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Effect of Organic Mineral Mixtures, Probiotics, Enzymes, Emulsifier and Liver Supplements on Nutrient Utilization and Haematological Profile of broilers

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ABSTRACT

A feeding trial was conducted to evaluate the effects of organic mineral mixture, probiotics, enzymes, emulsifier and liver supplements on nutrient utilization and haematological profile of broilers. For this purpose, a total of 396 day-old commercial broiler chicks (Cobb) were used and randomly allocated into 11 groups with three replicates of 12 chicks each. Broilers of T_4, T_5, T_9 and T_{10} groups showed significantly (P<0.05) increase in dry matter utilization as compared to T_0 group. All the supplemented group showed significant (P<0.05) increase in crude protein utilization than T_0 group except T_6 and T_7. All the supplemented group showed significant (P<0.05) increase in ether extract utilization than T_0 group except T_6, T_7 and T_8. All the supplemented group showed significant (P<0.05) increase in calcium utilization than T_0 group except T_6, T_7 and T_8. All the supplemented group showed significant (P<0.05) increase in phosphorus utilization than T_0 group except T_6 and T_7. All the supplemented groups showed significant (P<0.05) increase in TEC, TLC, PCV and Hb compared to T_0 group at 42^{nd} day. All the supplemented groups showed significant (P<0.05) increase in TLC compared to T_0 group except T_6 at 42^{nd} day. All the supplemented groups showed significant (P<0.05) increase in PCV compared to T_0 group except T_6 at 42^{nd} day. All the supplemented groups showed significant (P<0.05) increase in Hb compared to T_0 group at 42^{nd} day. All the supplemented groups showed significant (P<0.05) decrease in MCV and MCH as compared to T_0 group at 42^{nd} day. All the supplemented groups showed significant (P<0.05) decrease in MCHC compared to T_0 group except T_6 and T_7 at 42^{nd} day.

Key words: *Broilers, Dry matter, Crude Protein, Probiotics, TEC*

INTRODUCTION

Poultry is one of the fastest growing segments of the agricultural sector in India. Globally, India ranked 3^{rd} after China and USA with a production of 88.1 billion eggs and 6^{th} after USA, China, Brazil, Mexico and Indonesia with a production of 3.46 million tons of chicken meat.

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The poultry sector in totality accounts for 0.60 per cent of the national GDP. The annual egg and broiler production of India is 70 billion eggs and 3.8 million tons respectively, with per capita consumption of 68 eggs and 2.5 kg chicken meat against the ICMR recommendations of 180 eggs and 11 kg poultry meat[1]. Poultry meat has significant role in Indian diet valued at US $ 6.6 billion. Favoured by socio- economic conditions like rising purchasing power and changing food habits of the people this sector is driven by ever increasing domestic demand. Poultry meat is an excellent source of high quality protein, vitamins, and minerals and is not subjected to cultural and religious restrictions. Rising input cost in poultry production has necessitated the need to look for feed supplements which can enhance the nutrient utilization efficiency of feeds thereby improving performance of poultry and resultant increase in profitability. In this context use of organic minerals, probiotics, enzymes, emulsifiers and liver supplements seems promising. Use of organic minerals in poultry diets has been shown to have multiple beneficial effects including higher absorption and increased antibody levels as they may provide alternative pathways for absorption, by decreasing mineral excretion. Similarly, use of probiotics and feed enzymes have been reported to regulate gut integrity, reduce digestive disorders, improve nutrient absorption/ feed efficiency, increases production, check the mortality and lowering of feed cost. Poultry produces emulsifiers in the form of bile, however, at times it is insufficient in view of added fats and oils. Also, as the digestive tract in young birds is not completely developed, fat absorption from the feed matrix is hampered. Hence, addition of emulsifier into the diet can overcome this problem by reducing the size of the fat globules forming small micelles and increasing the total surface available for enzymatic digestion.The addition of synthetic emulsifier to broiler diets is a recent practice as compared to other dietary supplements. Polyherbal liver stimulants possess hepato – protective, hepatogenic, immunomodulatory and antioxidant properties, which tone up liver resulting in increased utilization of feed and better performance. Keeping the above facts in view, an experiment was conducted to determine the effect of supplementation of organic mineral mixture, probiotics, enzymes, emulsifier and liver stimulants on nutrient utilization and haematological profile of broilers

