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EFFECT OF USING FENUGREEK AND FENNEL SEEDS AS NATURAL FEED ADDITIVES ON PERFORMANCE OF BROILER CHICKS.

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SUMMARY

The objective of this study was to evaluate the effect of fenugreek (FK) and fennel (FL) seeds as natural feed additives in broiler diets. A total number of 280 unsexed one-day-old Hubbard chicks were used in this study. The broiler chicks were divided randomly into seven experimental groups. Each experimental group included 40 chicks in 4 replicates (10 chicks/replicate). The first experimental group represents the control and fed basal diets, while the groups from 2 to 7 received the basal diets supplemented with either fenugreek seeds (*Trigonella Foenum graecum L.*) or fennel seeds (*Foeniculum Vulgare Mill*) at different levels of 0.50, 1.0 and 1.50 % of diet, respectively. The experimental groups were nearly equal in the live body weight at the start of the experiment. The experiment was extended up to 7 weeks of age. The main results could be summarized as follows:-

- Live body weight at 7 week old, body weight gain, feed conversion ratio, protein efficiency ratio, performance index, economic efficiency and relative economic efficiency were significantly improved for chicks fed diets supplemented with FK or FL at 0.50% or 1.5% as compared to control diet. The higher values in average feed consumption were recorded for the groups fed diets with 1.5% FK or 1.0 and 1.5% FL while, the lower values were recorded in groups fed diets with 0.50 and 1.0% FK or 0.50% FL as compared to the control group during the whole experimental period.
- There were significant improvements in efficiency of energy utilization values for chicks fed either FK or FL at levels of 0.50 and 1.5% compared with the control group during the whole experimental period.
- Addition of FK and FL especially at 0.50% significantly improved CP and CF. While EE was improved by 0.50% FL only. The least value was observed for the control diet, while the highest value was for the diet supplemented with 0.50% FL.
- Generally, plasma total protein, albumin and globulin of broiler chicks were increased, while plasma total lipids, total cholesterol, uric acid, GPT and GOT were decreased for groups fed either FK or FL diets compared to those fed the control diet.
- Plasma level of calcium was increased, while plasma level of phosphorous was decreased in general for broiler chicks receiving FK or FL diets.
- Supplementation of FK and FL into broiler diets did not affect blood haemoglobin or relative internal organs weights (liver, heart, spleen, bursa and pancreas).

It is concluded that using fenugreek and fennel as natural feed additives at 0.50% can improve the productive performance, nutrients digestibility coefficients, blood components and the economic efficiency of broilers.

Keywords: *fenugreek, fennel, broiler diets, Hubbard chicks, performance, feed conversion, blood plasma*

INTRODUCTION

There are a large number of feed additives available for inclusion in animal and poultry diets to improve animal performance. However, the use of chemical products especially (hormones and antibiotics), may cause unfavorable side effects. Moreover, there is evidence indicating that these products could be considered as pollutants for human and threaten their health on the long-run. Attempts to use the natural materials such as medicinal plants could be widely accepted as feed additives to improve the efficiency of feed utilization and animal productive performance (Aboul-Fotouh *et al.* 1999).

Herbs and herbal extracts contain different phytochemical compounds with biological activity that may provide therapeutic effects. Several herbs, for example help to reduce high blood cholesterol concentrations, provide some protection against cancer, and/or stimulate the immune system. Furthermore, it was found that a diet in which culinary herbs are used generously to flavor food provides a variety of active phytochemical that promotes health and protect against chronic diseases (Craig, 1999 and Abdo *et al.* 2003).

Regarding fenugreek seeds (FK), it was found to be rich in protein, fat, total carbohydrates and minerals such as calcium, phosphorous, iron, zinc and magnesium (Gupta *et al.* 1996). Fenugreek benefits the digestive system as a laxative, intestinal lubricant, carminative, vomiting, colitis, swell, vermifuge, digestive and tonic, helps dissolve fat and cholesterol deposits, prevents fat accumulation and water retention, and helps lower blood sugar levels. It is traditionally used to treat wounds, inflammation, abscesses, arthritis, coughs and bronchitis as well as to reduce mucus production and good for asthma and lung disorders (Castleman, 1991; Ody, 1993; Duke, 2002 and Sahelian, 2004).

Fenugreek contains an amino acid called 4-hydroxyisoleucine, which appears to increase the body's production of insulin when blood sugar levels are high. It may reduce the amounts of calcium oxalate in the kidneys and conditions affecting the male reproductive tract. Recent studies suggest that fenugreek and its active constituents may possess anticarcinogenic potential. Studies in rodents indicate that fenugreek has immune stimulating, antioxidant and anti-tumor properties, and protects the liver against alcohol toxicity. Administration of fenugreek seed extract with ethanol to rats prevented the enzymatic leakage and the rise in lipid peroxidation. The seeds exhibited appreciable antioxidant property in vitro which was comparable with that of reduced glutathione and vitamin E. Further, examination of liver and brain revealed that, extract of fenugreek seeds could offer a significant protection against ethanol toxicity. Fenugreek also has anti- ulcer properties. (Sahelian, 2004).

