



Hemp Seed Supplementation in Layer Pullets

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Growth Performance and Nutrient Retention in Layer Pullets Fed Hemp Seed Supplemented Diet

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ABSTRACT

This study examined the effects of hemp seed supplementation on body weight, body weight gain (BWG), average daily feed intake (ADFI), and feed conversion ratio (FCR) in layer pullets over an 18-week period. A total of 72-day-old commercial white leghorn birds were divided into three treatment groups—T1, T2, and T3—based on their body weight. Each group consisted of four replicates, with six birds per replicate, resulting in 24 birds per group. The T1 group received a basal diet of maize and soybean meal, while the T2 and T3 groups were supplemented with hemp seeds at 1.5% and 3%, respectively. During the initial 0-8 weeks, the layer pullets were fed starter feed, transitioning to grower feed from 9 to 16 weeks of age. Daily feed intake, weekly residual feed, and biweekly body weight were monitored throughout both the starter and grower periods. During the starter phase, hemp seed supplementation showed no significant effect on initial body weight, final body weight, BWG, or ADFI. However, it significantly improved the feed conversion ratio (FCR) compared to the control group. Additionally, hemp supplementation improved the retention of crude fiber and calcium. In conclusion, the addition of hemp seed has the potential to enhance the growth performance of layer pullets during the growth phase of the experiment.

KEYWORDS: Body weight, Feed conversion ratio, Feed intake, Hemp seed, Nutrient retention.

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INTRODUCTION

Hemp seed has been a vital food source for thousands of years in various cultures (Callaway, 2004), and its nutritional profile makes it particularly advantageous for enhancing the growth performance of layer pullets. Comprising about 30% oil, 25% protein, and 34% carbohydrates, hemp seeds also provide dietary fiber, vitamins, and minerals (Callaway, 2004). The oil is rich in polyunsaturated fatty acids (PUFAs), including essential fatty acids like linoleic acid (55.48%) and alpha-linolenic acid (21.51%) (Uluata and Ozdemir, 2012), which are crucial for overall health and optimal growth (Schwab et al., 2006).

Incorporating hemp seed into layer hens' diets can significantly impact their growth performance by enhancing muscle development and supporting overall health. The essential amino acids found in

hemp seeds, such as arginine and methionine, contribute to muscle growth and development during this critical phase (Callaway, 2004). Additionally, the presence of linoleic and linolenic fatty acids can improve the nutritional quality of eggs and meat, potentially increasing their market value (Gakhar et al., 2012; Goldberg et al., 2012; Silversides and Le Francois, 2005).

Furthermore, hemp seeds are rich in antioxidants that help mitigate oxidative stress, promoting better health outcomes in young birds (Parker et al., 2003). The inclusion of hemp seed can lead to formulations that provide significant antioxidant benefits, which may enhance the growth rates and immune responses of layer pullets (Uluata and Ozdemir, 2012).

Given these potential benefits, the current study aims to assess the effects of hemp seed

supplementation on the growth performance of layer pullets. Moreover, research studies on the effect of hemp supplementation on layer pullet is lacking, and by exploring how this nutritious addition can improve growth metrics and overall health, this research seeks to contribute valuable insights into sustainable poultry production practices.

MATERIALS AND METHODS

Experimental Design and Housing

A total of 72-day-old layer pullets (n=72) were used in this experiment. The experiment was designed in 3 dietary treatments having four replications of each. In the study, 6-layer pullets for each replication and 24 for each treatment were used. The study was conducted at poultry farm of Directorate of livestock farm, Department of Animal Nutrition, Guru Angad Dev Veterinary and Animal Sciences University, Ludhiana. The investigation was carried out between July 2023 and November 2023, stretching over a duration of 16 weeks. Preceding the arrival of the chicks, the poultry shed had a white-washing process followed by disinfection with fumigants. Additionally, bedding material, measuring 6-8 cm in height, was laid on the floor to provide thermal insulation for the chicks. Pullets were labelled and weighed on the first day and then divided into three distinct groups, T1, T2, and T3, based on their weight. Conscientious adherence to the

vaccination schedule was maintained throughout the investigation. Periodic deworming was performed every two months. Throughout the starter and grower stages, the birds were raised in a deep litter system using conventional management practices, with unrestricted feeding.

Experimental diets

Proximate composition of all the raw materials used in the experiment were analysed using AOAC (2005) methods, and the experimental diets were formulated based on the findings of these analyses. T1 group received a basal diet based on maize and soybean meal. T2 and T3 groups received hemp seed supplementation at a concentration of 1.5%, and 3% respectively. The layer pullets were provided with starter feed from 0 to 8 weeks, and then transitioned to grower feed from 8 to 16 weeks of age. The formulated diets were both isonitrogenous and isocaloric. The ingredient and chemical composition of starter and grower diets is given in table 1 and 2, respectively. Starter diets were formulated for 2900 kcal/kg ME, 20.5% CP, Lysine 1.12%, Methionine 0.53%, Ca 1.05% and Phosphorous 0.48% whereas diet formulated for grower period contained 2800 kcal/kg ME, 18% CP, 0.96% lysine, 0.44% methionine, 1.05% Ca and 0.42% phosphorous. Major protein sources used during formulation were soybean meal and meat cum bone meal whereas energy sources were maize and rice polish.

