



EFFECT OF USING FENUGREEK SEEDS POWDER AS A FEED ADDITIVE IN BROILER CHICKS DIET ON GROWTH PERFORMANCE AND SOME METABOLIC RESPONSES

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ABSTRACT: This work was carried out to research the impact on growth performance, carcass characteristics, nutrient digestibility, some blood constituents and economic efficiency of the use of different levels of fenugreek seed powder (FSP) in growing Sasso chicks diet as a natural feed additive. A total of 120 unsexed Sasso broiler chicks, aged one day were divided into four care groups. There were three replicas of 10 birds each in each group. The 1st group was fed a control diet, while the 2nd, 3rd and 4th groups were fed a control diet plus 0.5 %, 1.0 % and 1.5% powder of fenugreek seeds. In order to estimate certain biochemical parameters, a digestibility trail was carried out and blood samples were taken. Economic efficiency was measured for the different levels of fenugreek seeds used in the diet of Sasso broiler chicks. The obtained results showed that the use of 1% fenugreek seed powder in the diet of Sasso broiler chicks significantly enhanced live body weight, body weight gain, feed conversion, crude protein digestibility, dressing percentage, blood serum total protein and cholesterol. Moreover, birds fed a diet supplemented by 1.0% fenugreek seed powder, the highest values of economic efficiency and relative economic efficiency were reported.

Keywords: fenugreek, broiler performance, digestibility, carcass, some blood parameters

INTRODUCTION

Feed additives have essential materials that can increase the efficiency of the utilisation of feed and the performance of animals. The prospect of using new natural alternative feed additives in animal diets instead of antibiotics and hormones has recently been exploited (Abbas, 2010). Phytogetic additives, which include a group of natural feed additives derived from herbs, spices or other plants or their extracts in the form of essential oils, are one of the potential alternatives identified in poultry production (Windisch et al., 2008). In order to increase efficiency by improving digestibility, nutrient absorption and removal of pathogens resident in the gut, Athansiadou et al. (2007) announced that phytoGENICS were introduced into the animal feed diet. Javed et al. (2009) suggested that different plant extracts would boost the ratio of feed conversion, increase the quality of carcasses, decrease the broiler's market age and decrease the cost of rearing. Fenugreek (*Trigonella foenum*), which has a medicinal plant and a strong spicy and seasoning type of sweet flavour, is one of the various phytoGENICS available (Blank, 1996). Fenugreek is used in functional foods, traditional foods, nutraceuticals, as well as in physiological uses such as antibacterial, antiparasitic, anti-cancer, anti-ulcer, anthelmintic, hypo-cholesterolemic, hypoglycemic, antioxidant, antidiabetic agent, and has a beneficial impact on digestion and the ability to alter food texture (Murlidhar and Goswami, 2012). Seeds of fenugreek are rich in proteins, fats, total carbohydrates and minerals such as calcium, phosphorus, iron, zinc, magnesium (Gupta et al., 1996), predominantly linoleic fatty acids. Linolenic, Palmitic and Oleic (Schryver, 2002). It also includes neurin, biotin, trimethylamine, which through its action on the nervous system helps to stimulate the appetite (Michael and Kumawat, 2003). PABA (Para-Amino Benzoic Acid), lecithin, choline, saponin, flavonoids and antibiotic compounds are also present in fenugreek seeds (Mamoun et al., 2014). Fenugreek seeds are regarded as an appetiser and assist in digestion; improving health and growth performance. Supplementation of fenugreek seed poultry diets decreased total plasma lipids and total cholesterol in broiler chicks (Azouz, 2001). (Azouz, 2001). The inclusion of fenugreek seeds in the diet significantly improved broiler chicken's body weight (Qureshi et al., 2015) and improved broiler breeder males' reproductive and physiological efficiency (Taha, 2008).

The current work was carried out to research the effect on growth efficiency of adding fenugreek seed powder to broiler diets, carcass characteristics, metabolic and physiological responses.

MATERIAL AND METHODS

A total number of one hundred twenty unsexed, one day old Sasso broiler chicks were randomly divided into 4 experimental groups, 30 birds each. Each group contained 3 replicates of 10 birds. Chicks in the 1st group were provided with commercial diet contained (crude protein 20%, crude fiber 3.50%, ether extract 3.85% and 2950 Kcal/kg diet metabolizable energy) and considered control group. The 2nd, 3rd and 4th groups were fed the control diet supplemented with 0.5, 1.0 and 1.5% fenugreek seeds powder, respectively. Fenugreek seeds were purchased from locally market and grinded to a fine powder and kept at room temperature until requested. Sample of grinded seeds was taken for proximate analysis as shown in Table (1).