Fennel seeds are rich in total carbohydrates (61.0%) and low in total soluble sugars (7.6%). The seeds are rich in calcium, phosphorous and magnesium and contained considerable amounts of potassium, iron and zinc and traces of manganese. The major fatty acid components of fennel seeds are 18:1 (71.31%) and 18:2 (11.66%). Fennel seeds are high in isoleucine and histidine (Abou-Raiia *et al.* 1991). Fennel is a good herb for the entire

digestive system as a laxative, appetite stimulant, antispasmodic and carminative, relieves abdominal pain, and is useful for gastrointestinal and colon disorders, may help acid stomach. Fennel acts as a mild expectorant; useful for coughs or bronchitis and to resolve phlegm, promotes liver and kidney function and health (Simon *et al.* 1984).

The objectives of the present study were to investigate the effect of fenugreek (FK) and fennel (FL) seeds addition at different levels (0.50, 1.0 or 1.5%) into broiler diets on growth performance, nutrients digestibility coefficients, some blood biochemical parameters and economic efficiency.

MATERIALS AND METHODS

The present study was carried out at the Poultry Nutrition Research Section, Department of Poultry Production, Faculty of Agriculture, Ain Shams University, Cairo, Egypt.

A total number of 280 unsexed one-day-old Hubbard chicks were used in this study. The broiler chicks were divided randomly into seven experimental groups. Each experimental group included 40 chicks in 4 replicates (10 chicks/replicate). The first experimental group represents the control and fed basal diets (Table 1), while the groups from 2 to 7 received the basal diets supplemented with either fenugreek seeds (Trigonella Foenum graecum L.) or fennel seeds (Foeniculum Vulgare Mill) at different levels of 0.50, 1.0 and 1.50 % of diet, respectively. The fenugreek and fennel seeds were supplemented on the expense of yellow corn. The experimental groups were nearly equal in the live body weight at the start of the experiment. The experiment was extended up to 7 weeks of age.

The experimental period included three feeding phases (starter, from 0-3 weeks of age; grower, from 3-5 weeks of age and finisher, from 5-7 weeks of age). The basal diets were 23.07%, 20.10% and 18.02% CP and 3105, 3205 and 3201 kcal ME /kg diet of the starter, grower and finisher, respectively. All diets within each feeding period were formulated to be nearly isonitrogenous and isocaloric. Experimental diets were formulated to meet the nutrient requirements of the broiler chicks (NRC, 1994). The composition and chemical analysis of the control diets are presented in Table (1).

Feed and water were supplied ad libitium during the experimental periods. Chicks were grown in brooders with raised wire floors and exposed to 24 hours of constant light. All chicks were kept under the same managerial hygienic and environmental conditions.

Individual body weight was recorded at one day, three, five and seven weeks of age. Live body weight (LBW), body weight gain (BWG), feed consumption (FC), feed conversion ratio (FCR, g feed/g gain), protein efficiency ratio (PER, g gain/g crude protein consumed) and efficiency of energy utilization (EEU, ME consumed kcal/g gain) were also recorded during these periods.

At 7 weeks of age, 6 birds from each experimental group were used to determine the digestibility coefficients of nutrients. Faecal nitrogen was determined according to the method outlined by Jakobsen *et al* (1960). The proximate analysis of the experimental

Table (1). Composition of basal diets and their chemical analysis.

Items	Starter (0-3 weeks)	Grower (3-5 weeks)	Finisher (5-7 weeks)
Ingredients (%):			
Yellow corn	52.40	61.34	67.00
Soybean meal (44%)	33.00	24.40	22.45
Corn gluten meal	7.00	7.00	4.10
Plant Oil	4.00	4.00	3.45
Bone meal	2.50	1.90	1.48
Limestone	0.40	0.65	0.90
Premix*	0.30	0.30	0.30
NaCl	0.25	0.25	0.25
DL- Methionine	0.10	0.04	0.02
L- Lysine	0.05	0.12	0.05
Total	100	100	100
Chemical analysis:			
Detemined analysis (%) :			
Dry matter (DM)	91.80	91.09	90.83
Organic matter (OM)	85.32	84.93	84.83
Crude protein (CP)	23.07	20.10	18.02
Crude Fiber (CF)	4.07	3.87	3.65
Ether Extract (EE)	6.40	6.70	6.33
Nitrogen free extract (NFE)	51.78	54.26	56.83
Total ash	6.48	6.16	6.00
Calculated analysis:			
ME Kcal/Kg diet	3105	3205	3201
Calcium (%)	1.01	1.01	0.91
Availabile phosphorous (%)	0.45	0.45	0.37
Lysine (%)	1.32	1.32	1.09
Methionine (%)	0.56	0.56	0.43
Cystine (%)	0.36	0.36	0.31
Meth. + Cystine (%)	0.92	0.92	0.74