MATERIAL AND METHODS

A total number of 396 day old commercial broiler chicks (Cobb) were procured for undertaking the experiment. All the chicks were individually weighed and randomly allotted to eleven different groups each with three replicates of 12 chicks. The groups were designated as T_0; basal diet, T_1; chicks fed basal diet along with organic mineral mixture 1 (Organomin forte) @ 0.5 g per kg feed, T_2; basal diet along with organic mineral mixture 2 (Vannamin) @ 0.5 g per kg feed,T_3; basal diet along with probiotics (Microguard) @ 0.1g per kg feed,T_4; basal diet along with enzymes + probiotics (Brozyme - XPR) @ 0.5 g per kg feed, T_5; basal diet along with emulsifier (Lipigon) @ 0.5 g per kg feed, T_6; basal diet with 3% less energy, T_7; basal diet with 3% less energy along with liver supplement 1(Superliv premix) @ 0.5 g/kg feed, T_8; basal diet with 3%2 less energy along with liver supplement 2 (X- liv Pro) @ 0.5 g/kg feed, T_9; basal diet along with enzymes with probiotics (Brozyme - XPR) and liver supplement 1(Superliv premix) @ 0.5 g/kg feed, and T_{10}; basal diet along with enzyme with probiotics (Brozyme - XPR), liver supplement 1(Superliv premix) and emulsifier (Lipigon) @ 0.5 g/kg feed. Average body weight of chicks was similar for all the treatment groups. The broiler chicks were housed in deep litter system under standard management practices. To estimate the nutrient utilization a metabolic trial of 7 days duration was conducted between 36th to 42nd days of the For this purpose two birds i.e. one male and one female from each replicate (6 birds/ treatment) were housed in metabolic cages**.** Birds were given 4 days adaptation period followed by 3 days collection period. During the adaptation period, excess amount of weighed diet was offered to the birds at a fixed time in morning and the residue left was weighed next day morning at the same time. During the collection period, 70 per cent of the diet consumed in the adaptation period per day was calculated and offered to the birds at the same time every day. Simultaneously, galvanized iron trays layered with polythene sheets were placed for collection of excreta. Excreta were pooled, weighed and dried in hot air oven for dry matter estimation and thereafter stored for further analysis. Representative samples of dried excreta were drawn for chemical analysis. For nitrogen estimation, fresh samples of excreta were preserved in 5 per cent sulphuric acid (v/v). The pooled samples of feed and excreta were analyzed to determine nutrient balances.

$$\text{Nutrient utilization (\%)} = \frac{\text{Nutrient intake in feed} - \text{Nutrient loss in faeces}}{\text{Nutrient intake in feed}} \times 100$$

Blood samples were collected from six experimental birds of each group i.e. two broiler chicks from each replicate on 42^{nd} day of experimental feeding. Blood samples (about 4.0 ml) were collected aseptically from their wing vein, using sterilized syringes and needles (24 gauge needle). Collected blood samples was transferred to the vials containing anticoagulant ethylene diamene tetra acetate (EDTA) and used for estimation. Total erythrocytes count (TEC) was done as described by Natt and Herrick[7]. Total leukocyte count (TLC) was performed with Neubauer's counting chamber[5]. Packed cell volume (PCV) was estimated using micro haematocrit method as described by Sharma and Singh[9]. Haemoglobin (Hb) concentration was estimated spectrophotometrically at 540 nm by cyanomethemoglobin method, using Drabkin's solution[2]. MCV, MCH and MCHC were done by fully automatic blood cell counter model – PCE – 210. The experimental data obtained were analyzed statistically using completely randomized design (CRD) as per the methods given by[10]. The significant mean differences between the treatments were determined by using Duncan's Multiple Range Test (DMRT) as given by Kramer[6]**.**

RESULTS AND DISCUSSION

Nutrient utilization

Data pertaining to the average nutrient utilization of different supplemented and control groups in the experiment are presented in Table 1

a) Dry matter

The broilers of , T_4, T_5, T_9 and T_{10} groups absorbed significantly (P<0.05) higher amount of dry matter compared to the T_0 group broilers, which showed lowest (70.61 ± 0.29 per cent) absorption during the experiment. Among the supplemented groups, maximum (74.60 ± 0.34 per cent) utilization was noted in the T_{10} group broilers. Dry matter digestibility of broilers among T_2 and T_3, T_6, T_7 and T_8, T_9 and T_{10} were statistically similar.

