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Nutrient Utilization in Mewari Chicks Fed Different Levels of Metabolizable Energy under Intensive System

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Abstract
An experiment was conducted to evaluate the dietary energy requirements of Mewari chicks reared under an intensive system in Southern Rajasthan. A total of 510 one-day-old, single-hatched Mewari chicks were randomly distributed into 5 dietary treatment groups. Each treatment group received a diet formulated to provide different levels of metabolizable energy 2600 (T_1), 2700 (T_2), 2800 (T_3), 2900 (T_4), and 3000 (T_5) kcal ME/kg, while maintaining a constant crude protein level of 20%. Each treatment was replicated 6 times with 17 chicks per replicate. The chicks were housed in deep litter cages of dimension 5 ft × 3 ft × 2.5 ft and reared for a duration of 8 weeks under uniform management conditions. Significant higher digestible intake of DM, CP, EE, CF and NFE were observed in groups fed 17 and 18% CP than other groups. The digestibility coefficients of dry matter, crude protein, ether extract were significantly higher ($P<0.01$) in T_3 compared to treatment groups T_4 and T_5, while digestibility coefficient of crude fiber and Nitrogen-free extract were higher ($P<0.01$) in T_1 and T_2, T_3 groups, respectively. Chicks fed the T_2 and T_3 diets showed higher digestible nutrient intakes and better digestibility coefficients, indicating improved nutrient utilization. Based on the results obtained, it can be concluded that a dietary level of 2800 kcal ME/kg along with 20% crude protein was found to the optimum in enhancing nutrient utilization in Mewari chicks.

Keywords: Mewari chicks, Metabolizable energy Crude protein, Digestibility, Nitrogen-free extract

Introduction
Poultry farming is a major and profitable industry, offering job opportunities to many people. It encompasses the raising of chickens, quails, ducks, geese, and turkeys by humans for their eggs, meat, and feathers. The poultry sector includes activities such as breeding, hatching, raising, and processing these domesticated birds. India ranks 7th in the world poultry population at 851.81 million of which 534.74 million numbers in commercial poultry and 317.07 million number in backyard poultry, (BAHS, 2024).

Backyard poultry farming is a traditional and profitable practice in India, contributing about 15% to the country's total poultry output. In Southern Rajasthan, the indigenous Mewari chicken is commonly reared in backyard systems. The home tract of Mewari breed is Udaipur, Bhilwara, Dungarpur, Banswara, Rajasamand and Pratapgarh District of Rajasthan. However, with an average annual egg production of 37-52 eggs and age at first egg ranging from 6 to 7.5 months, its productivity remains low (Mishra *et al.*, 2022) [7]. Energy plays a vital role in the nutrition of indigenous layer chicks, directly impacting their early growth, health, and future egg-laying ability. Unlike fast-growing commercial breeds, indigenous chicks tend to grow more slowly and are well-suited to local climates, which influences their specific dietary needs. An appropriate level of metabolizable energy (ME) in their feed is important during the initial stages to ensure proper body development, immune strength, and internal organ growth. If the energy level is too low, it can result in stunted growth, late onset of laying, and lower productivity. On the other hand, too much energy may lead to excessive fat accumulation and inefficient feed use. Hence, it is important to provide a diet that maintains the right balance between energy and protein to promote healthy development and optimal performance in indigenous layer birds.

Adjusting dietary energy levels according to the bird's age, production phase and environmental conditions is critical for optimizing productivity and maintaining bird health (Lesson and Summers, 2005).

In case of poultry group feeding is done so the nutrient requirement is expressed in terms of percent or per kg of ration, the CP requirement is expressed as CP% and energy expressed as ME kcal/kg of ration. The information with respect to metabolizable energy in the diet of Mewari chicks is not available. The present research paper is the part of feeding trial to study the energy requirement of Mewari chicks and a metabolism trial was conducted to study nutrient utilization.