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Table 1. Ingredient composition of starter diet

Ingredient	T1	T2	T3
Maize (%)	64.8	64.5	64
Soybean meal (%)	21.7	21.3	20.6
Meat cum bone meal (%)	5	5	5
Rice Polish (%)	6	5.26	4.96
Hemp seed (%)	0	1.5	3
Dicalcium Phosphate (%)	0.65	0.65	0.65
Limestone Powder (%)	0.85	0.85	0.85
Salt (%)	0.26	0.26	0.26
Lysine (%)	0.17	0.18	0.19
Methionine (%)	0.18	0.19	0.18
Vitamin/mineral premix (%)	0.31	0.31	0.31
Total	100	100	100
Calculated Analysis			
Metabolizable Energy (Kcal/kg)	2900	2900	2900
Lysine (%)	1.12	1.12	1.12
Methionine (%)	0.53	0.53	0.53
Analyzed values			
Crude Protein (%)	20.5±0.09	20.5±0.11	20.5±0.10
Calcium (%)	1.05±0.03	1.06±0.05	1.14±0.07
Phosphorous	0.47±0.01	0.46±0.01	0.48±0.02
Crude Fiber	4.40±0.26	5.14±0.19	5.48±0.08
Ether Extract	3.23±0.02	3.47±0.17	3.68±0.10

Table 2. Ingredient composition of Grower diet

Ingredient	T1	T2	T3
Maize (%)	62	57.3	55.5
Soybean meal (%)	20.9	19.2	18.2
Meat cum bone meal (%)	5	5	5
De-oiled Rice Polish (%)	10	15	16.3
Hemp seeds (%)	0	1.5	3
Dicalcium Phosphate (%)	0.25	0.2	0.2
Limestone Powder (%)	1.1	1.1	1.1
Salt (%)	0.26	0.26	0.26
Lysine (%)	0.01	0.02	0.03
Methionine (%)	0.1	0.09	0.09
Vitamin/mineral premix (%)	0.31	0.31	0.32
Total	100	100	100
Calculated Analysis			
Metabolizable Energy (Kcal/kg)	2800	2800	2800
Lysine (%)	0.96	0.96	0.96
Methionine (%)	0.44	0.44	0.44
Analysed values			
Crude Protein (%)	18.0±0.12	18.0±0.06	18.05±0.05
Calcium (%)	1.05±0.022	1.07±0.02	1.06±0.02
Phosphorous	0.42±0.014	0.43±0.01	0.43±0.02
Crude Fiber	6.29±0.071	6.52±0.14	7.31±0.09
Ether Extract	3.03±0.028	3.18±0.03	3.49±0.05

Collection of samples and measurements

Layer pullets were individually weighed every two weeks using a digital electronic weighing balance. The average body weights and weight gain for the starter (0-8 weeks) and grower phases (8-16 weeks) were then determined.

Each replicate of birds was given an appropriate and adequate quantity of feed. On a weekly basis, the residue was collected. The average weekly feed intake of each group was calculated by subtracting the feed residue from the total feed supplied, then by dividing the total feed intake in that week by the number of birds (hen days), taking into account any mortality, if any. Body weight gain, ADFI and FCR were calculated for each phase.

The Feed Conversion Ratio (FCR) was calculated by dividing the total amount of feed consumed during the particular period by the cumulative gain in weight during the same period.

Feed Intake (g)

$$\text{FCR} = \frac{\text{Feed Intake (g)}}{\text{Body weight gain (g)}}$$

A 4-day metabolic trial was conducted in the 8th week of the experimental period using 4 birds per treatment, following the approach of Hill and Anderson (1958), to determine the utilization of crude protein, crude fiber, dry matter, organic matter, ether extract, calcium, and phosphorus using cages. After the adaptation period of 4 days, a measured quantity of feed for the next 3 days was offered to each replicate during the morning and evening hours. The feed residue and excreta voided were collected carefully during the 3 days collection period. An aliquot of excreta was mixed with pre weighed 25 mL of 10% Sulphuric acid and stored to avoid nitrogen loss till nitrogen analysis. Other excreta collected and feed residue were oven-dried for 24 h at 80 °C. The metabolizability of the nutrients are calculated as per the following formula.

$$\% \text{ Metabolizability} = \frac{\text{Amount of nutrient intake} - \text{Amount of nutrient excreted}}{\text{The amount of nutrient intake}} \times 100$$

*Amount of nutrient intake = (Amount of nutrient in feed offered) – (Amount of nutrient in feed residue)

Statistical analysis

The data pertaining to the various parameters were analyzed using one way ANOVA (SPSS (2012) version 21) as per Snedecor and Cochran (1994). The means were compared using Duncan's multiple range test (Duncan, 1955) for significance at 5% level.