Kumar *et al.*[11], noted that the percentage retention of dry matter was significantly higher in probiotics supplemented groups of broilers

b) Crude protein

Broilers of T_1, T_2, T_3, T_4, T_5, T_8, T_9 and T_{10} groups supplemented had significantly (P<0.05) better crude protein utilization than the T_0 group. Broilers of T_{10} group (59.93 ± 0.50 per cent) absorbed highest percentage of crude protein among all groups of the experiment. At the same time no significant difference was observed in protein utilization of broilers of T_1, T_2 and T_8, T_3 and T_5 groups. Improved protein utilization was also reflected by better muscling in the broilers of supplemented groups.

Table 1: Effect of feed supplementations on nutrient utilization (%) of broilers

Treatments	Dry matter	Crude protein	Ether extract	Ca	P
T_0	$70.61^{a} \pm 0.29$	$54.42^{a} \pm 0.31$	$72.16^{a} \pm 0.35$	$55.81^{a} \pm 0.47$	$65.77^{a} \pm 0.44$
T_1	$71.43^{a} \pm 0.27$	$56.92^{b} \pm 0.54$	$75.02^{b} \pm 0.23$	$57.89^{b} \pm 0.53$	$69.24^{b} \pm 0.42$
T_2	$71.63^{ab} \pm 0.28$	$57.15^{b} \pm 0.40$	$76.11^{bc} \pm 0.33$	$57.88^{b} \pm 0.50$	$69.76^{b} \pm 0.55$
T_3	$72.60^{ab} \pm 0.28$	$58.09^{bc} \pm 0.42$	$78.00^{c} \pm 0.52$	$59.89^{c} \pm 0.44$	$71.75^{c} \pm 0.51$
T_4	$73.71^{b} \pm 0.38$	$58.92^{c} \pm 0.54$	$78.96^{c} \pm 0.37$	$60.88^{cd} \pm 0.50$	$72.85^{c} \pm 0.50$
T_5	$72.84^{c} \pm 0.32$	$57.83^{bc} \pm 0.49$	$76.99^{bc} \pm 0.48$	$58.82^{bc} \pm 0.56$	$70.91^{bc} \pm 0.45$
T_6	$70.90^{ac} \pm 0.42$	$55.68^{ab} \pm 0.45$	$72.99^{ab} \pm 0.36$	$56.88^{ab} \pm 0.51$	$67.49^{ba} \pm 0.32$
T_7	$70.79^{ac} \pm 0.56$	$54.98^{a} \pm 0.50$	$72.81^{a} \pm 0.44$	$56.19^{a} \pm 0.38$	$65.94^{a} \pm 0.42$
T_8	$70.95^{ac} \pm 0.51$	$56.36^{b} \pm 0.34$	$74.03^{ab} \pm 0.28$	$57.20^{ab} \pm 0.29$	$67.90^{b} \pm 0.49$
T_9	$73.70^{bc} \pm 0.51$	$59.45^{c} \pm 0.34$	$79.89^{cd} \pm 0.40$	$62.01^{d} \pm 0.44$	$74.05^{d} \pm 0.46$
T_{10}	$74.60^{cb} \pm 0.34$	$59.93^{c} \pm 0.50$	$81.28^{d} \pm 0.28$	$63.22^{d} \pm 0.52$	$74.87^{d} \pm 0.45$

Means bearing different superscripts in a column differ significantly ($P < 0.05$)

Pattanaik *et al.*[13], observed significant increase in nitrogen retention in broilers supplemented with enzymes.

c) Ether extract

The broilers of T_1, T_2, T_3 ,T_4 T_5, T_9 and T_{10} groups showed significantly ($P<0.05$) higher utilization of ether extract compared to the T_0 group (control) broilers. Maximum (81.28 ± 0.28 per cent) ether extract utilization was noted in the broilers of T_{10} group, The broilers of control group showed minimum (72.16 ± 0.35 per cent) utilization of ether extract which was statistically similar to the utilization of T_7 groups. Improved fat utilization was evident from the better fleshing of broilers of the supplemented groups.

