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Optimization of Crude Protein, Metabolized Energy, Lysine and Methionine Requirement for Commercial Broilers Reared Under Open Sided Housing System in Hot Weather Condition

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ABSTRACT:
The biological experimental was conducted to optimize the crude protein, metabolized energy, lysine and methionine requirement for broilers in summer season (hot weather condition) under open sided deep litter system feeding with different levels of composition of metabolized energy, crude protein, lysine and methionine for broilers. The sex separated, day-old commercial broiler chicks (Vencobb 430) were used for the experimental study. Six weeks data was collected on production performance parameter like body weight and were calculated. The results showed that there was a significant difference ($P<0.05$) on mean body weight (g) of commercial broilers from first to sixth week of age. Comparatively the group T_9 recorded higher mean body weight (2502.43g) which did not differed significantly among other treatment groups except T_6 group. The T_9 group recorded significantly higher mean body weight (2502.43g) than the other treatment groups. Other treatment groups recorded intermediary body weight was fed with broiler pre-starter feed with 2900 kcal/kg of ME and 23% CP, 1.30% lysine and 0.80% methionine, broiler starter feed with 3000 kcal/kg of ME and 22% CP, 1.20% lysine and 0.70% methionine and broiler finisher feed with 3100 kcal/kg of ME and 21% CP, 1.10% lysine and 0.60% methionine This indicated that the summer had influenced the cumulative low feed consumption irrespective of different levels of combinations of Crude protein, metabolized energy, lysine and methionine to the commercial broilers with higher environmental temperature (38.6^0C) than the required one to the broilers which is resulting in lower feed intake. Hence, it is advised to formulate the feed for broilers with 2900 k.cal/kg M.E and 23% CP., 1.30% lysine and 0.80% methionine in the pre-starter feed, 3000 k.cal/kg M.E and 22% C.P., 1.20% lysine and 0.70% methionine in the starter feed and 3100 k.cal/kg M.E and 21% CP., 1.10% lysine and 0.60% methionine in the finisher feed. Subsequently, it may be concluded that for getting better result and profit, in summer season (hot weather condition) broilers reared under open sided

deep litter housing system that the broilers requires 1% excess crude protein, 0.20% excess methionine and 1% excess lysine.

Keywords:
Crude protein, Metabolized Energy, Lysine, Methionine, Summer, Temperature.

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1. INTRODUCTION

The Indian commercial broiler industry has been growing tremendously at around 10-12 per cent annually over the last two decade and at more than 15 per cent in the last five years. The commercial broiler production is evaluated to increased from 1.5 million tonnes in 2000 to 3.6 million tonnes in 2012 and with per capita availability from 0.6 kg to 2.6 kg. Since, the per capita broiler meat consumption in India remains low with vast gap as recommended by NIN (National Institute of Nutrition) recommended levels of 12 kg. This offers an immense opportunity for the commercial growth of broiler industry.

The productivity obtained from commercial broiler industry is returned of relatively lower rates than the other meat items to increase in poultry meat during last five years in contrast to other meat products. Poultry WPI (wholesale price index) was grown at 15 per cent year during 2013-2018 collate to 20 per cent to the other meat products which is providing an affordable alternative for meeting protein requirements in Indian food. ICRA (Investment Information and Credit Rating Agency) expect commercial broiler meat demands further to grow and may reach upto 18-20% with the prediction to increase 19.64 million tonnes in 2023.
This is due to the major changes in the construction, size and the number of commercial broiler sheds since three decades. Due to the modernization of broiler production performance practices the feed conversion ratio (FCR) has been improved from 2.3 to 1.5. Since, the body weight which was attained at ten weeks of age during the 1980`s and is now noticed in 35 to 42 days of age by the commercial broilers.

Perhaps, the commercial broiler production performance in moderate temperature tropical countries like India facing many provocation which results in lowering the production performance of commercial broilers. One of the major challenge is the variations in temperature and relative humidity especially during in summer season in open sided deep litter system. The damaging effects of high surrounding temperature on intake of feed, rate of growth and feed efficiency ratio of commercial broilers are well documented by Hacina *et al*., (1996).

Optimization of key nutrients is the best solution which provides to overcome the adverse effects of climatic variation in temperature inside the poultry farm in open sided deep litter system. Consistently at present, due to progress in rearing system of commercial broilers in open sided deep litter system implementing with optimization of key nutrients in various temperature conditions in open sided deep litter system in hot weather condition for easy management and utilizing the maximum genetic potency of the commercial broilers.