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Chicks were distributed in wire cages and housed in two-tiers floor batteries located in an open house under similar managerial and hygienic conditions. Artificial lighting was provided 24 hours daily during the first week, after that it was reduced to 23 hours until the end of experimental period (8 weeks of age). The temperature in brooding house was about 36° C for the first 3 days of age, after that it was reduced 2 degrees weekly up to 24° C then was kept till the end of experimental period. Free access water and feed were available all time. The live body weight and feed consumption of each replicate were recorded to the nearest gram each two weeks throughout the experimental periods from 0 to 8 weeks of age. Body weight gain was calculated as g / bird and feed conversion as g feed/g weight gain biweekly and during the whole experimental period from 0 to 8 weeks of age. At the end of the experiment (8 weeks of age), three birds from each group were randomly chosen to estimate carcass traits. Birds were individually weighed, slaughtered and after complete bleeding, scalded and feathers were plucked. Carcasses were eviscerated, heads and shanks were separated, then the carcasses were chilled in tap water for about 10 minutes. Eviscerated carcasses were individually weighed and dressing percentage was calculated (weight of carcass × 100 / pre-slaughter weight). Percentage of giblets (liver + gizzard + heart + abdominal fat) and offal's were calculated in relation to carcass weight.

Blood samples were collected from slaughtered birds in un-heparinized tubes, then were centrifugated at 3000 rpm\min. for 20 minutes to obtain blood serum. The serum was stored at -20 °C until analysis. Some chemical blood serum parameters (total protein, albumin, glucose and total cholesterol) were determined according to (Gornal et al., 1949), (Tietz and Saunders, 1995) and (Trinder, 1969) respectively. Globulin was calculated (total protein- albumin). Also, albumin\globulin ratio was calculated.

At the beginning of the 9th week of age, three birds from each treatment were randomly chosen in digestibility trial and fed on the same diets used during the experimental period. Feed consumed was determined and feces output was collected daily, scattered feed and feather were separated and taken out of the feces. Samples of the tested diets and collected feces for each treatment were pooled together, dried at 60° C till constant weight, ground in a mill and then kept in glass cans for chemical analysis. Digestion coefficient was calculated as follow:

$$\text{Digestibility (\%)} = \frac{\text{Nutrient in feed} - (\text{Nutrient in feces})}{\text{Nutrient in feed}} \times 100$$

Approximate chemical analysis of the experimental diets and excreta were undertaken according to the official methods of A.O.A.C (1990). Fecal nitrogen was determined according to Jakobsen *et al* (1960). Economic efficiency of dietary treatments was estimated at the end of period as described by Bayoumi, (1980) as net revenue per unit of feed cost. Cost of one kilogram feed for different diets, the cost of feed/ kg gain, and the cost of feed/ birds were calculated based on the prices of feed and one kilogram of live body weight prevailing in local market at the time of experimental. The relative economic efficiency was estimated as follow:

$$\text{Total revenue (TR)} = \text{final live body weight (FLBW)} \times \text{market price of one kg of LBW}$$

$$\text{Net revenue (NR)} = \text{total revenue} - \text{total feed cost (TFC)}$$

$$\text{Whereas, TFC} = \text{total feed intake} \times \text{price of feed}$$

Economic efficiency (EE)= NR\TFC

Data were statistically analyzed by the analysis of variance using the General Linear Model (GLM) procedure of Statistical Analysis System (SAS, 1998). Significant differences among treatments were separated by Duncan's multiple range tests Duncan (1955).