Siyal *et al.*[12], reported that that digestibility of ether extract in chickens fed diet with SL0.10 was significantly improved in comparison with those fed SL0.05 and control.

Calcium

Calcium utilization in broilers indicated that the broilers of T_1, T_2, T_3, T_4, T_5, T_9 and T_{10} groups showed significantly ($P<0.05$) higher amount of calcium utilization compared to the T_0 groups. Maximum (63.22 ± 0.52 per cent) utilization of calcium was observed in broilers of T_{10} group, while minimum (55.81 ± 0.47 per cent) utilization was noted in T_0 group of broilers.

Kumar *et al.*[11], noted that the percentage retention of calcium were significantly higher in probiotics supplemented groups of broilers.

e) Phosphorus

Broilers of T_1, T_2, T_3, T_4, T_5, T_8, T_9 and T_{10} groups supplemented had significantly ($P<0.05$) better phosphorus utilization than the T_0 groups. Broilers of T_{10} group (74.87 ± 0.45 per cent) absorbed highest and T_0 group (65.77 ± 0.44 per cent) absorbed lowest per centage of phosphorus among all groups of the experiment. There were no significant differences among the in broilers of T_0 and T_7 , T_1, T_2 and T_8, T_3 and T_4, T_9 and T_{10} groups.

Kumar *et al.*[11], noted that the percentage retention of phosphorus were significantly higher in probiotics supplemented groups of broilers.

Haematological parameters (42nd day)

The data representing the haematological parameters in broilers fed diet supplemented with organic mineral mixture, probiotics, enzymes, emulsifier and liver supplements on 42nd day of feeding trail are summarized in Table 2.

Total erythrocyte counts (TEC)

Total erythrocyte count values in T_1, T_2, T_3, T_4, T_5, T_6, T_7, T_8, T_9 and T_{10} groups were significantly (P<0.05) higher than T_0 group, however, there were no significant differences in the total erythrocyte count values between T_1 and T_2, T_9 and T_{10} groups of broilers. Total erythrocyte count value was maximum (3.14 ± 0.02 x 10^6/µl) in T_{10} and minimum (2.14 ± 0.06 x 10^6 / µl) in T_0 group. Similar results of significant increase in TEC were also reported by Rahman *et al.*[8],

Total leukocyte counts (TLC)

Total leukocyte count values in T_1, T_2, T_3, T_4, T_5, T_7, T_8, T_9 and T_{10} groups were significantly (P<0.05) higher than T_0 (control) group, however, there were no significant differences in the total leukocyte count values between T_7 and T_8, T_2, T_3, T_4, T_5 and T_9 groups of broilers. Total leukocyte count value was maximum (28.14 ± 0.02x 10^3 / µl) in T_{10} and minimum (26.63 ± 0.10x 10^3 / µl) in T_0 group. Similar results of significant increase in total leukocyte count (TLC) were also reported by Rahman *et al.*[8],

Packed cell volume (PCV)

Packed cell volume values in in T_1, T_2, T_3, T_4, T_5, T_7, T_8, T_9 and T_{10} groups were significantly (P<0.05) higher than T_0 (control) group, however, there were no significant differences in the packed cell volume values between T_1 and T_2, T_3, T_4 and T_5, T_7 and T_8 groups of broilers. Packed cell volume value was maximum (30.36^e ± 0.05 per cent) in T_{10} and minimum (26.85 ± 0.01 per cent) in T_0 group. Similar results of significant increase in packed cell volume (PCV) were also reported by Rahman *et al.*[8],

Haemoglobin (Hb)

Haemoglobin values in T_1, T_2, T_3, T_4, T_5, T_6, T_7, T_8, T_9 and T_{10} groups were significantly (P<0.05) higher than T_0 (control) group, however, there were no significant differences in the haemoglobin values between T_3 and T_5, T_6 and T_7, T_1 and T_8 groups of broilers.

