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Kanishka Solavia
M.Sc. Scholar, Department of Animal Production, Rajasthan College of Agriculture, Maharana Pratap University of Agriculture and Technology, Udaipur, Rajasthan, India

Siddhartha Mishra
M.Sc. Scholar, Department of Animal Production, Rajasthan College of Agriculture, Maharana Pratap University of Agriculture and Technology, Udaipur, Rajasthan, India

Pavan Salvi
M.Sc. Scholar, Department of Animal Production, Rajasthan College of Agriculture, Maharana Pratap University of Agriculture and Technology, Udaipur, Rajasthan, India

Harshvardhan Singh Purawat
M.Sc. Scholar, Department of Animal Production, Rajasthan College of Agriculture, Maharana Pratap University of Agriculture and Technology, Udaipur, Rajasthan, India

Corresponding Author:
Kanishka Solavia
M.Sc. Scholar, Department of Animal Production, Rajasthan College of Agriculture, Maharana Pratap University of Agriculture and Technology, Udaipur, Rajasthan, India

Nutrient utilization in Mewari chicks fed varying crude protein in the diet under intensive system in southern Rajasthan

Kanishka Solavia, Siddhartha Mishra, Pavan Salvi and Harshvardhan Singh Purawat

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Abstract
The purpose of this study was to determine the most effective protein levels for Mewari chicks. Five hundred ten day-old unsexed Mewari chicks were obtained from AICRP on Poultry Breeding, Rajasthan College of Agriculture, Udaipur. They were then randomly separated into five feeding groups, each with six repetitions of 17 birds. The chicks were raised using a deep litter housing system according to standard methods until they were 8 weeks old. These day-old Mewari chicks were given five distinct experimental diets that had the same calorie content but varied in crude protein levels: 16%, 17%, 18%, 19%, and 20%. To assess how different dietary protein levels affected nutrient use, a metabolic trial was performed once the feeding period concluded. The digestibility rates for all nutrients, except for dry matter (DM) which showed no significant difference, were notably higher in treatment group 3 (T_3) when compared to the other groups.
The average digestibility rates for crude protein (78.38±0.88), crude fiber (76.33±1.00), ether extract (EE) (85.91±0.59), and nitrogen-free extract (NFE) (80.14±0.840) were significantly greater ($p<0.01$) in the group that consumed the diet with 18% crude protein. Based on these outcomes, it can be concluded that providing 18% crude protein in the diet enhanced the digestibility of all nutrients in Mewari chicks, identifying this as the most favorable level for them during their first 0-8 weeks of age.

Keywords: Mewari chicks, crude protein, digestibility coefficients

Introduction
Poultry farming is a largest profitable and economically viable venture as it provides employment to the large section of the society. Poultry refers to birds like chickens, ducks, and turkeys that people raise for their eggs, meat and feathers. The poultry industry involves the breeding, hatching, rearing and processing of domestic birds. Rearing poultry is a very old practice in our country and it is now an important contributor to the economy in rural and semi- urban areas. In the Indian poultry market, approximately 70% of the total production originates from the organized sector, with the remaining 30% coming from the unorganized sector. For egg production, India's southern region is the biggest contributor at around 57%. The eastern and central regions collectively produce about 17%, and the northern and western regions together account for 26% of the total Mewari is the only registered breed of Rajasthan which has been originated from Southern Rajasthan and is distributed in many other districts of Rajasthan. This breed is small to medium-sized, distinguished by its multi-colored feathers and a red, single comb. In their natural environment, adult females usually weigh between 1.09 and 1.47 kg, with males typically weighing 2.29 kg. However, an average egg production of 37-52 an age at first egg ranging from 6-7.5 months, its productivity remains low (Mishra *et al.*, 2022) [4].
Soybean De-oiled Cake (DOC) stands out as the most popular vegetable protein source, despite its frequent high cost. Due to the increased availability and reasonable price of synthetic amino acids, new diet formulations have been adopted. These diets are now created with precise amino acid concentrations and minimum protein levels to effectively reduce costs and lessen nitrogen excretion. There has been lot work on utilization of nutrients in broiler, however such work on indigenous chicken is very scarce and the information on Mewari chick is not available.

Materials and Methods

Experimental birds and diets

A total of 510 straight-run, day-old Mewari chicks were obtained from AICRP on Poultry breeding, Rajasthan College of Agriculture, Udaipur. They were randomly separated into five different dietary treatment groups, with each group further divided into six replicates of 17 birds. The chicks were reared in a deep litter housing system, adhering to standard practices.