* Each 3 kg of vit-mineral mixture contain vit A 10 m IU, vit D3 1 m IU, vit E 10 g, vit k3 1 g, vit B1 1g, vit B2 4.0g, vit B6 1.5g, Nicotinic acid 20g, Pantothenic acid 10g,vit B12 0.01g, Biotin 0.05g, Folic acid 30g, Choline chloride 50g, Iron 30g,Manganese 40g, Copper 3g, Iodine 0.45g, Zinc 45g and Selenium 0.1g.

diets and excreta were carried out according to A.O.A.C (1990).

Ten blood samples were collected from each experimental group at 7 weeks of age (5 male and 5 female birds) in heparinized tubes. Hematocrit (PCV %) was determined using heparinized capillary tubes and microhematocrit centrifuge. The blood samples were centrifuged at 3000 rpm for 15 min. and plasma obtained was stored at -20°C until analysis. Plasma total protein, albumin, total lipids, total cholesterol, uric acid, transaminase enzyme activities (GPT and GOT) and minerals (calcium and phosphorous) were determined calorimetrically using available commercial kits produced from Bio-Systems, Barcelona, Spain. The globulin values were obtained by subtracting the values of albumin from the corresponding values of total protein. Relative weights of liver, heart, spleen, bursa and pancreas were estimated after slaughter test for each experimental group (5 male and 5 female birds).

The economic efficiency (%) was calculated from the input-output analysis based upon the differences in both growth rate and feeding cost (Heady and Jensen, 1954). Performance index (live body weight (kg)/ feed conversion ratio x 100) was calculated according to North (1981).

The obtained data were statistically analyzed using the general linear model procedure described in SAS User's Guide (SAS, 1998). Differences among means were tested using Duncan's multiple range test (Duncan, 1955).

RESULTS AND DISCUSSION

1-Proximate analysis of fenugreek (FK) and fennel seeds (FL):-

The proximate analysis of tested natural feed additives is presented in Table (2). The proximate analysis of FK on air dry matter basis was found to be:- 9.03, 90.97, 84.47, 30.05, 15.02, 8.63, 30.77 and 6.50% for moisture, DM, OM, CP, EE, CF, NFE and total ash, respectively. However, the chemical analysis values of FK were partially within the published values reported by Azouz (2001), except CP, EE and CF which were lower than the values of this study. Nitrogen free extract (NFE) value obtained by Azouz (2001) was higher in FK than the value found in the present study. Fennel seeds contained nutrient compounds on air dry matter basis were moisture (8.75%), DM (91.25%), OM (87.34%), CP (30.12%), EE (7.13%), CF (6.44%), NFE (43.65%) and ash (3.91%). The values of metabolizable energy (ME) were 3852 and 3729 kcal/kg for FK and FL, respectively. The obtained results indicated that, FL contained almost the same values of DM, OM and CP as compared to FK but, lower values of both EE and total ash. The fennel seeds contained higher level of NFE as compared to FK. The results indicated the nutritious value of FK and FL in addition to their active medicinal substances. It was found that the active chemical components of fenugreek seeds included high percentages of carbohydrate fraction (mucilaginous fiber, galactomannan); 20-30% protein high in tryptophan and lysine; pyridine-type alkaloids; flavonoids; free amino acids (4-hydroxyisoleucine, arginine, lysine, histidine); saponins; glycosides; vitamins, minerals, and volatile oils (Sahelian, 2004). The aroma and flavor components of the essential oils for fennel seeds contain anethole, limonene,

Table (2): Chemical composition of fenugreek (FK) and fennel (FL) seeds.

Items	On air dry basis		On dry matter basis	
	FK seeds	FL seeds	FK seeds	FL seeds
Moisture (%)	9.03	8.75	-	-
Dry matter (%)	90.97	91.25	100	100
Organic matter (%)	84.47	87.34	92.85	95.72
Crude protein (%)	30.05	30.12	33.03	33.01
Ether extract (%)	15.02	7.13	16.51	7.81
Crude fiber (%)	8.63	6.44	9.49	7.06
Total ash (%)	6.50	3.91	7.15	4.28
NFE (%)	30.77	43.65	33.82	47.84
ME (kcal/kg)#	-	-	3852	3729

Calculated according to Carpenter and Clegg (1956) by applying the equation:-
ME (kcal/kg) = (35.3*CP %)+(79.5*EE %)+(40.6*NFE %) +199.

fenchone, estragole (methyl chavicol), safrole, alpha-pinene, camphene, beta-pinene, sabenine, beta-myrcene, phellandrene, cis-ocimene, para-cymene, gamma-terpinene, camphor, and several other volatile constituents as well as a fixed oil (Simon *et al.* 1984).