At present, it was very well acknowledge that the feed represent the major notable cost of commercial broiler production which ranges from 60 - 80% of the total production cost (Durunna *et al.,* 2005). Usually, the metabolized energy (ME), crude protein (CP), lysine and methionine are the key nutrients required for the normal body functions and acting as essential ingridients for broilers. Among from

these, the crude protein having major requirement on growth production of the broilers and also the most costly or high price of the nutrients in broiler feed preparation other than metabolized energy (Kamran *et al*., 2004). Lysine and methionine are universally recognized as the most two restricted amino acids in maize and soya bean meal present in commercial broiler feeds. However, a good proportion of said nutrients are more essential to ensure topmost utilization of all the nutrients for optimum growth of commercial broilers.

Persuading environmental conditions of increasing surrounding temperature and the rearing system in tropical countries (Hot weather condition) are the major aspect in commercial broiler production. The commercial broiler industry is still increasingly depend open sided deep litter system, implementing and practicing in preparation of low cost for easy construction. In India, people still learning and being concentrated the first and foremost on the requirement of metabolized energy (M.E.), crude protein (C.P.), lysine and methionine and on their quantity for development of the commercial broilers production only for open sided deep litter system.

2. OBJECTIVE

To determine and standardize the optimum level of metabolized energy and crude protein, lysine and methionine requirement for the commercial broilers reared in summer season (hot weather condition) under open sided deep litter system.

3. MATERIALS AND METHODS

The experiment was conducted to optimize the metabolized energy, crude protein, lysine and methionine requirement in summer season (hot weather condition) under open sided deep litter system for commercial broilers. The experiment was conducted by feeding feed with different levels of metabolized energy and crude protein, lysine and methionine to the commercial broilers. Based on the results of the experimental study, the best and suitable metabolized energy and crude protein, lysine and methionine level requirement was recorded to make consistent and standardized for commercial broiler chicken which were reared in summer season (hot weather condition) under open sided deep litter system. The optimum levels required for the broilers reared in summer (hot weather condition) were obtained has taken as standard quality for the preparation of feed for commercial broilers.

Location and climate

The experiments was conducted during March and April, and March in summer season (hot weather condition) under open sided deep litter system located at the Research Poultry Farm, Department of Poultry Science, Lal Bahadur College, Warangal which is situated in northern region of agro-climatic zone of Telangana state at 18º00′ N latitude and 79º34′ and 48^0.00`E longitude at an altitude of 258 or 846 feets above the mean sea level. The Minimum and maximum environmental temperature (T) in degrees centigrade and relative humidity (R.H.) in per cent in winter and summer season(cold and hot weather condition) during study period were 18.80ºC and 27.60ºC, 44.6 % and 56.2% in winter season and in summer season 30.2^{0}C and 38.6^{0}C , 54% and 78% respectively in summer, **(Anonymous, 2014).**

	March		**April**	
	Min.	**Max.**	**Min.**	**Max.**
Mean Temperature in degrees	**30.2^{0}C**	**31.7^{0}C**	**33.4^{0}C**	**38.6^{0}C**
Mean Relative Humidity in percentage	**54%**	**69%**	**61%**	**76%**

	March		April	
	Min.	**Max.**	**Min.**	**Max.**
Mean Temperature in degrees	**30.2^{0}C**	**31.7^{0}C**	**33.4^{0}C**	**38.6^{0}C**
Mean Relative Humidity in percentage	**58%**	**66%**	**63%**	**78%**

Study period:
The experiment was conducted in commercial broilers from day old to six weeks of age. The total experimental study period was divided into three phases namely, pre-starter (1 to 14 days), starter (15 to 28 days) and finisher phase (29 to 42 days) during summer season (hot weather condition) under open sided deep litter system.

Plan for the experiment:
The experiment was carried out with one hundred and eighty (Ninety birds each during summer season (hot weather condition) under open sided deep litter system, The sex separated, day-old commercial broiler chicks (Vencobb 430) which were obtained from the Tirumala Hatchery, Warangal for the experiment.

The commercial broiler chicks were leg banded, taken record of individual weights and allotted into nine treatment groups with two replicates (male and female) of five broiler chicks in each treatment during summer season (hot weather condition) under open sided deep litter system.