Materials and Methods

Experimental birds and diets

Five hundred ten mixed sex day old Mewari chicks were randomly allocated to five dietary treatments in six replicates of 17 chicks each. Five iso-nitrogenous diets containing metabolizable energy at 2600 (T1), 2700 (T2), 2800 (T3), 2900 (T4) and 3000 (T5) kcal per kg were formulated and fed to the chicks for the entire experimental period of 8 weeks.

The experimental diets comprised of Maize, Soybean de-oiled cake, De-oiled rice bran (DORB), Rice bran oil, Dicalcium Phosphate and Vitamin mineral premix, the detailed ingredient and nutrient composition of experimental diets used for feeding of chicks is presented in Table-1. The chicks were fed as per recommendation of BIS (2007) feeding standard to meet energy and protein requirements during chick stage for the entire experimental period.

The birds were reared deep litter in cages of 5 x 3 x 2.5 ft dimensions of each replicate. Standard brooding management practices and vaccination schedule were followed, for the first two weeks, chicks were fed using feed trays and thereafter chick feeders were used for feeding. Free choice clean and fresh drinking water was made available to all experimental birds for the entire duration of the experiment.

Table 1: Ingredient composition of chick ration

Ingredient	T_1	T_2	T_3	T_4	T_5
Maize	42	49	54	56	56
Soya DOC	30	31	31	32	32
DORB	24	16	10.5	6.5	5
Rice Bran Oil	0	0	0.5	1.5	3
DCP	1.5	1.5	1.5	1.5	1.5
PM	2.5	2.5	2.5	2.5	2.5
Total feed (kg)	100	100	100	100	100
Nutrient Composition (% on DM basis)					
CF%	6.46	5.86	6.43	5.63	6.32
EE%	2.09	2.12	2.25	2.46	3.16
NFE%	65.71	65.05	65.36	64.96	63.80
ASH%	6.72	6.76	6.69	6.74	6.68
Calculated CP (%)	20.16	20.28	20.07	20.22	20.04
Calculated ME (kcal/kg)	2616	2712	2810	2906	3003

Observations

Metabolic trial

At the end of feeding trial, after 8th week, a metabolic trial was conducted. Six birds from each treatment were randomly selected and shifted into metabolic cage. There was arrangement for measured quality of feed and collection of faeces in the metabolic energy free choose water was available through nipple dripper. The birds were individually fed with experimental treatment diet. The birds were given an adaptation period followed by 3 days collection of excreta. The quantity of excreta voided by individual treatment bird was collected and weighed quantitatively after every 24 hours and representative feed sample were collected and similarly aliquot of faecal samples were also processed for proximate principle in the feed and faeces as per AOAC, 2005.

The digestibility of nutrients was calculated using the following formula.

$$Digestibility\ percentage\ of\ nutrient = \frac{Nutrient\ in\ feed\ -\ Nutrient\ in\ faeces}{Nutrient\ in\ feed} \times 100$$

Statistical Analysis

The observations recorded during the experiment were statistically analyzed by using standard procedure for analysis of variance of CRD (Completely Randomized Design) as suggested by Snedecor and Cochran (1994).

Results and Discussion

All dietary treatments were isonitrogenous with crude protein ranged from 20.04 to 20.22 per cent. However, the calculated metabolizable energy were 2616, 2712, 2810, 2906 and 3003 kcal per kg diet. All other nutrients in experimental diets were in normal range across all the dietary treatment groups (Table-1). The nutrient intake, digestible nutrient intake and digestibility coefficients are presented in Table 2 and Fig. 1.

The intake and digestible intakes of nutrients viz DM, CP, EE, CF and NFE was significantly (P<0.01) higher in T1, T2 and T3 compared to T4 and T5 except DMI was found to be lowest in T1.

The significantly higher (P<0.01) in T_1 and T_2 group as compare to T_4, T_5 values observed in T_3 and T_4 didn't differ with T_1, T_2 and T_5 groups, respectively. The ether extract intake was significantly higher (P<0.01) in groups T_1, T_2 and T_5, with no significant difference among them, while T_3 and T_4 showed significantly lower intake. The result revealed was significantly (P<0.01) higher in T_1 group.