2- Productive performance:-

2.A- Live body weight (LBW) and body weight gain (BWG):-

Values of LBW and BWG of hatching day-old broiler chicks fed on experimental diets are shown in Table (3). There were insignificant differences in initial LBW among different experimental groups. In general, there were significant ($P \leq 0.0.05$ or 0.01) increases in LBW at 3, 5 and 7 weeks of age and BWG from 0-3 weeks, 3-5 weeks, 5-7 weeks and 0-7 weeks of most treated groups with FK or FL, in comparison to experimental group fed on the un-supplemented control diet. These results are in agreement with that of El-Ghamry et al (2004) who found that, addition of FK to Muscovy ducklings at 1.5% level had significantly ($P \leq 0.0.05$) heavier LBW and BWG than those fed on control diet. Similarly, Morsy (1995) reported that there was a significant improvement ($P \leq 0.05$) in LBW and BWG of Hubbard broiler chicks fed 500 g FK/ton diet. While, no significant differences in LBW and BWG were found for birds fed 1000 g FK/ton diet compared to the control diet at 7 weeks of age. Azouz (2001) reported that addition of FK at levels 1 and 1.5% to diets (23% CP) containing two levels of metabolizable energy (3200 and 3000 kcal /kg, respectively) had no significant effect on BWG, whereas, supplementation of FK to low energy diets (2800 kcal /kg) up till 2% increased significantly ($P \leq 0.05$) BWG as compared with those of the control diet. Tollba (2003) found that, broiler chicks fed on dried grounds of thyme or fennel increased ($P<0.05$) LBW and BWG at 35, 42 or 49 days of age when compared to those fed on un-supplemented control diets. Similar results were noticed previously by Abdel-Malak, et al. (1995) and Ibrahim, *et al.* (1998) in broiler, Ghazalah and Ibrahim (1996) in ducks and Abdel-Latif, *et al.* (2002) in Japanese quail when reported that adding fennel to the control diet at a level of 1000g/ton improved ($P<0.05$) LBW and BWG. Such improvement may be due to the antibacterial and antifungal properties of fennel as explained by Hodgson, et al. (1998) who reported that fennel oil has inhibitory properties to bacteria or yeast (*E. coli, C. albicans and S. aureus*) very susceptible to inhibition by oil of fennel or in combination with propyl paraben or the major components of the fennel oil, such as fenchone, methyl chavicol and anethole may have biological function.

The improvement in live body weight and body weight gain may be due to antibacterial related to flavonoids in fenugreek (Bhatti *et al.*, 1996) or in fennel (Abou-Raiia *et al.*,1991) that led to maintaining normal intestine microflora by competitive exclusion and antagonism, altering metabolism and increased liver and muscle glycogen contents (Gomez *et al.*, 1998). Oktay *et al.* (2003) indicated that the fennel is a potential source of natural antioxidant due to increasing digestive enzymes activities and decreasing bacterial enzyme activity.

It seems that, this improvement was not due to the FK or FL seed level alone but some other factors may responsible such as the number of males in every treatment (sex effect was not determined) and/or the different responses of chicks to some managerial and vaccination programs. However, all the differences

Table (8): Effect of dietary supplementation with graded levels of fenugreek and fennel seeds on blood constituents of broiler chicks.