The chicks were fed five different iso caloric experimental rations containing five different levels of crude protein *viz.* 16, 17, 18 19 and 20%. The experimental diets comprised of Maize, Soyabean De Oiled Cake (DOC), De oiled Rice Bran (DORB), Rice bran oil, Dicalcium Phosphate and vitamin mineral premix as depicted in Table-1

Table 1: Ingredients and nutrient composition or ration

	Kg/100 kg				
Ingredient	**T_1**	**T_2**	**T_3**	**T_4**	**T_5**
Maize	55	54	53	52	52
Soya DOC	20	23	26	29	31
DORB	20	18	16	14	12
Rice bran oil	1	1	1	1	1
DCP	1.5	1.5	1.5	1.5	1.5
PM	2.5	2.5	2.5	2.5	2.5
Total	100	100	100	100	100
Nutrient composition (% on DM basis)					
DM	90.47	90.63	90.14	89.63	90.02
CP	16.40	17.37	18.39	19.41	20.07
EE	2.75	2.67	2.59	2.38	2.21
CF	5.68	5.78	6.12	6.08	5.98
NFE	71.66	70.36	68.92	68.08	67.63
Calculated ME (kcal/kg)	2829	2829	2831	2832	2842

At eight weeks of age, a metabolic trial was commenced. This involved randomly selecting two birds (one male and one female) from each replicate within the treatment groups and transferring them to metabolic cages. This ensured precise measurement of feed intake and the complete collection of all excreta (faeces and urine combined) from a total of ten birds per treatment. This is done to accurately determine the digestibility and utilization of nutrients from different diets. The birds were individually fed with experimental diet. The birds were given adaptation period of 6 days followed by 3 days collection of excreta voided. For subsequent nutrient analysis, measurements of feed offered, feed waste, and voided excreta were meticulously recorded during the collection phase. During the trial, the excreta (droppings) from each individual bird in every treatment group were collected and weighed every 24 hours at precisely 8:00 AM. Simultaneously, representative samples of the feed offered were taken for a detailed proximate analysis. Following this, aliquots (sub-samples) of the faecal matter were also carefully prepared for a comprehensive nutrient analysis. This meticulous collection ensured accurate data for understanding nutrient digestion and utilization. The proximate principles present in the feed and faeces were determined as per AOAC, 2005.

Statistical Analysis

The experiment's structure was based on the completely randomized design (CRD). All collected data, encompassing parameters like body weight, body weight gain, feed intake, feed conversion ratio, nutrient digestibility, and the economic aspects of rearing Mewari chicks, underwent analysis via analysis of variance, adhering to the methodology presented by Snedecor and Cochran (1994).

Results and Discussion

All the dietary treatments were iso caloric with metabolizable energy ranged from 2829-2842 Kcal/kg diet, However the CP contents were 16.40, 17.37, 18.39, 19.41 and 20.07% in T_1, T_2, T_3, T_4 and T_5 respectively. All the other nutrients were in experimental diets were normal range across all dietary treatments groups (Table 1). The nutrient intake, digestible nutrient intake and digestibility coefficients are presented in Table 2 and Fig.1.

Table 2: Effect of different levels of protein in diet on nutrient intake (g) and digestibility coefficients (%)