Experimental feed:
The experiment for the commercial broilers the control feed was prepared with the help of **Pearsons` square method** for the feed formulation for the nine treatment groups as low, medium and high of crude protein in percentage and metabolized energy to the standard requirement of the commercial according to the age or phase into nine different levels of nine treatment groups as per the experimental plan. The prepared commercial broiler pre starter, starter and finisher feeds were presented in table 1, 2 and 3 were fed with ***ad libitum*** to the broilers from 1 to 14, 15 to 28 and 29 to 42 days of age respectively during three phases.

Feed formulated with the help of Pearson`s square method for the nine treatment groups for the experiment in summer season (hot weather condition) under open sided deep litter system is as follows:

Treatment groups for each system of rearing	**Particulars**					**Number of replicates per treatment**	**Number of birds per replicate**	**Total number of birds per treatment**
	Type of feed	**CP (%)**	**ME (kCal/kg)**	**Lysine (%)**	**Methionine (%)**			
T_1	Pre-starter	23	2900	1.30	0.60	2	5	10
	Starter	22	3000	1.20	0.50			
	Finisher	21	3100	1.10	0.40			
T_2	Pre-starter	24	2900	1.40	0.60	2	5	10
	Starter	23	3000	1.30	0.50			
	Finisher	22	3100	1.20	0.40			
T_3	Pre-starter	25	2900	1.50	0.60	2	5	10
	Starter	24	3000	1.40	0.50			
	Finisher	23	3100	1.30	0.40			
T_4	Pre-starter	23	3000	1.30	0.70	2	5	10
	Starter	22	2900	1.20	0.60			

	Finisher	21	2800	1.10	0.50			
T_5 controlled group	Pre-starter	24	3000	1.40	0.70	2	5	10
	Starter	23	2900	1.30	0.60			
	Finisher	22	2800	1.20	0.50			
T_6	Pre-starter	25	3000	1.50	0.70	2	5	10
	Starter	24	2900	1.40	0.60			
	Finisher	23	2800	1.30	0.50			
T_7	Pre-starter	23	3100	1.30	0.80	2	5	10
	Starter	22	3200	1.20	0.70			
	Finisher	21	3300	1.10	0.60			
T_8	Pre-starter	24	3100	1.40	0.80	2	5	10
	Starter	23	3200	1.30	0.70			
	Finisher	22	3300	1.20	0.60			
T_9	Pre-starter	25	3100	1.50	0.80	2	5	10
	Starter	24	3200	1.40	0.70			
	Finisher	23	3300	1.30	0.60			
Total								**90**

Table 1: Ingredients and nutrient composition in percentage of the experimental study of pre-starter feed for broilers reared in summer season (hot weather condition) under open sided deep litter system

Ingredient	**T_1**	**T_2**	**T_3**	**T_4**	**T_5**	**T_6**	**T_7**	**T_8**	**T_9**
Maize	46.96	45.40	43.35	46.58	45.12	44.07	46.15	45.01	44.25
Raw Soya	43.29	44.75	46.70	43.57	44.93	45.88	43.90	44.94	45.60
Salt	0.38	0.38	0.38	0.38	0.38	0.38	0.38	0.38	0.38
Di-calcium phosphate	2.20	2.20	2.20	2.20	2.20	2.20	2.20	2.20	2.20
Oil	4.50	4.50	4.50	4.50	4.50	4.50	4.50	4.50	4.50
Lysine	1.30	1.40	1.50	1.30	1.40	1.50	1.30	1.40	1.50
Methionine	0.60	0.60	0.60	0.70	0.70	0.70	0.80	0.80	0.80
Vitamin AB_2D_3K mix[1]	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10
Vitamin B-complex[2]	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10
Trace mineral mixture[3]	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15
Choline chloride	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15
Toxin binder	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15
Anticoccidial	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10
Anti-oxidant	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02
Total	**100**	**100**	**100**	**100**	**100**	**100**	**100**	**100**	**100**
Nutrient composition* (on dry matter basis)									
Crude Protein (%)	23	23	23	23	23	23	23	23	23
ME (kcal/Kg)	2900	2900	2900	2900	2900	2900	2900	2900	2900
Lysine (%)	1.30	1.40	1.50	1.30	1.40	1.50	1.30	1.40	1.50
Methionine (%)	0.60	0.60	0.60	0.70	0.70	0.70	0.80	0.80	0.80
Crude fibre(%)	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5

* Calculated values

1 One gram of Vitamin AB_2D_3K supplement contained 80000 IU of Vitamin-A Palmitate, 50 mg of Vitamin-B_2,6000 IU of Vitamin-D_3, Vitamin-E 48 mg and 10 mg of Vitamin-K.