		Fenugreek Seeds (%)		Fennel Seeds (%)			Sig.
Items	Control	0.50	1.0	1.5	0.50	1.0	1.5	
Total protein (g/dl)	$5.25^{bc}\pm0.27$	$4.77^{c}\pm0.19$	$5.51^{b}\pm0.17$	$5.97^{b}\pm0.26$	$5.83^{b}\pm0.29$	$5.83^{b}\pm0.23$	$6.90^{a}\pm0.31$	**
Albumin (g/dl)	$2.69^{b}\pm0.12$	$2.48^{b}\pm0.08$	$2.72^{b}\pm0.11$	$3.15^{a}\pm0.19$	$2.90^{ab}\pm0.23$	$2.82^{ab}\pm0.16$	$3.00^{a}\pm0.18$	*
Globulin (g/dl)	$2.55^{bc}\pm0.18$	$2.29^{c}\pm0.16$	$2.78^{b}\pm0.11$	$2.81^{b}\pm0.12$	$2.94^{b}\pm0.13$	$3.03^{b}\pm0.17$	$3.90^{a}\pm0.24$	**
A/G ratio	$1.08^{a}\pm0.05$	$1.11^{a}\pm0.08$	$0.97^{ab}\pm0.05$	$1.13^{a}\pm0.06$	$1.00^{a}\pm0.09$	$0.95^{ab}\pm0.08$	$0.78^{b}\pm0.06$	*
Total lipids (mg/dl)	$545.7^{a}\pm27.4$	$402.0^{b}\pm66.2$	$364.0^{b}\pm33.8$	$417.7^{b}\pm40.0$	$370.8^{b}\pm13.1$	$378.0^{b}\pm23.5$	$338.3^{b}\pm48.5$	*
Total cholesterol (mg/dl)	$184.1^{a}\pm5.7$	$121.0^{c}\pm3.9$	$140.5^{bc}\pm9.3$	$138.6^{bc}\pm15.9$	$155.6^{b}\pm8.2$	$142.5^{bc}\pm10.1$	$155.4^{b}\pm12.2$	**
Uric acid (mg/dl)	$5.03^{a}\pm0.31$	$3.73^{b}\pm0.53$	$3.16^{b}\pm0.44$	$4.09^{b}\pm0.44$	$3.86^{b}\pm0.30$	$3.00^{b}\pm0.34$	$3.41^{b}\pm0.24$	**
GPT (µ/L)	$75.44^{a}\pm4.73$	$69.89^{ab}\pm1.29$	$65.43^{b}\pm3.00$	$64.67^{b}\pm1.80$	$61.33^{b}\pm4.09$	$60.60^{b}\pm2.23$	$63.40^{b}\pm4.30$	**
GOT(µ/L)	$87.92^{a}\pm12.0$	$53.71^{b}\pm6.45$	$58.67^{b}\pm8.21$	$38.23^{b}\pm6.25$	$55.43^{b}\pm3.17$	$48.67^{b}\pm5.46$	$46.17^{b}\pm3.70$	**
Calcium (mg/dl)	$8.18^{b}\pm0.33$	$10.40^{a}\pm0.29$	$8.61^{b}\pm0.26$	$8.40^{b}\pm0.10$	$9.26^{ab}\pm0.71$	$8.40^{b}\pm0.05$	$9.87^{ab}\pm0.63$	*
Phosphorous (mg/dl)	$6.28^{a}\pm0.38$	$4.43^{b}\pm0.15$	$6.08^{a}\pm0.08$	$5.28^{a}\pm0.36$	$6.37^{a}\pm0.32$	$5.62^{a}\pm0.44$	$6.16^{a}\pm0.39$	**
Haemoglobin (g/dl)	7.52±0.31	7.35±0.21	7.63±0.21	7.75±0.28	7.77±0.17	7.34±0.15	7.62±0.35	NS
Hematocrit %	$46.17^{ab}\pm1.83$	$50.40^{a}\pm0.98$	$43.00^{b}\pm1.32$	$44.30^{b}\pm0.47$	$48.00^{ab}\pm1.22$	$45.17^{b}\pm1.83$	$47.83^{ab}\pm2.77$	*

Means within the same row with different superscripts are significantly different, NS = Not significant, Sig. = Significance, * ($P\leq0.05$), ** ($P\leq0.01$)

between 0.50 and 1.0% were not statistically significant.

2.B- Feed consumption (FC) and Feed conversion ratio (FCR): -

During the starter period (0-3 weeks of age) and the finisher period (5-7 weeks of age), broiler chicks fed on 0.50% FK diets recorded the lowest FC (953.7 and 1480.7 gm), while the broilers group received 1.0% FL diets recorded the highest value for FC (1055.7 and 1742.3gm). The other treatment groups were recorded the intermediate values for FC.

During the grower (3-5 weeks), broilers group received 1.5% FK diet gave the highest FC (1621.0gm), while the lowest FC (1467.3gm) was for broilers group fed on 0.50% FL diet as compared to those receiving other experimental diets.

Overall the experimental period (0-7 weeks of age), birds fed on 1.0% and 1.5% FL or 1.5% FK recorded the highest values for FC (4391.3, 4246.7 or 4244.7gm respectively), but birds given 0.50% and 1.0% FK or 0.50% FL diets recorded the lowest values for FC (3946, 4075.7 and 4019.7gm respectively) as compared to control group (4183.3gm), respectively. This may be due to the change in the taste of feed, as reported by Sturkie (1986) who indicated that, birds have a sense of taste.

Results summarized in Table (4) indicated that, there were significant differences ($P \leq 0.0.05$ or 0.01) in FCR values during the different experimental periods in this study.

During the starter period and the grower period, the broiler chicks fed on 0.50% and 1.5% FL and 0.50% FK diets utilized the feed more efficiently than those received 1.0% FL, 1.0% and 1.5% FK and the control diets.

The best FCR was obtained by birds given 0.50% FL diet followed by birds given 1.5% FL or 0.50% FK diets, while the worst FCR (1.96) was obtained by the control group during the overall experimental period (0-7 weeks of age). Similar trend was observed by Abdel-Latif, *et al.* (2002) in Japanese quail when reported that adding fennel to the control diet at a level of 1000g/ton improved FCR while, FC values were declined.