Particulars	**T_1**	**T_2**	**T_3**	**T_4**	**T_5**	**SEM**	**CD**
Dry Matter Intake (DMI)	58.44±1.59	56.10±1.01	59.92±2.43	58.04±1.67	56.63±1.56	1.72	NS
Digestible DMI	41.30±1.24	42.14±1.18	46.58±2.19	41.37±1.33	42.24±0.81	1.43	NS
Digestibility Coefficient of DM	73.76±1.60	73.55±0.32	72.96±1.03	73.22±0.98	74.05±1.39	1.15	NS
Crude Protein Intake (CPI)	$9.52^{c} \pm 0.22^{c}$	$9.91^{c} \pm 0.18$	$11.11^{ab} \pm 0.38$	$10.93^{b} \pm 0.25$	$11.71^{a} \pm 0.16$	0.25	0.74**
Digestible CP intake	$6.89^{c} \pm 0.20$	$7.73^{b} \pm 0.21$	$9.07^{a} \pm 0.40$	$8.63^{a} \pm 0.25$	$8.82^{a} \pm 0.16$	0.26	0.76**
Digestibility Coefficient of CP	$72.43^{c} \pm 0.89$	$74.92^{b} \pm 0.78$	$78.38^{a} \pm 0.88$	$75.56^{b} \pm 0.57$	$75.27^{b} \pm 0.37$	0.73	2.13**
Crude Fibre Intake (CFI)	3.29±0.07	3.30±0.06	3.69±0.12	3.56±0.08	3.75±0.05	0.08	NS
Digestible CF intake	$2.16^{c} \pm 0.07$	$2.37^{bc} \pm 0.07$	$2.82^{a} \pm 0.13$	$2.61^{ab} \pm 0.08$	$2.54^{b} \pm 0.05$	0.08	0.25**
Digestibility Coefficient of CF	$65.51^{c} \pm 1.12$	$71.94^{b} \pm 1.05$	$76.33^{a} \pm 1.00$	$73.19^{b} \pm 0.64$	$67.87^{c} \pm 0.49$	0.89	2.62**
Ether Extract Intake (EEI)	$1.59^{a} \pm 0.03$	$1.52^{a} \pm 0.02$	$1.56^{a} \pm 0.05$	$1.34^{b} \pm 0.03$	$1.28^{b} \pm 0.01$	0.03	0.11**
Digestible EE Intake	$1.29^{a} \pm 0.03$	$1.28^{a} \pm 0.03$	$1.34^{a} \pm 0.05$	$1.12^{b} \pm 0.03$	$0.98^{c} \pm 0.01$	0.03	0.11**
Digestibility Coefficient of EE	$81.30^{c} \pm 0.60$	$84.31^{b} \pm 0.58$	$85.91^{a} \pm 0.59$	$83.55^{b} \pm 0.39$	$76.22^{d} \pm 0.35$	0.51	1.52**
NFE Intake (NFEI)	41.60±0.97	40.15±0.74	41.64±1.45	38.35±0.89	39.47±0.55	0.97	NS
Digestible NFE Intake	30.45±0.89	31.31±0.87	33.42±1.51	29.48±0.90	28.53±0.55	0.99	NS
Digestibility Coefficient of NFE	$73.16^{c} \pm 0.87$	$77.92^{b} \pm 0.83$	$80.14^{a} \pm 0.84$	$76.82^{b} \pm 0.56$	$72.27^{c} \pm 0.42$	0.72	2.12**
N intake	$1.52^{c} \pm 0.03$	$1.58^{c} \pm 0.02$	$1.77^{ab} \pm 0.06$	$1.75^{b} \pm 0.04$	$1.87^{a} \pm 0.02$	0.04	0.11**
N balance	$1.10^{b} \pm 0.03$	$1.16^{b} \pm 0.02$	1.45 ± 0.06^{a}	1.38 ± 0.04^{a}	1.41 ± 0.02^{a}	0.04	0.12**

Figures presenting a different superscript within its row denotes a statistically significant divergence ($P<0.01$).

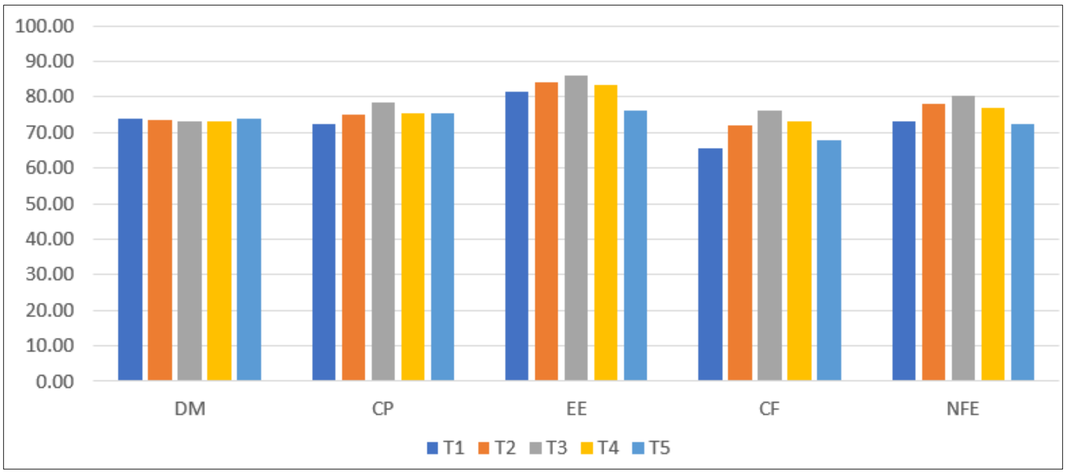

Fig 1: Digestibility coefficients of nutrients in Mewari chicks fed different levels of Crude Protein

Following the conclusion of the 8-week feeding trial, a comprehensive metabolic trial was executed to ascertain the digestibility coefficients of the various dietary regimens administered to the Mewari chicks. The ensuing data, precisely detailing nutrient intake and subsequent utilization, is meticulously catalogued within Table 4.6.