2 One gram of B-complex supplement contained 8 mg of Vitamin-B_1, 16 mg of Vitamin B_6, 20 mcg of Vitamin B_{12}, , 120 mg of Niacin, 8 mg of folic acid, 80 mg of Calcium - D – pantothenate and 86 mg of calcium.

3 One gram of Trace minerals contained 54 mg of Manganese, 52 mg of Zinc, 20 mg of Iron, 2 mg of Iodine and 1mg of Cobalt.

Table-2: Ingredients and nutrient composition in percentage of the experimental study of starter feed for broilers reared in summer season (hot weather condition) under open sided deep litter system

Ingredient	**T_1**	**T_2**	**T_3**	**T_4**	**T_5**	**T_6**	**T_7**	**T_8**	**T_9**
Maize	50.31	49.34	49.24	49.34	49.24	49.04	49.24	49.04	48.94
Raw Soya	40.20	40.30	40.30	40.30	40.30	40.40	40.30	40.40	40.40
Salt	0.39	0.39	0.39	0.39	0.39	0.39	0.39	0.39	0.39
Di-calcium phosphate	2.40	2.40	2.40	2.40	2.40	2.40	2.40	2.40	2.40
Oil	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00
Lysine	1.20	1.30	1.40	1.20	1.30	1.40	1.20	1.30	1.40
Methionine	0.50	0.50	0.50	0.60	0.60	0.60	0.70	0.70	0.70
Vitamin AB_2D_3K mix[1]	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10
Vitamin B-complex[2]	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10
Trace mineral mixture[3]	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15
Choline chloride	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15
Toxin binder	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15
Anticoccidial	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10
Anti-oxidant	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02
Total	**100**	**100**	**100**	**100**	**100**	**100**	**100**	**100**	**100**
Nutrient composition* (on dry matter basis)									
Crude Protein (%)	22	22	22	22	22	22	22	22	22
ME (kcal/Kg)	3000	3000	3000	3000	3000	3000	3000	3000	3000
Lysine (%)	1.20	1.30	1.40	1.20	1.30	1.40	1.20	1.30	1.40
Methionine (%)	0.50	0.50	0.50	0.60	0.60	0.60	0.70	0.70	0.70
Crude fibre(%)	3.8	3.8	3.8	3.8	3.8	3.8	3.8	3.8	3.8

* Calculated values

1 One gram of Vitamin AB_2D_3K supplement contained 80000 IU of Vitamin-A Palmitate, 50 mg of Vitamin-B_2,6000 IU of Vitamin-D_3, Vitamin-E 48 mg and 10 mg of Vitamin-K.

2 One gram of B-complex supplement contained 8 mg of Vitamin-B_1, 16 mg of Vitamin B_6, 20 mcg of Vitamin B_{12}, , 120 mg of Niacin, 8 mg of folic acid, 80 mg of Calcium - D – pantothenate and 86 mg of calcium.

3 One gram of Trace minerals contained 54 mg of Manganese, 52 mg of Zinc, 20 mg of Iron, 2 mg of Iodine and 1mg of Cobalt.

Table 3: Ingredients and nutrient composition in percentage of the experimental study of finisher feed for broilers reared in summer season (hot weather condition) under open sided deep litter system

