: The study revealed no significant (Pd≤0.05) influence of dietary crude protein and energy levels on abdominal fat percentage of Giriraja birds (Table III). Present observations are in agreement with Hidalgo *et al.* (2004) who reported no differences in carcass yield, breast meat yield and abdominal fat pad in broilers fed low CP diets with constant ME:CP ratio, but incontrary with the findings of Leeson *et al.* (1996) and Zamana *et al.* (2008) who reported that the abdominal fat pad decreased significantly with a decrease in diet energy level. Raju *et al.* (2004) also found similar effect in naked neck birds when fed with different energy levels. The results of the present study confirmed the positive relationship between dietary energy and abdominal fat deposition which is in agreement with Yalcin *et al.* (1998).

**Immunological parameters**

*Antibody titre against New Castle Disease and Infectious Bursal Disease virus*: The results (Table IV) revealed that there was no significant effect of varied levels of dietary crude protein and metabolizable energy on antibody titre against New Castle Disease Virus in Giriraja birds. These findings are in agreement with Haunshi *et al.* (2012) who reported that antibody titres against Newcastle disease virus were not significant with respect to different levels of metabolizable energy in Aseel chicken.The results are also in agreement with Praharaj *et al.*(1999) in commercial broilers fed diets differing in energy (2500, 2650 and 2800 Kcal ME/kg) and Vahid *et al*. (2012) who reported that antibody titres against Newcastle disease virus were not significant with respect to different levels of metabolizable energy.

TABLE IV

*Effect of varied levels of dietary crude protein and metabolizable energy immune status (Antibody titre against ND and IBD virus) at 8th week in giriraja birds*

| Treatment | ND | IBD |
|---|---|---|
| $T_1$ | 2.33 ± 0.17 | 1983.63 ± 101.48 |
| $T_2$ | 2.18 ± 0.17 | 1933.75 ± 149.01 |
| $T_3$ | 1.95 ± 0.80 | 2098.13 ± 122.49 |
| $T_4$ | 2.03 ± 0.18 | 1952.00 ± 132.33 |
| $T_5$ | 2.10 ± 0.15 | 2148.63 ± 152.86 |
| $T_6$ | 2.10 ± 0.80 | 1842.88 ± 23.09 |
| $T_7$ | 1.92 ± 0.55 | 1854.25 ± 23.90 |
| $T_8$ | 2.14 ± 0.12 | 2060.13 ± 144.69 |
| $T_9$ | 1.99 ± 0.79 | 1899.13 ± 91.99 |

The results of the present study showed that there was no significant effect of varied levels of dietary crude protein and metabolizable energy on antibody titre against Infectious Bursal Disease Virus in Giriraja birds. Present observations are in agreement with Zouelfakar and Moubarak (1998) who reported that sustainability of maternal immunity against Infectious Bursal disease virus was not affected by different energy levels in the diet. The antibody response to variation in diets depends on several aspects including genetic background, dosage, and type of antigen, route of administration and effectivefunctioning of immune system of bird.

It is concluded that varied levels of dietary crude protein and energy had no significant effect on both the carcass characteristics and immune status (ND and IBD). Hence, other growth parameters such as Body Weight Gain and FCR might be considered to determine the diets for optimal profit in Giriraja birds.

REFERENCES

ALLAN, W. H. AND GOUGH, R. E., 1974, A standard haemag glutinition inhibition test for newcastle disease. A comparision of macro and micro methods. *Vet. Rec*., **95** (6) : 120 - 123.

BESBES, B., THIEME, O., ROTA, A., GUEYE, E. F. AND ALDERS , R. G., 2012, Technology and programmes for sustainable improvement of village poultry

production. In: Sandilands V, Hocking P. M, editors. Alternative Systems for Poultry: Health, Welfare and Productivity. *Wallingford: CAB International*, pp. 110 - 127.

BIS, 2007, Indian Standard, Poultry Feeds Specifications. 5th Review. New Delhi, India: Bureau of Indian Standards.

DAIRO, F. A. S., ADESEHINWA, A. O. K., OLUWASOLA, T. A. AND ANDOLUYEMI, J. A., 2010, High and low dietary energy and protein levels for broiler chickens. *African J. Agricult. Res.*, **5** (15) : 2030 - 2038.