RESULTS AND DISCUSSION

Live body weight and body gain:

The data provided in Table (2) showed that adding fenugreek seed powder to broiler diets recorded significant ($P \leq 0.05$ or $P \leq 0.01$) on average live body weight at 6 and 8 weeks of age and average weight gain during periods of 6-8 and 0-8 weeks. Chicks fed diets containing 1.0 % fenugreek seeds powder, the heaviest body weight at 6 and 8 weeks of age and the highest weight gain between 6 to 8 weeks and the entire period (0-8 weeks). On the other hand, the lightest body weight at 6 and 8 weeks of age and the lowest weight gain during 6-8 and the whole duration (0 – 8 weeks) were significantly reported for chicks fed diet containing 1.5 % fenugreek seeds powder. Similar results were obtained by Toaha *et al.* (2016), concluding that the addition of moderate levels (1-2 %) for broiler diets by fenugreek seeds increased both body weight and body weight gain, while the addition of high body weight and body weight gain were significantly lower (3 %). Azouz (2001), Abu-Dieyeh and Abou-Darwish (2008), Alloui *et al.* (2012), and Qureshi *et al.* (2015) have pointed to a rise in live body weight and body weight by feeding broiler chicks on diets containing fenugreek seeds.

The improvement in live body weight and body weight gain of broilers fed diet supplemented with 1.0% fenugreek seeds may be due to that the fenugreek seeds contain of fat soluble, unidentified factors (Murray *et al.*, 1991), The existence of important fatty acids and high-quality proteins has a stimulating impact on the villus height of the broiler digestive system (Mamoun *et al.*, 2014) and the contents of active compounds such as antibacterial, antifungal, anti-inflammatory, carminative and antioxidant activities that have improved the body gain (Hamden *et al.*, 2010). These results are consistent with the findings of Toaha *et al.*, (2016) which concluded that the moderate level of FSP had the highest body weight for broilers when these broilers were fed on a diet containing 2% FGS during the whole feed trial and the broilers fed on a high level (3 %) of FGS had significantly lower live body weight and weight gain ($P \leq 0.05$) than those fed on other levels (1 and 2 %) of FGS.

Feed intake (g/ bird):

The effect of using fenugreek seeds powder in broiler diets on average of feed intake was significant ($P \leq 0.05$ or $P \leq 0.01$) during 2 – 4, 4 – 6, 6 – 8 0 – 8 weeks of age intervals (Table 3). The data showed that broiler chicks fed diet supplemented with .0 or 1.5% fenugreek seeds powder were significantly consumed lower amount of feed compared to those fed control or diet containing 0,5% fenugreek seeds powder during all age intervals except at 0-2 weeks. These results indicated that feed consumption of broiler chicks was decreased with increasing fenugreek seeds powder levels in the diet. In agreement with the present results, Abbas (2010) observed that feed intake of broiler chicks fed fenugreek seed diets decreased significantly over 42 days of age, although differences were not significant over 21 days of age. Durrani et

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al. (2007) and Abbas and Ahmed (2010) concluded that adding a high level of ground fenugreek seed to the broiler chick diet reduced feed consumption.

Decreased feed consumption of broiler chicks with rising levels of fenugreek seed in the diet could be due to the presence of bitter taste and pungent odour in fenugreek seeds (Kout El-Kloub, 2006).

Feed conversion(g feed/g weight gain):

Average of feed conversion of broiler chicks was significantly affected by addition fenugreek seeds only during the whole experimental period from 0 to 8 weeks of age (Table 3). These findings showed that compared to the other dietary treatments, broiler chicks fed diet supplemented with 1.0 % fenugreek seed powder had substantially improved feed conversion. The present results were consistent with those obtained by Abu-Dieyeh and Abu-Darwish (2008) and AL-Betawi and El-Ghousein (2008), which revealed that broiler chicks' feed conversion ratio was improved by adding fenugreek seeds to their diet.

The improvement in the feed conversion ratio of broilers fed with fenugreek seed supplemented diets may be due to an increase in body weight gain and a decrease in feed intake. In addition, Alloui et al., (2012); Mukhtar et al., (2013)a and Weerasingha and Atapattu, 2013) indicated that the improved feed conversion for birds fed diets containing 1.0% fenugreek seeds could be related to the development of gastrointestinal tissue morphological changes in broiler chicks gut that can be induced by differences in microbial content of gut fluid including their metabolization.

Digestibility of nutrients:

Averages of nutrients digestibility coefficients as affected by addition of different levels of fenugreek seeds powder are presented in (Table 4). The data showed that the effect of addition fenugreek seeds to broiler chicks diets on digestibility of nutrients was highly significant only on crude protein. The greatest value of crud protein digestibility was recorded for birds fed diet containing 1.0% fenugreek seeds powder. Results obtained by Magda (2012) showed that inclusion 1.5 % fenugreek seeds in broiler diet was useful for improving protein efficiency ratio. Improving the digestibility of crude protein for birds fed diets supplemented with fenugreek seeds can result in long contact between the digesta and mucosal epithelium due to its positive impact on intestinal morphology, which may be more effective for digestion and absorption of nutrients (Boguslawska-Tryk et al., 2012).