Crude fiber intake was significantly (P<0.01) higher in T_1, followed by T_2 and T_3 group. T1 showed the highest digestible CF intake followed by T3 and lowest in T4 and T5 groups. Nitrogen-free extract intake was significantly higher in T_1 and T_2 group. Similarly, the digestible nitrogen-free extract was significantly highest in T_2 group and lowest T_5 group. The digestibility coefficients of dry matter, crude protein, ether extract, crude fiber, and nitrogen-free extract (NFE) were significantly (P<0.01) influenced by dietary energy levels. T_2 showed the highest digestibility of dry matter (79.52%), ether extract (81.66%), and NFE (78.23%), while T_3 had the highest crude protein digestibility (82.46%). T_5 consistently showed the lowest digestibility values across all parameters. Crude fiber digestibility decreased gradually from T_1 to T_5 group.

Rao et al. (2005) and Yang et al. (2020) [4, 10], who reported improved dry matter digestibility in similar energy levels as reported in the present study. Significantly (P<0.01) highest (82.46%), CP digestibility was observed at moderate ME levels (2800 kcal) in present study which corroborates the results of Feitosa et al. (2023) [4], who observed improved CP digestibility with nutrient-balanced high ME diets.

EE intake and digestibility were higher in T_1 and T_3, consistent with Hernandez et al. (2024) [5]. CF intake and digestibility declined at higher ME levels, likely due to reduced fiber utilization, supporting energy-fiber interaction effects. NFE digestibility and nitrogen balance were highest in T_1 and T_2. Higher ME diets led to lower values, suggesting decreased carbohydrate and nitrogen utilization, as also noted by Yang et al. (2020) [4]. Nitrogen intake was not significantly affected by treatments. However, nitrogen balance was significantly ($P<0.01$) higher in T_1 and T_2 followed by T_3, while T_4 and T_5 had the lowest values. This indicates better protein utilization in diets with 2800 kcal ME/kg.

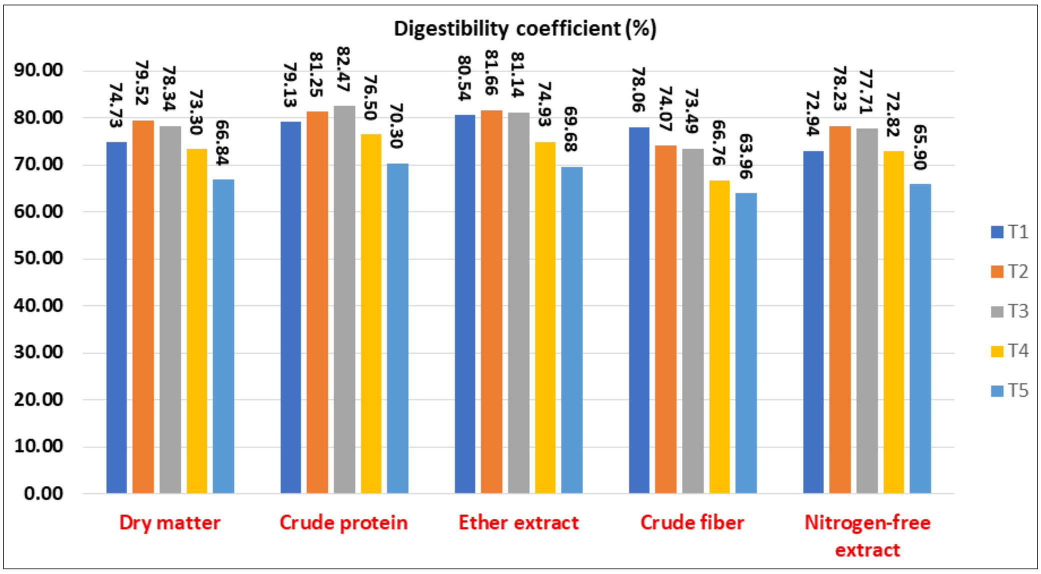

Fig 1: Effect of varying dietary energy levels on nutrient intake and utilization