Table 2: Effect of feed supplementation on haematological profile of broilers (42nd day)

Treatments	TEC (10^6/µl)	TLC (10^3/µl)	PCV (%)	Haemoglobin (g/dl)	MCV (fl)	MCH (pg)	MCHC (%)
T_0	2.14^a ± 0.06	26.63^a ± 0.10	26.85^a ± 0.01	9.45^a ± 0.08	125.46^a ± 0.12	44.15^a ± 0.09	35.52^a ± 0.02
T_1	2.72^b ± 0.01	27.50^b ± 0.05	28.84^b ± 0.15	9.93^b ± 0.04	106.02^b ± 0.13	36.50^b ± 0.02	34.43^b ± 0.08
T_2	2.78^{be} ± 0.01	27.64^{bc} ± 0.02	29.15^b ± 0.03	10.05^{bc} ± 0.02	104.85^{bc} ± 0.03	36.15^{bc} ± 0.14	34.47^b ± 0.02
T_3	2.93^c ± 0.03	27.84^{bc} ± 0.01	29.64^c ± 0.02	10.23^c ± 0.04	101.16^c ± 0.21	34.91^c ± 0.03	34.51^b ± 0.02
T_4	3.03^d ± 0.01	27.90^{bc} ± 0.02	29.85^c ± 0.09	10.32^{ce} ± 0.01	98.51^{ce} ± 0.10	34.05^{cf} ± 0.14	34.57^b ± 0.12
T_5	2.84^e ± 0.01	27.74^{bc} ± 0.03	29.42^c ± 0.11	10.12^c ± 0.00	103.59^{bc} ± 0.10	35.63^{cb} ± 0.03	34.39^b ± 0.03
T_6	2.30^f ± 0.02	26.84^a ± 0.01	27.05^a ± 0.02	9.61^d ± 0.01	117.60^d ± 0.16	41.78^d ± 0.15	35.19^a ± 0.09
T_7	2.44^g ± 0.04	27.02^b ± 0.09	27.81^d ± 0.14	9.73^d ± 0.04	113.97^d ± 0.04	39.87^e ± 0.01	34.98^{ba} ± 0.02
T_8	2.62^h ± 0.04	27.30^b ± 0.05	28.30^d ± 0.15	9.82^b ± 0.00	108.01^b ± 0.03	37.48^b ± 0.10	34.69^b ± 0.08
T_9	3.09^{di} ± 0.01	27.68^{bc} ± 0.33	30.14^c ± 0.06	10.38^{ce} ± 0.01	97.54^{ce} ± 0.03	33.59^{cf} ± 0.03	34.43^b ± 0.02
T_{10}	`3.14^i ± 0.02	28.14^c ± 0.02	30.36^e ± 0.05	10.44^e ± 0.02	96.68^e ± 0.13	33.24^f ± 0.06	34.38^b ± 0.06

Means bearing different superscripts in a column differ significantly (P < 0.05)

Haemoglobin was maximum (10.44± 0.02g/dl) in T_{10} and minimum (9.45±0.08g/dl) g in T_0 group. Similar results of significant increase in (Hb) were also reported by Rahman *et al.*[8],

Mean corpuscular volume (MCV)

Mean corpuscular volume values in T_1, T_2, T_3, T_4, T_5, T_6, T_7, T_8, T_9 and T_{10} groups were significantly (P<0.05) lower than T_0 group, however, there were no significant differences in the mean corpuscular volume values between T_6 and T_7, T_1 and T_8 groups of broilers. Mean corpuscular volume value was maximum (125.46 ± 0.12fl) in T_0 and minimum (96.68 ± 0.13 fl) in T_{10} group. Similar results of significant decrease in mean corpuscular volume were also reported by Hosseini[3].

Mean corpuscular haemoglobin (MCH)

Mean corpuscular haemoglobin values in T_1, T_2, T_3, T_4, T_5, T_6, T_7, T_8, T_9 and T_{10} groups were significantly (P<0.05) lower than T_0 group, however, there were no significant differences in the mean corpuscular haemoglobin values between T_1 and T_8 groups of broilers. Mean corpuscular haemoglobin was maximum (44.15 ± 0.09 pg) in T_0 and minimum (33.24 ± 0.06 pg) in T_{10} group. Similar results of significant decrease in mean corpuscular volume were also reported by Hosseini[3].