DEHURY, P. K., PANDA, N., DAS, N., MISHRA, S. C., MISHRA, P. K. AND LAS, S. K., 2007, Evaluation of energy and protein requirement of broiler finisher in summer under hot humid condition. *Indian J. Poult. Sci.,* **43** (1) : 55 - 58

HAUNSHI, S., PANDA, A. K., RAJKUMAR, U., PADHI, M. K, NIRANJAN, M. AND CHATTERJEE, R. N., 2012, Effect of feeding different levels of energy and protein on performance of Aseel breed of chicken during juvenile phase. *Trop. Anim. Health Prod.*, **44** (7) : 1653 - 1658.

HIDALGO, M. A., DOZIER,W. A., DAVIS, A. J. AND GORDON, R. W., 2004, Live performance and meat yield responses of broilers to progressive concentrations of dietary energy maintained at a constant metabolizable energy-to-crude protein ratio. J. *Appl. Poult. Res.*, **13** : 319 - 327.

KAMRAN, Z., SARWAR, M., NISA, M., NADEEM, M. A., AHMAD, S., BABAR, M. E. AND AHMAD, S., 2008, Effect of low-protein diets having constant energy-to-protein ratio on performance and carcass characteristics of broiler chickens from one to thirty-five days of age. *Poult. Sci.,* **87** (3) ; 468 - 474.

LEESON, S., CASTON, L. AND SUMMERS, J. D., 1996, Broiler response to energy. *Poult. Sci.*, **75** (4) : 529 - 535.

NGUYEN, T. V. AND BUNCHASAK, C., 2005, Effects of dietary protein and energy on growth performance and carcass characteristics of Betong chicken at early growth stage. *Songklanakarin J. Sci. Technol.*, **27** (6) : 1171 - 1178.

PRAHARAJ, N. K., REDDY, M. R., RAMA RAO, S. V., SHYAM SUNDER, G. AND REDDY, B. L. N., 1999, Energy by sire family interactions for growth, feed efficiency, immune competence in commercial broilers. *Archiv fur geflugelkund*, **63** : 82 - 86

RAJU, M. V., SUNDER, G. S., CHAWAK, M. M., RAO, S. V. R. AND SADAGOPAN, V. V., 2004, Response of naked neck (nana) and normal (nana) broiler chickens to dietary energy level in a subtropical climate. *Br. Poult. Sci.*, **45** (2) : 186 - 193.

REDDY, B. S. V. AND RAJENDIRAN, A. S., 2002, Nutritional support for Giriraja under adverse environment. Paper presented at State level Seminar on Giriraja bird – A boon for rural economy organized by the State Department of Animal Husbandry and Veterinary Services, Govt. of Karnataka held on 8th March, 2002 at Bangalore**.**

SI, J., FRITTS, C. A., BURNHAM, D. J. AND WALDROUP, P. W. 2001, Relationship of dietary lysine level to the concentration of all essential amino acids in broiler diets. *Poult. Sci.,* **80 (**10) : 1472 - 1479.

SNEDECOR, G. W. AND COCHRAN, A.W. 1994. Statistical Methods (IX$^{th}$Edn.), Oxford and IBH Publ. Co., Calcutta.

YALCIN, S., OZKAN, S., ACIKGOZANDAND OZKAN, K., 1998, Influence of dietary energy on bird performance, carcass parts yields and nutrient composition of breast meat of heterozygous naked neck broilers reared at natural optimum and summer temperatures. *Br. Poult. Sci.,* **39** (5) : 633 - 638.

ZAMANA, Q. U., MUSHTAQ, T., NAWAZA, H., MIRZA, M. A., MAHMOODB, S., AHMAD. T., BABAR, M. E. AND MUSHTAQ, M. M. H., 2008, Effect of varying dietary energy and protein on broiler performance in hot climate. *Anim. Feed Sci. Technol.*, **146 (**3) : 302 - 312.

ZOUELFAKAR, S. A. AND MOUBARAK, S. T., 1998, Effect of high energy diet (using 2% Ultrakeal R) on broiler performance, litter quality and immune response. *Veterinary-Medical-Journal-Giza.*, **46** (2) : 199 - 208.

(*Received :* April, 2017 *Accepted :* Oct., 2017**)**