The dry matter intake (g/bird/day) was 58.44±1.59, 56.10±1.01, 59.92±2.43, 58.04±1.67 and 56.63±1.56 g in T_1, T_2, T_3, T_4 and T_5 groups respectively. Nevertheless, no statistically significant variation in DMI was observed among the distinct dietary treatment groups.

The mean digestible dry matter intakes were 41.30±1.24, 42.14±1.18, 46.58±2.19, 41.37±1.33 and 42.24±0.81 g in T_1, T_2, T_3, T_4 and T_5 groups respectively. The variations in mean digestible dry matter intake among groups were minor and not statistically significant.

The mean digestibility coefficients of dry matter for groups T_1, T_2, T_3, T_4, and T_5 were recorded as 73.76±1.60%, 73.55±0.32%, 72.96±1.03%, 73.22±0.98%, and 74.05±1.39% respectively. However, the differences in dry matter digestibility between these groups were not statistically significant.

The mean crude protein intakes (g/bird/day) were 9.52±0.22, 9.91±0.18, 11.11±0.38, 10.93±0.25 and 11.71±0.16 in T_1, T_2, T_3, T_4 and T_5 groups respectively. The data revealed that the difference in the mean CP intake was significantly higher in ($P<0.01$) T_5 followed by T_3, T_4 and lowest in T_2 and T_1. However, T_3 did not differ with T_5 and T_4. Similarly, the difference in CP intake in T_1 and T_2 was also found to be non-significant.

The mean digestible crude protein intakes were 6.89±0.20, 7.73±0.21, 9.07±0.40, 8.63±0.25 and 8.82±0.16 g in T_1, T_2, T_3, T_4 and T_5 groups respectively. The data revealed that the mean digestible CP intake was significantly higher ($P<0.01$) in T_3, T_5, T_4, followed by T_2 and lowest in T_1. The difference between T_3, T_5 and T_4 was found to be non-significant.

The mean digestible crude protein coefficients were 72.43±0.89, 74.92±0.78, 78.38±0.88, 75.56±0.57 and 75.27±0.37% in T_1, T_2, T_3, T_4 and T_5 respectively. It was found that T_3 demonstrated significantly higher crude protein digestibility ($P<0.01$). While, the overall ranking from highest to lowest digestibility was T_3 followed by T_4, T_5, T_2 and lowest in T_1. The differences in digestibility among T_4, T_5 and T_2 were not statistically significant.

The mean crude fibre intake (CFI) were 3.29±0.07, 3.30±0.06, 3.69±0.12, 3.56±0.08 and 3.75±0.05 g in T_1, T_2, T_3, T_4 and T_5 groups respectively. The keen perusal of data revealed that the difference in mean CF intake was non-significant.

The mean digestible CF intakes were 2.16±0.07, 2.37±0.07, 2.82±0.13, 2.16±0.08 and 2.54±0.05 g respectively in T_1, T_2, T_3, T_4 and T_5 groups. The difference in mean digestible CF intake was found to be significantly higher in T_3 ($P<0.01$) followed by T_4, T_5, T_2 and lowest in T_1. However, the digestible CF intake in T_3 did not differ significantly with T_3, T_5 and T_2. Similarly, the digestible CF intake in T_2 was found to be statistically non-significant with T_4, T_5 and T_1.

The mean digestibility coefficients of crude fibre were 65.51±1.12, 71.94±1.05, 76.33±1.00, 73.19±0.64 and 67.87±0.49% in T_1, T_2, T_3, T_4 and T_5 groups respectively. The mean value was significantly higher in T_3 ($P<0.01$) followed by T_4, T_2 and lowest in T_5 and T_1. However, the difference in mean digestibility in T_4 and T_2 and T_5 and T_1 did not differ significantly.

The mean Ether Extract intakes were 1.59±0.03, 1.52±0.02, 1.56±0.05, 1.34±0.03 and 1.28±0.01 g in T_1, T_2, T_3, T_4 and T_5 groups respectively. It was found that the mean EE intake was significantly higher ($p<0.01$) in T_1, T_3 and T_2 as compared to T_4 and T_5. However, the difference in ether extract intake among T_1, T_3 and T_2 and T_5 and T_4 was small and statistically non-significant.