RESULTS AND DISCUSSION

Chemical composition of hemp seeds

Proximate study of hemp seed revealed a crude protein content of 26.04%, a crude fiber content of 30.2%, and an ether extract content of 32.75%. Silversides and Lefrancois (2005), reported that hemp seed contains 93.4% DM, 24.9% CP, 5.8% ash, and 33.2% EE. Neijat et al. (2014) reported that on proximate analysis hemp seed has values of DM (93.8%), CP (37.8%), CF (29.2%), and ash (6.24%).

Hemp seeds have 95.11 percent dry matter, 21.05% crude protein, 31.45% fat, and 8.8% ash, according to research by Konca et al. (2014). The following was reported by Mierliã (2019): 91.1% DM, 24.68% CP, 31.19% EE, 4.72% ash, and 16.06% fiber in hemp seed. Using proximate analysis based on data compilation from the aforementioned studies, hemp seed contains approximately 21.05–37.8% CP, 16.06–29.2% CF, and 31.19–33.2% EE. The values of proximate components of hemp seed are comparable to the levels reported by the forementioned researchers.

Table 3. Chemical composition of hemp seeds

Particulars	Hemp seed(n=5)
Crude protein (%)	26.1±0.18
Crude Fibre (%)	30.2±0.09
Ether Extract (%)	32.7±0.15

Impact on growth parameters during different phases

The growth performance of layer pullet fed hemp seed @ 1.5 % and 3.0 % for starter phase (0-8 week) is presented in Table 4. Non-significant effect of hemp seed on initial body weight, final body weight, body weight gain (BWG), and average daily feed intake (ADFI) was observed during the starter phase but FCR was significantly improved with hemp supplementation as compared to control. Khan et al. (2010) also observed the same trend where better FCR was observed with increasing levels of hemp supplementation.

Significant effect of hemp seed on growth parameters was observed during grower phase (Table 4) where hemp seed supplementation significantly improved ADFI at 3% level. But non-significant difference between hemp supplemented groups and control was observed for body weight, BWG and FCR. BWG was numerically higher in hemp supplemented group @3% but the effect was statically non-significant. The increased feed intake could be due to the presence of Tetrahydrocannabinol (THC) which is a potent lipophilic antioxidant which stimulates appetite (Hampson et al., 2000; Koch, 2001).

Table 4. Effect of feeding different levels of hemp seeds on the growth performance of layer pullet during starter phase (0-8 weeks)

Treatment	T1	T2	T3	SEM	P Value
Starter Phase (0-8 weeks)					
Initial body weight (g)	38.58	38.36	38.54	0.059	0.281
Final body weight (g)	533.03	535.13	538.46	3.509	0.845
BWG (g)	494.45	496.77	499.92	3.490	0.842
ADFI (g)	30.48	29.16	29.54	0.254	0.077
FCR	3.45 ^b	3.29 ^a	3.31 ^a	0.029	0.023
Grower Phase (9-16 weeks)					
Initial body weight (g)	533.03	535.13	538.46	3.510	0.845
Final body weight (g)	1003.05	1009.31	1017.98	3.302	0.186
BWG (g)	470.02	474.19	479.52	2.763	0.409
ADFI (g)	47.15 ^a	47.31 ^a	48.76 ^b	0.229	0.000
FCR	5.62	5.59	5.70	0.034	0.438

^{ab}Means bearing different superscripts in a row differ significantly (P <0.05).

Nutrient retention

The digestibility coefficients of dry matter, crude protein, crude fibre, organic matter and retention of calcium and phosphorus in starter pullets fed various level of hemp seed is presented in table 5. There was no significant effect on dry matter, crude protein, ether extract and organic matter digestibility at 1.5

% and 3% level of hemp seed supplementation as compare to control. But significantly higher CF retention was observed in hemp seed supplemented treatment (T2 & T3) as compared to control (T1). Hemp supplementation significantly affected the apparent utilization of minerals where calcium retention was higher in T3 group where hemp seed was supplemented @3% as compared to control.

Table 5. Effect of supplementation of hemp seeds on retention of nutrients in layer pullet

Treatment	T1	T2	T3	SEM	P Value
DMD (%)	70.0	70.1	69.6	0.38	0.89
CPD (%)	65.5	66.4	66.7	0.44	0.64
CFD (%)	35.6 ^a	42.7 ^b	42.1 ^b	1.45	0.01
EED (%)	85.2	87.6	87.9	0.86	0.46
OMD (%)	76.9	75.7	75.9	0.42	0.32
Ca (%)	41.0 ^a	42.2 ^{ab}	43.6 ^b	0.49	0.02
P (%)	40.3	39.8	41.5	0.45	0.37

^{ab}Means bearing different superscripts in a row differ significantly (P <0.05).

CONCLUSION

Hemp supplementation enhanced the feed conversion ratio (FCR) of layer pullets during the starter phase. Additionally, the groups receiving hemp showed improved nutrient retention for calcium and crude fiber. These results indicate that hemp supplementation not only improves FCR but also enhances nutrient retention, ultimately promoting the growth of layer pullets.

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