Table 2: Effect of varying dietary energy levels on nutrient utilization in Mewari chicks

Particulars	T1	T2	T3	T4	T5	S. Em	CD	P value
DM intake (g/bird/day)	66.68±1.74^a	65.00±3.02^a	54.72±1.06^b	49.33±2.67^b	48.72±1.04^b	2.07	8.18**	0.001
Digestible DMI intake (g/bird/day)	49.92±2.08^c	79.52±3.33^a	78.34±1.08^a	73.30±2.74^{ab}	66.84±1.03^b	2.24	8.85**	0.001
CP intake (g/bird/day)	13.44±0.35^a	13.18±0.61^a	10.98±0.21^b	9.98±0.54^b	9.76±0.21^b	0.42	1.65**	0.001
Digestible CP intake (g/bird/day)	10.65±0.40^a	10.71±0.57^a	9.06±0.22^{ab}	7.67±0.55^{bc}	6.87±0.21^c	0.42	1.66**	0.001
EE intake (g/bird/day)	1.39±0.04^a	1.38±0.06^a	1.23±0.02^b	1.21±0.07^b	1.54±0.03^a	0.05	0.20**	0.001
Digestible EE intake (g/bird/day)	1.13±0.04^a	1.13±0.07^a	1.00±0.02^{ab}	0.92±0.07^b	1.07±0.03^{ab}	0.05	0.19*	0.025
CF intake (g/bird/day)	4.31±0.11^a	3.81±0.18^b	3.52±0.07^b	2.78±0.15^c	3.08±0.07^c	0.12	0.48**	0.001
Digestible CF intake (g/bird/day)	3.37±0.13^a	2.84±0.20^{ab}	2.59±0.07^b	1.87±0.15^c	1.97±0.07^c	0.13	0.53**	0.001
NFE intake (g/bird/day)	43.82±1.14^a	42.28±1.97^a	35.22±0.68^b	32.05±1.73^b	31.08±0.66^b	1.35	5.32**	0.001
Digestible NFE intake (g/bird/day)	32.02±1.38^{ab}	33.23±2.18^a	27.38±0.70^{bc}	23.49±1.78^{cd}	20.51±0.65^d	1.47	5.79**	0.001
Nitrogen intake (g/bird/day)	2.15±0.06	2.11±0.09	1.76±0.03	1.60±0.07	1.56±0.03	0.17	NS	0.070
Nitrogen balance (g/bird/day)	1.70±0.06^a	1.71±0.08^a	1.45±0.03^b	1.23±0.08^c	1.12±0.03^c	0.07	0.20**	0.001
Digestible coefficient								
Digestible coefficient of DMI	74.74±1.23^a	79.52±1.45^a	78.34±0.53^a	73.30±1.77^b	66.84±0.68^c	1.22	4.82**	0.001
Digestible coefficient of CP	79.13±1.01^a	81.26±1.67^a	82.46±0.43^a	76.50±1.56^b	70.30±0.61^c	1.17	4.60**	0.001
Digestible coefficient of EE	80.54±0.95^a	81.66±1.13^a	81.14±0.46^a	74.93±1.66^b	69.67±0.62^c	1.05	4.15**	0.001
Digestible coefficient of CF	78.06±1.06^a	74.07±1.83^b	73.49±0.65^b	66.76±2.20^c	63.96±0.74^c	1.43	5.66**	0.001
Digestible coefficient of NFE	72.94±1.31^b	78.23±1.54^a	77.71±0.54^{ab}	72.82±1.80^b	65.90±0.70^c	1.27	5.02**	0.001

Conclusion

It may be inferred from present study that diets containing 2800 kcal ME/kg energy and 20% crude protein found to be optimal for maximizing nutrient efficiency.

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