Mean corpuscular haemoglobin concentration (MCHC)

Mean corpuscular haemoglobin concentration values in T_1, T_2, T_3, T_4, T_5, T_7,T_8, T_9 and T_{10} groups were significantly (P<0.05) lower than T_0 group, however, there were no significant differences in the mean corpuscular haemoglobin concentration values between T_1, T_2, T_3, T_4, T_5, T_7,T_8, T_9 and T_{10} groups of broilers. Mean corpuscular haemoglobin concentration was maximum (35.52 ± 0.02) in T_0 and minimum (34.38 ± 0.06) in T_{10} group. Similar results of significant decrease in mean corpuscular haemoglobin concentration were also reported by Hosseini[3].

CONCLUSION

The broilers of supplemented groups absorbed significantly (P<0.05) higher amounts of dry matter, crude protein, ether extract, calcium and phosphorus compared to the control group indicating that inclusion of supplements led to release of more nutrients and helped in absorption of more nutrients. The TEC, TLC, PCV, Hb values in supplemented groups were significantly (P< 0.05) higher than control group. This had helped birds to live with maximum physiological fitness and excel in performance and fetch more income.

REFERENCES

1. CARI VISION., Central Avian Research Institute, Izatnagar, Bareilly, India. (2050).
2. Fudge, A. M., Avian Complete Blood Count. *In:* Laboratory Medicine: Avian and Exotic Pets, 1st ed. *Saunders Company*, U.S.A. 9-18 (2000).
3. Hosseini, S. M., The effect of *Saccharomysec cerevisiae* on blood parameters of broiler chickens. *Global Veterinaria* **7(4):** 411-414 (2011c).
4. Hosseini, S. M., The effect of utilization of different levels of *Saccharomysec cerevisiae* on broiler chickens performance. *Global Veterinaria* **6(3):** 233-236 (2011a).
5. Jain, N. C., Schalm's Veterinary Haematology. Lea and Febiger, Philadelphia, USA. **2:** 56-61 (1986).
6. Kramer, C. Y., Extension of multiple range tests to group correlated adjusted means. *Biometrics*, 13: 13-17 (1957).
7. Natt, M. P. and Herrick, C. A., A new blood diluent for conducting the erythrocytes and leucocytes of the chicken. *Poult. Sci.* **31(1):** 735-738 (1952).
8. Rahman, M. S., Mustari, A., Salauddin, M. and Rahman, M. M., Effects of probiotics and enzymes on growth performance and haematobiochemical parameters in broilers. *J. Bangladesh Agril. Univ.* **11(1):** 111–118 (2013).
9. Sharma, I. J. and Singh, H. S., Student's Laboratory Manual of Veterinary Physiology. *Kalyani Publishers, New Delhi*. **5:** 26-38 (2000).
10. Snedecor, G. W. and Cochran, W. B., *Statistical Methods.* 8th ed. The Iowa State

University Press, Ames, IOWA, USA. (1994).

11. Kumar, L. S., Chandramoni, P. K. and Kumar, M., Effect of dietary supplementation of combination of probiotics on the growth performance and immune response of broiler chickens. Anim. *Nutr. Feed Technol*. **13:** 15-25 (2013).
12. Siyal, F.A., Abd, M.E., Mahmoud, E.H., Chao, A., Xioli, W., , Jintian, W., Mingfa, H., Lili, W., Zhang, Z.X., Wang**,** T. and Dhama, K., Effect of Soy Lecithin on Growth Performance, Nutrient Digestibility and Hepatic Antioxidant Parameters of Broiler Chickens. *International Journal of Pharmacology*.*Volume* **13(4):** 396-402 (2017).
13. Pattannaik, J. R., Das, S. K., Mishra, S. K., Panda, N., Pati, P. K. and Dehuri, P. K., Effect of fibre degrading multi-enzyme on the performance of commercial broiler. *Indian J. Anim. Sci.* **81:** 1052 -1058 (2011).