Carcass characteristics:

Data presented in Table (5) showed that the effect of dietary fenugreek seeds on some carcass characteristics for Sasso broiler chicks was significant ($P \leq 0.05$) only on dressing percentage. The greatest dressing percentage was recorded for birds fed (1.0%) fenugreek seeds powder compared with other dietary treatments. the improvement of dressing percentage as a result of adding 1.0% fenugreek seeds to Sasso broiler may be due to the heavier body weight at slaughter. Similar results were obtained by Mamoun *et al.* (2014) and Toaha et al. (2016) they observed that dressing percentage of broiler chicks was significantly improved by addition fenugreek seeds to the diet at 1% and 2%, respectively. Recent findings are also consistent with those obtained by Elkhider (2002), Alloui et al. (2012), Nadir et al. (2012) and Isam et al.

(2018), who concluded that the dressing percentage was substantially influenced by the addition of FSP but had no significant effects on the characteristics of the carcass.

Biochemical blood parameters:

The impact of dietary fenugreek seeds on the biochemical blood parameters of Sasso broiler chicks on serum total protein and cholesterol concentration was significant ($P \leq 0.05$), while serum glucose, albumin, globulin and albumin/globulin ratio variations were not significant (Table 6). Broiler chicks fed diet supplemented with 1.0% fenugreek seeds powder had significantly the highest value of serum total protein and the lowest value of cholesterol concentration compared to other dietary treatments. Birds fed control diet without addition recorded the highest value of cholesterol. In agreement with the present results, Azouz (2001) found that total protein and globulin of serum increased significantly by feeding Hubbard broiler chicks on diets supplemented with fenugreek seeds. Similarly, Khadr and Abdel-Fattah (2007) concluded that supplementation of the broiler diet with 1 % fenugreek modulated cholesterol profile in the serum may be reflected in the meat and benefit human diets. Also, Duru et al. (2013) and Abdul-Rahman (2012), Safaei et al. (2013) and Mamoun et al. (2014) reported that feeding commercial broiler chicks on diet containing fenugreek seed powder lowered total plasma lipids and cholesterol levels. The increase in total serum proteins can mainly be due to the fact that fenugreek seeds can directly stimulate the thyroid gland as serum T3 and T4 are significantly increased and contribute to increased serum protein content (Hassan, 2000). The decrease in serum cholesterol levels may be due to the presence of saponins and resins in fenugreek seeds (such as hemicelluloses, mucilage, tannin and pectin) that inhibit bile acid, help lower LDL-cholesterol and inhibit intestinal cholesterol absorption, thereby reducing blood cholesterol levels (Petit et al., 1995 and Mukhtar et al., 1995).

Economic efficiency:

Total feed cost, total revenue, net revenue, economic efficiency and relative economic efficiency for Sasso broiler chicks fed diets supplemented with different levels of fenugreek seeds powder are presented in (Table 7). The highest values of total revenue, net revenue, economic efficiency and relative economic efficiency recorded for birds fed diet containing 1.0 % fenugreek seeds powder compared with other dietary treatments. These results are in line with the findings of Mamoun et al., (2014), Toaha et al., (2016) and Mukhtar et al. (2013 b) they concluded that broiler chicks fed on diet containing 1% fenugreek seeds recorded the highest profit compared to control group.

The improvement in economic efficiency and relative economic efficiency by addition fenugreek seeds powder to broiler diet is due to the heavier final body weight and the lower total feed consumption which decreased the total feed cost and increased total revenue. In addition, Toaha et al., (2016) stated that the increased profitability of broilers fed rations containing herbal growth promoters can be attributed to improved feed utilisation quality, leading to more growth and better conversion feed for live weight gain.

CONCLUSION

Addition of fenugreek seeds powder (as natural feed additives) at level 1.0% to Sasso broiler diet improved growth performance, digestibility of crude protein, dressing

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percentage, some blood parameters and economic efficiency.

Table (1): The proximate analysis of fenugreek seeds powder.

Nutrient	%
Dry matter	90.67
Crude protein	30.82
Crude fiber	14.80
Ether extract	3.42
Ash	4.50
Nitrogen free extract	46.46

Table (2): Effect of fenugreek seeds powder on live body weight (LBW) and body weight gain (BWG) of Sasso broiler chicks.