The mean digestible EE intakes were 1.29±0.03, 1.28±0.03, 1.34±0.05, 1.12±0.03 and 0.98±0.01 g in T_1, T_2, T_3, $T_4$and T_5 groups respectively. The difference in mean digestible EE intake amongst different groups was found to be significantly higher in T_3 followed by T_1, T_2 and lowest in T_4 and T_5. However, the difference in T_3, T_1, T_2 were found to be non-significant.

The mean digestibility coefficients of ether extract were 81.30±0.60, 84.31±0.58, 85.91±0.59, 83.55±0.39 and 76.22±0.35% in T_1, T_2, T_3, T_4 and T_5 groups respectively. The mean digestibility coefficient in significantly higher in ($P<0.01$) T_3 followed by T_2, T_4, T_1 and lowest in T_5. Based on the data analysis, it was determined that the mean digestibility coefficient of ether extract for groups T_2 and T_4 was statistically non- significant.

The mean NFE intake was 41.60±0.97, 40.15±0.74, 41.64±1.45, 38.35±0.89 and 39.47±0.55 g in T_1, T_2, T_3, T_4 and T_5 groups respectively. The keen perusal of data revealed that the difference in mean NFE intake was non-significant.

The mean digestible NFE intakes were 30.45±0.89, 31.31±0.87, 33.42±1.51, 29.48±0.90 and 28.53±0.55 g in

T_1, T_2, T_3, T_4 and T_5 respectively. The mean digestible intake was found to be statistically non-significant.

The mean digestibility coefficients of NFE were 73.16±0.87, 77.92±0.83, 80.14±0.84, 76.82±0.56 and 72.27±0.42% in T_1, T_2, T_3, T_4 and T_5 respectively. The perusal of data revealed that the mean digestibility coefficient of NFE was significantly highest ($P<0.01$) in T_3 followed by T_2, T_4 and lowest in T_1 and T_5. However, the difference in T_2 and T_4 and T_1 and T_5 were found to be non-significant.

The nitrogen intakes in different groups were 1.52±0.03, 1.58±0.02, 1.77±0.06, 1.75±0.04 and 1.87±0.02 g in T_1, T_2, T_3, T_4 and T_5 respectively. It was found from the perusal of data that the nitrogen intake was significantly ($P<0.01$) higher in T_5 followed by T_3, T_4 and lowest in T_2 and T_1. However, the difference between T_1 and T_2 was non-significant and value observed in T_3 did not differ with T_4 and T_5.

The nitrogen balances were 1.10±0.03, 1.16±0.02, 1.45±0.06, 1.38±0.04 and 1.41±0.02 g in T_1, T_2, T_3, T_4 and T_5 groups respectively. The mean of nitrogen balance was significantly higher ($P<0.01$) in T_3, T_5 and T_4 as compared to T_2 and T_1. However, the difference between T_3, T_5 and T_4 and T_2 and T_1 was found to be statistically non-significant.

The digestibility coefficients of CP, CF, EE and NFE were found to be significantly higher in T_3 compared to other treatment groups indicating better utilization of nutrients which resulted in higher body weight gains and feed efficiency.

In opposition to the findings of this study, Perveen *et al.* (2017) [5] observed non-significant effect on digestibility and nutrient balances in Vanaraja chicken fed different levels of protein and energy. Similar results were also observed by Candrawati (2020) [3] in a study determine the effects of disparate dietary energy-to-protein ratios on both feedstuff digestibility and the initial growth performance of indigenous chicken breeds.

Wang *et al.* (2020) [7] studied the impact of disparate dietary crude protein inclusion rates and exogenous protease on growth performance. A total of 960 fourteen-day-old male ducks were systematically allocated to ten distinct dietary treatments, each replicated in six pens. A regimen featuring 13.5% CP evinced a propitious effect ($P<0.05$) on meat quality, the utilization efficiency of dietary dry matter, energy and nitrogen as well as the standardized ileal digestibility of amino acids. Nevertheless, within the confines of this study, an 18% protein concentration markedly elevated the digestibility coefficients of nutrients.

Sefat *et al.* (2022) [2] examined how supplementing diets with an emulsifier blend at varying metabolizable energy and crude protein levels affected broiler performance. It was observed that the emulsifier blend increased the ileal digestibility of crude protein and crude fat, along with the apparent metabolizable energy for nitrogen balance ($P<0.05\%$). Notably, this positive response was more pronounced at lower ME concentrations, indicating a significant ME x Emulsifier blend (EB) interaction.

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