Ingredient	T_1	T_2	T_3	T_4	T_5	T_6	T_7	T_8	T_9
Maize	53.22	52.72	52.62	52.72	52.62	52.52	52.62	52.52	52.32
Raw Soya	36.00	36.40	36.40	36.40	36.40	36.40	36.40	36.40	36.50
Salt	0.41	0.41	0.41	0.41	0.41	0.41	0.41	0.41	0.41
Di-calcium phosphate	2.60	2.60	2.60	2.60	2.60	2.60	2.60	2.60	2.60
Oil	5.50	5.50	5.50	5.50	5.50	5.50	5.50	5.50	5.50
Lysine	1.10	1.20	1.30	1.10	1.20	1.30	1.10	1.20	1.30
Methionine	0.40	0.40	0.40	0.50	0.50	0.50	0.60	0.60	0.60
Vitamin AB_2D_3K mix[1]	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05
Vitamin B-complex[2]	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05
Trace mineral mixture[3]	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10
Choline chloride	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
Anticoccidial	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05
Anti-oxidant	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
Total	**100**	**100**	**100**	**100**	**100**	**100**	**100**	**100**	**100**
Nutrient composition* (on dry matter basis)									
Crude Protein (%)	21	21	21	21	21	21	21	21	21
ME (kcal/Kg)	3100	3100	3100	3100	3100	3100	3100	3100	3100
Lysine (%)	1.10	1.20	1.30	1.10	1.20	1.30	1.10	1.20	1.30
Methionine (%)	0.40	0.40	0.40	0.50	0.50	0.50	0.60	0.60	0.60
Crude fibre (%)	4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00

* Calculated values

1 One gram of Vitamin AB_2D_3K supplement contained 80000 IU of Vitamin-A Palmitate, 50 mg of Vitamin-B_2,6000 IU of Vitamin-D_3, Vitamin-E 48 mg and 10 mg of Vitamin-K.

2 One gram of B-complex supplement contained 8 mg of Vitamin-B_1, 16 mg of Vitamin B_6, 20 mcg of Vitamin B_{12}, , 120 mg of Niacin, 8 mg of folic acid, 80 mg of Calcium - D – pantothenate and 86 mg of calcium.

3 One gram of Trace minerals contained 54 mg of Manganese, 52 mg of Zinc, 20 mg of Iron, 2 mg of Iodine and 1mg of Cobalt.

4. RESULTS AND DISCUSSION:

The results were obtained from this experimental study on the production performance like body weight, of the commercial broilers fed with different levels of metabolized energy, crude protein, lysine and methionine in summer season (hot weather condition) under open sided deep litter system. The mean (± S.E.) body weight (g) of commercial broilers reared in summer season (hot weather condition) under open sided deep litter system from 1 to 6 weeks of age as influenced by various combinations of metabolized energy and crude protein were presented in Table 4.

The result showed that there was significant difference throughout the study period on mean body weight (g) of commercial broilers fed with different levels of metabolized energy and crude protein. At the end of sixth week, the group T_9 (high metabolized energy and low crude

protein) had significantly (P<0.05) higher body weight (g) (2502.43 g) as compared to controlled group T_5 (2413.48g) and also than T_1 (2298.31 g) and T_4 (2338.34 g), whereas body weight of other treatment groups of the body weight ranges from 2336.34 to 2413.48 g.

The results are in accordance with the earlier reports of Al-Batshan and Hussein (1999), Mengistu and Yami (2000), Kamran *et al.* (2008b), Zaman *et al.* (2008), Golian *et al.* (2010), Jafernejad *et al.* (2010), Kabir *et al.* (2010), Moosavi *et al.* (2012), Ullah *et al.* (2012) and Bahreiny *et al.* (2013) who also reported that broilers fed with high level of energy and protein increased the body weight (g).

Table 4: Mean (± S. E.) body weight (g) of commercial broilers reared in summer season in open sided deep litter system from 1 to 6 weeks of age as influenced by different levels of metabolized energy and crude protein, lysine and methionine