Items	Age\ weeks	Fenugreek seeds powder levels				SE	Sign.
		0.0%	0.5%	1.0%	1.5%		
LBW	0	43.00	40.67	40.76	40.7	0.95±	NS
	2	219.04	210.7	228.0	222.3	8.47±	NS
	4	639.40	659.67	683.00	631.0	14.10±	NS
	6	1344.50 ^b	1330.33 ^b	1422.0 ^a	1291.67 ^b	19.98±	**
	8	2095.12 ^a	2088.09 ^{ab}	2204.9 ^a	1960.67 ^b	37.51±	*
BWG	0-2	176.04	170.03	186.7	181.8	±8.89	NS
	2-4	420.63	448.90	455.0	408.78	±19.17	NS
	4-6	705.10	670.60	709.0	660.08	±21.25	NS
	6-8	750.70 ^{ab}	757.85 ^{ab}	782.9 ^a	672.00 ^b	±23.09	*
	0-8	2052.12 ^{ab}	2047.40 ^{ab}	2164.14 ^a	1920.0 ^b	±36.89	*

^{a, b and c} means in the same rows for each treatment having different letter(s) are significantly different ($p \leq 0.05$) NS= not significant ($p > 0.05$) * = significant ($p \leq 0.05$) ** = high significant ($p \leq 0.01$)

Table (3): Effect of fenugreek seeds powder on feed intake (FI) and feed conversion ratio (FCR) of Sasso broiler chicks.

Items	Age\ weeks	Fenugreek seeds powder levels				SE	Sign.
		0.0%	0.5%	1.0%	1.5%		
FI	0-2	327.0	315.70	283.33	306.67	10.03±	NS
	2-4	869.66 ^a	844.8 ^{ab}	803.76 ^b	730.00 ^c	18.72±	**
	4-6	1489.33 ^a	1398.96 ^{ab}	1313.38 ^b	1336.5 ^b	39.75±	*
	6-8	1832.0 ^{ab}	1956.8 ^a	1746.7 ^b	1710.28 ^b	38.78±	*
	0-8	4522.9 ^a	4488.08 ^a	4143.35 ^b	4116.70 ^b	75.81±	**
FCR	0-2	1.87	1.86	1.51	1.70	±0.09	NS
	2-4	2.07	1.89	1.76	1.89	±0.07	NS
	4-6	2.11	2.09	1.85	2.02	±0.06	NS
	6-8	2.44	2.59	2.28	2.56	±0.11	NS
	0-8	2.21 ^a	2.19 ^a	1.91 ^b	2.14 ^a	±0.04	**

^{a, b and c} means in the same rows for each treatment having different letter(s) are significantly different ($p \leq 0.05$) NS= not significant ($p > 0.05$) *= significant ($p \leq 0.05$) **= high significant ($p \leq 0.01$)

Table (4): Effect of fenugreek seeds powder on nutrients digestibility.

Items	Fenugreek seeds powder levels				SE	Sign.
	0.0%	0.5%	1.0%	1.5%		
DM%	75.95	73.75	76.81	74.61	±2.07	NS
OM%	74.06	73.99	75.78	73.30	±1.65	NS
CP%	74.99 ^{ab}	73.93 ^{bc}	78.95 ^a	69.27 ^c	±1.45	**
CF%	34.07	32.51	33.21	32.43	±4.12	NS
EE%	83.00	82.01	81.59	80.75	±1.21	NS
NFE%	75.00	74.55	76.36	75.38	±1.86	NS

^{a, b and c} means in the same rows for each treatment having different letter(s) are significantly different ($p \leq 0.05$) NS= not significant ($p > 0.05$) **= high significant ($p \leq 0.01$)

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Table (5): Effect of fenugreek seeds powder on carcass characteristics .