The present results are in harmony with the conclusion reported by El-Hindawy *et al.* (1996) who found that, incorporation of Bio-Activator (herbal mixture) into broiler diets improved body weight gain and decreased insignificantly feed consumption. Morsy (1995) showed that no significant differences in FC and FCR were observed when broiler chicks fed diets containing 500 or 1000 g FK/ton as compared with control diets. Azouz (2001) found that no significant differences in FC and FCR were observed between birds fed FK (1.0%, 1.5% or 2.0%, respectively) and control diets. Generally, it was observed that broiler chicks received 0.50% FL diet converted their feed intake into BWG more efficiently than those given the studied experimental treatments.

No dead chicks due to any of the experimental treatment groups were observed through the experimental period of this present study, whereas the mortality rate for chicks was 0.0% (zero) from hatching day until 7 weeks of age. Most herbs and spices contain various chemicals as part of their intercellular composition. These chemicals have a demonstrated ability to help animals stay healthy when fed as

Table (4): Effect of dietary supplementation with graded levels of fenugreek and fennel seeds on feed conversion ratio, protein efficiency ratio and efficiency of energy utilization of broiler chicks.

Items	Fenugreek Seeds (%)				Fennel Seeds (%)			Sig.
	Control	0.50	1.0	1.5	0.50	1.0	1.5	
Feed conversion ratio (FCR):-								
0-3 weeks	$1.47^{a}\pm0.05$	$1.36^{ab}\pm0.03$	$1.38^{ab}\pm0.04$	$1.42^{ab}\pm0.02$	$1.32^{b}\pm0.04$	$1.45^{a}\pm0.02$	$1.36^{ab}\pm0.02$	*
3-5 weeks	$1.87^{a}\pm0.10$	$1.73^{b}\pm0.11$	$1.98^{a}\pm0.12$	$1.86^{a}\pm0.11$	$1.68^{b}\pm0.02$	$1.87^{a}\pm0.08$	$1.70^{b}\pm0.05$	*
5-7 weeks	$2.59^{a}\pm0.15$	$2.07^{b}\pm0.03$	$2.09^{b}\pm0.08$	$2.01^{b}\pm0.05$	$2.00^{b}\pm0.14$	$2.23^{b}\pm0.05$	$2.02^{b}\pm0.16$	**
0-7 weeks	$1.96^{a}\pm0.08$	$1.72^{bc}\pm0.04$	$1.81^{abc}\pm0.06$	$1.76^{bc}\pm0.03$	$1.66^{c}\pm0.02$	$1.86^{ab}\pm0.02$	$1.70^{bc}\pm0.05$	**
Protein efficiency ratio (PER):-								
0-3 weeks	$2.97^{b}\pm0.11$	$3.21^{ab}\pm0.08$	$3.15^{ab}\pm0.09$	$3.07^{ab}\pm0.04$	$3.30^{a}\pm0.11$	$2.99^{b}\pm0.05$	$3.15^{ab}\pm0.09$	*
3-5 weeks	$2.69^{b}\pm0.13$	$2.92^{a}\pm0.20$	$2.54^{b}\pm0.15$	$2.70^{b}\pm0.16$	$2.98^{a}\pm0.04$	$2.68^{b}\pm0.11$	$2.54^{b}\pm0.15$	*
5-7 weeks	$2.16^{b}\pm0.14$	$2.68^{a}\pm0.04$	$2.67^{a}\pm0.10$	$2.77^{a}\pm0.07$	$2.81^{a}\pm0.19$	$2.49^{ab}\pm0.06$	$2.67^{a}\pm0.10$	*
0-7 weeks	$2.23^{d}\pm0.08$	$2.55^{ab}\pm0.06$	$2.40^{bcd}\pm0.08$	$2.47^{abc}\pm0.04$	$2.62^{a}\pm0.04$	$2.34^{cd}\pm0.02$	$2.40^{ab}\pm0.08$	**
Efficiency of energy utilization (EUU):-								
0-3 weeks	4.56±0.18	4.23±0.10	4.32±0.13	4.43±0.06	4.13±0.13	4.53±0.06	4.23±0.13	NS
3-5 weeks	5.99±0.31	5.53±0.36	6.33±0.39	5.96±0.34	5.38±0.07	6.00±0.25	6.33±0.39	NS
5-7 weeks	7.96±0.88	7.00±0.47	6.28±0.25	7.16±0.52	6.03±0.40	7.25±0.37	6.12±0.25	NS
0-7 weeks	$6.24^{a}\pm0.26$	$5.53^{bc}\pm0.12$	$5.84^{abc}\pm0.20$	$5.49^{bc}\pm0.09$	$5.18^{c}\pm0.08$	$5.93^{ab}\pm0.06$	$5.45^{bc}\pm0.20$	**

Means within the same row with different superscripts are significantly different, Sig. = Significance, NS = Not significant, * ($P\leq0.05$), ** ($P\leq0.01$).

dietary components and may extend the self life of the animal products when treated with them (Ziauddin *et al.*, 1996; Dickens *et al.*, 2000 and Heejeong *et al.*, 2001). This may be due to the ability of these plants to produce chemicals to protect themselves from insects, fungi, bacteria and viruses. When animals were fed these plants at a reasonable amount based on their active principle (chemicals and phytochemical extracts) may give the animal's protection. These may extend the use of medicinal plants as therapeutic agents.