Treatment groups	I Week	II Week	III Week	IV Week	V Week	VI Week
T_1	156.45^{b}±3.35	376.67^{b}±7.14	712.64^{B}±15.85	1211.20^{b}±24.79	1695.11^{b}±36.11	2298.31^{d}±55.43
T_2	157.42^{b}±3.34	389.68^{ab}±7.80	757.82^{ab}±16.05	1270.61^{ab}±27.85	1771.79^{ab}±36.50	2376.38^{c}±56.53
T_3	160.36^{ab}±3.66	393.92^{ab}±8.40	751.86^{ab}±15.26	1288.14^{ab}±27.53	1729.45^{ab}±39.09	2336.34^{c}±60.14
T_4	163.01^{ab}±3.19	388.36^{ab}±9.54	761.73^{ab}±17.53	1241.67^{b}±28.79	1719.57^{b}±44.06	2338.45^{c}±65.05
T_5	164.04^{ab}±3.10	398.01^{ab}±8.66	786.39^{a}±119.09	1299.32^{ab}±31.51	1802.78^{ab}±45.10	2413.48^{b}±66.18
T_6	167.96^{a}±3.34	399.57^{ab}±7.53	789.61^{a}±15.22	1307.56^{ab}±26.48	1818.22^{ab}±38.08	2431.32^{b}±62.13
T_7	163.01^{ab}±3.52	392.42^{ab}±8.70	764.72^{ab}±18.73	1266.82^{ab}±23.61	1733.10^{ab}±33.89	2348.31^{c}±58.93
T_8	161.60^{ab}±3.50	394.10^{ab}±8.09	772.17^{ab}±14.05	1285.10^{ab}±28.04	1784.11^{ab}±35.83	2401.31^{b}±61.83
T_9	164.40^{ab}±4.41	405.17^{a}±9.95	810.32^{a}±17.68	1371.07^{a}±27.25	1883.36^{a}±42.57	2502.43^{a}±69.64

Value given in each cell is the mean of 10 observations

$^{a \text{ and } b}$ means within a column there is no common superscript differ significantly with (P<0.05)

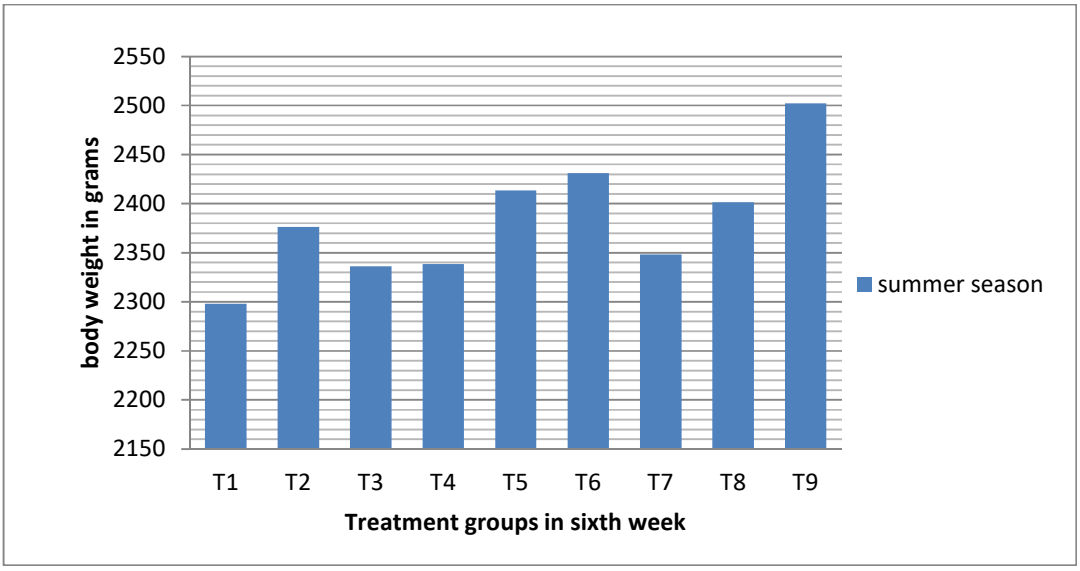

Figure 1: Body weight (g) of commercial broilers reared in summer season in open sided deep litter system from 1 to 6 weeks of age as influenced by different levels of Metabolized energy, crude protein, lysine and methionine.

5. CONCLUSIONS

The crude protein, Metaboilzed energy, lysine and methionine content of the feed had significant influence on body weight, of the commercial broilers in summer season under open sided deep litter housing system and the net profit per broiler was the highest in the treatment group T_9 as compared with control group T_5. Hence, it is advised to formulate the feed for broilers with 2900 k.cal/kg M.E and 23% CP., 1.30% lysine and 0.80% methionine in the pre-starter feed, 3000 k.cal/kg M.E and 22% C.P., 1.20% lysine and 0.70% methionie in the starter feed and 3100 k.cal/kg M.E and 21% CP., 1.10% lysine and 0.60% methionine in the finisher feed. Subsequently, it may be concluded that for getting better result and profit, in summer season (hot weather condition) broilers reared under open sided deep litter housing system that the broilers requires 1% excess crude protein, 0.20% excess methionine and 1% excess lysine than the standard recommended feed.

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