Items	Fenugreek seeds levels				SE	Sign.
	0.0%	0.5%	1.0%	1.5%		
Pre slaughter W.	2221.76	2128.09	2218.30	2250.0	110.09±	NS
Carcass w.	1520.25	1438.53	1656.0	1529.33	92.64±	NS
Dressing %	68.43 ^b	67.97 ^b	74.65 ^a	67.86 ^b	1.90±	*
Liver %	3.48	3.51	3.98	4.35	0.38±	NS
Gizzard %	1.85	2.13	2.46	1.82	0.18±	NS
Heart %	0.94	1.37	1.40	0.98	0.22±	NS
Abd. Fat %	1.90	2.12	1.99	2.22	0.39±	NS
Giblets %	7.66	9.21	9.80	9.37	0.93±	NS

^{a,b and c} means in the same rows for each treatment having different letter(s) are significantly different ($p \leq 0.05$) NS= not significant ($p > 0.05$) *= significant ($p \leq 0.05$)

Table (6): Effect of fenugreek seeds on some biochemical blood parameters of Sasso broiler chicks.

Items	Fenugreek seeds levels				SE	Sign.
	0.0%	0.5%	1.0%	1.5%		
Glucose (mg/dl.)	177.06	180.54	186.66	185.67	18.82±	NS
Total protein (g/dl)	2.63 ^b	2.72 ^b	3.90 ^a	3.13 ^{ab}	0.29±	*
Albumin (g/dl)	1.22	1.18	1.36	1.21	0.59±	NS
Globulin (g/dl)	1.41	1.54	2.43	1.93	±0.37	NS
Alb./glob.	0.87	0.77	0.63	0.39	0.17±	NS
Cholesterol (mg/dl)	156.03 ^a	129.17 ^{ab}	110.67 ^b	123.33 ^{ab}	6.20±	*

^{a and b} means in the same rows for each treatment having different letter(s) are significantly different ($p \leq 0.05$) NS= not significant ($p > 0.05$) *= significant ($p \leq 0.05$)

Table (7): Effect of fenugreek seeds on economic efficiency and relative feed efficiency of Sasso broiler chicks.

Items	Fenugreek seeds powder levels			
	0.0%	0.5%	1.0%	1.5%
Live weight (0-8) wks	2095.12	2088.09	2204.9	1960.7
Feed intake(0-8) wks	4522.9	4488.1	4243.3	4116.7
Price of feed E.P.\1 kg	6.20	6.25	6.30	6.35
Total feed cost	28.04	28.05	26.10	26.14
Total revenue	52.38	52.20	55.00	49.00
Net revenue	24.33	24.15	28.90	22.9
Economic efficiency	0.87	0.86	1.12	0.89
Relative economic efficiency	100.00	98.85	130.23	103.49

Price of fenugreek seeds= 10.00 E.P. \ 1 kg
Selling price = 25.00 E.P.\1 kg live body weight

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الملخص العربي

تأثير استخدام مسحوق بذور الحلبة كأضافة غذائية على النمو وبعض الاستجابات التمثيلية لدجاج الساسو النامي

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اجريت هذه التجربة لدراسة تأثير استخدام مستويات مختلفة من مسحوق بذور الحلبة كأضافة غذائية طبيعية على النمو ، صفات الذبيحة، معامل هضم المواد الغذائية، بعض مكونات الدم والكفاءة الاقتصادية في دجاج الساسو النامي. تم استخدام ١٢٠ كتكوت ساسو عمر يوم ، غير مجنس وتم تقسيمهم الى ٤ مجموعات كل مجموعة ٣ مكررات فى مكررة ١٠ طيور. المجموعة الاولى أختيرت ككنترول والمجموعات الثانية والثالثة والرابعة تم تغذيتهم على عليقة الكنترول مضافا اليها مسحوق بذور الحلبة بنسبة ٠,٥ و ١,٠ و ١,٥ % على التوالي. تم تقدير بعض مكونات الدم كما اجريت تجربة هضم و اخذت عينات الدم . و تم حساب الكفاءة الاقتصادية للمستويات المختلفة المستخدمة من مسحوق بذور الحلبة في علائق دجاج الساسو النامى .

النتائج المتحصل عليها اظهرت ان الطيور التى تغذت على عليقة الكنترول مضافا اليها ١% من مسحوق بذور الحلبة سجلت تحسن معنوى فى كل من الوزن الحى، الزيادة فى وزن الجسم، معدل التحويل الغذائى، معامل هضم البروتين، نسبة التصافى ، والبروتين الكلى والكوليسترول الكلى لسيرم الدم . كما أوضحت النتائج ايضا ان اعلى قيمة للكفاءة الاقتصادية و الكفاءة الاقتصادية النسبية تم تسجيلها للطيور المغذاه على ١% بذور حلبة كإضافة غذائية لعليقة الكنترول وذلك مقارنة بالمجموعات الاخرى.