2.C- Protein efficiency ratio (PER) and efficiency of energy utilization (EEU): -

Results presented in Table (4) showed that, the biological feed additives especially at 0.50% (FK and FL) addition to broiler chick's diets significantly ($P \leq 0.05$ or 0.01) improved PER values compared with those fed on the un-supplemented control diet during all the studied experimental period. Chicks fed diet supplemented with 0.50% FL gave the best PER as compared to the other experimental groups during the whole experimental period of the present study.

There were no significant differences ($P > 0.05$) in EEU values between chicks fed the different levels of FK and FL in their diets compared with those received the un-supplemented control diet at 0-3, 3-5 and 5-7 weeks of age. There were significant ($P \leq 0.01$) improvements in EEU values for chicks fed diets containing 0.50 and 1.5% of either FK or FL as compared to control group which recorded the worst EEU at 0-7 weeks of age (Table 4).

2.D- Performance index (PI) and economic evaluation: -

It is clear that, addition of FK and FL at 0.50 or 1.5% of broiler diets significantly ($P \leq 0.01$) improved PI when compared with the control group during the whole experimental period (Table 5).

The economic evaluation of experimental diets is shown in Table (5). The addition of either FK or FL into broiler diets increased the percent of economic efficiency (expressed as % of net revenue/feed cost, EEf) and relative economic efficiency (REE) than those received un-supplemented control diet through the whole experimental period. This was due to the improvement in body weight and feed conversion efficiency for broilers fed dietary levels of FK or FL. These results agreed with El-Gendi *et al.* (2000) who indicated that, feeding chicks on diets containing 0.5 kg/ton of Bio-tonic (herbal mixture) improved PI and EEf. Similar results were shown by Abdel-Azeem (2002), Abdel-Latif, *et al.* (2002 and 2004) and Abdel-Malak *et al.* (1995) who reported that, using herbs and medicinal plants in broiler and quail diets increased PI, EEf and REE values.

3- Nutrients digestibility coefficients: -

Results shown in Table (6) indicated that addition of natural feed additives (FK and FL seeds) into broiler diets at 0.50% improved non-significantly the apparent digestibility coefficients of OM and NFE as compared to un-supplemented control diet, while EE digestibility coefficient was improved by 0.50% FL only. However, these differences were not significant ($P > 0.05$) between treated groups and control group. Natural feed additives supplementation to broiler diets significantly ($P \leq 0.05$ or 0.01)

Table (5): Effect of dietary supplementation with graded levels of fenugreek and fennel seeds on performance index and economic evaluation of broiler chicks.

Items	Control	Fenugreek Seeds (%) 0.50	1.0	1.5	Fennel Seeds (%) 0.50	1.0	1.5	Sig.
Performance index (PI):-								
0-3 weeks	$46.72^{b}\pm3.42$	$52.15^{ab}\pm3.26$	$52.16^{ab}\pm2.94$	$49.68^{ab}\pm1.39$	$56.10^{a}\pm2.99$	$50.07^{ab}\pm1.39$	$52.16^{ab}\pm2.94$	*
3-5 weeks	$44.28^{ab}\pm4.61$	$51.64^{a}\pm6.04$	$39.85^{b}\pm2.20$	$46.88^{ab}\pm2.11$	$51.87^{a}\pm1.05$	$45.57^{ab}\pm2.26$	$53.13^{a}\pm1.30$	*
5-7 weeks	$25.39^{b}\pm3.89$	$34.63^{ab}\pm2.63$	$35.31^{ab}\pm2.26$	$40.59^{a}\pm3.10$	$40.58^{a}\pm5.40$	$35.44^{ab}\pm2.41$	$43.24^{a}\pm5.83$	*
0-7 weeks	$110.76^{c}\pm11.2$	$136.61^{ab}\pm8.52$	$124.58^{bc}\pm5.55$	$136.79^{ab}\pm1.34$	$145.93^{a}\pm5.64$	$126.53^{abc}\pm1.2$	$146.58^{a}\pm5.55$	**
Economic evaluation:-								
Total feed consumed (kg)	4.183	3.946	4.076	4.245	4.020	4.391	4.247	
Body weight gain (kg)	2.149	2.321	2.251	2.418	2.422	2.357	2.492	
Total feed cost (LE/kg)	5.765	5.547	5.791	6.090	5.705	6.295	6.275	
Total revenue	12.891	13.924	13.504	14.504	14.529	14.142	14.954	
Net revenue	7.126	8.376	7.712	8.415	8.824	7.846	8.679	
Economic efficiency (EEf):-								
0-7 weeks	123.62	151.00	133.18	138.19	154.69	124.62	138.32	
Relative economic efficiency (REE):-								
0-7 weeks	100.00	122.15	107.74	111.79	125.13	100.81	111.90	

Means within the same row with different superscripts are significantly different, Sig. = Significance, * ($P\leq0.05$), ** ($P\leq0.01$).
Selling price of one kg live body weight=6.0 LE, price/kg fenugreek seeds=3.0 LE and price/kg fennel seeds=6.0 LE.
Price/kg of starter, grower and finisher diet= 1.47, 1.41 and 1.32 LE, respectively.

increased the apparent digestibility coefficients of DM and CP, except the DM digestibility coefficient of 1.0% FK diet, which gave the lowest value when compared to control group.

The highest ($P \leq 0.01$) CF digestibility coefficient was recorded with birds received 0.50% FL diet compared with the other dietary treatments, which had higher CF digestibility coefficient when compared with control diet. The obtained results are in harmony with the conclusion reported by Abdel-Latif *et al.* (2004) who found that herbal feed additives supplementation to growing quail diets enhanced the digestibility of all nutrients (OM, CP, EE, CF and NFE). Similarly, Abdel-Azeem (2002) who indicated that addition of Digeston as a herbal mixture at 1g/kg of broiler diet significantly ($P \leq 0.01$) increased the digestibility coefficients of DM, OM, EE, CF and NFE. The positive effect of these coefficients as affected by adding herbal feed additives was parallel to the enhancements in live body weight, body gain (Table, 3) and feed conversion ratio (Table, 4) and this may give approve to the critical role of these additives in improving growth performance and feed utilization (Abdel-Latif *et al.* 2002 or 2004 and Abdo *et al.* 2003). In addition, this enhancement may be due to incorporating these herbal feed additives in some essential nutrients such as:-natural tonic, restoratives, antibacterial and antiparasitic drugs (Soliman *et al.* 1995), which may improve the absorption of nutrients through the small intestine of the bird as well as the digestibility coefficients. These results agreed with Ibrahim *et al.* (1998) who reported that adding different sources as natural growth promoters such as Bio-Tonic, Compisol and Bio-Tonic and Compisol 1:1 by level of 1000gm/ton in chicks diet, improved OM, CP and EE digestibility compared with the control diet. This may explain the significant effects of dietary herbal feed additives on metabolic process. Similar trend was observed by Abdel-Malak *et al.* (1995).

In general, it was observed that broiler chicks received 0.50% FL diet had the higher values of the nutrients digestibility coefficients.

4- Relative organs weight:-

Data displayed in Table (7) showed that, supplementation of FK and FL into broiler diets did not affect the relative weights of liver, heart, spleen, bursa and pancreas. The present results agree with the result of Abdel-Malak *et al.* (1995) and Tollba (2003) who reported that no significant differences on relative or absolute organ weights of liver, heart, spleen and bursa of fabricus.

5- Blood parameters: -

Effect of dietary treatments on blood parameters is shown in Table (8). Plasma total protein, albumin and globulin of broiler chicks fed either FK or FL (except, 0.50% FK diet) were superior ($P \leq 0.01$) to those of broiler chicks fed the control diet (Table 8). The majority of the increase in plasma total protein, albumin and globulin occurred at the highest levels (1.5%) of FK or FL. Conversely, the lower values of the above parameters occurred with the low level of FK (0.50%). These results agreed with those of El-Ghamry *et al.* (2004) who reported that, Muscovy ducks fed on FK diets (1.0% and 1.5%) significantly increased plasma total protein and its fractions. Azouz (2001)

Table (6): Effect of dietary supplementation with graded levels of fenugreek and fennel seeds on nutrients digestibility coefficients of broiler chicks.

Items	Fenugreek Seeds (%)				Fennel Seeds (%)			Sig.
	Control	0.50	1.0	1.5	0.50	1.0	1.5	
Nutrients digestibility coefficients								
DM	77.02^{bc}±5.61	80.73^{ab}±0.73	75.22^{c}±1.44	78.16^{ab}±3.05	82.86^{a}±1.35	80.69^{ab}±2.11	81.40^{ab}±2.81	*
OM	79.55±1.65	83.49±1.12	79.50±1.91	81.13±2.63	84.47±0.73	82.79±2.12	82.44±3.20	NS
CP	88.42^{b}±1.34	93.20^{a}±0.49	92.21^{a}±0.56	93.35^{a}±0.51	93.59^{a}±0.51	92.03^{a}±1.18	92.83^{a}±0.41	**
EE	86.04±2.04	85.22±1.26	85.73±1.47	86.50±1.33	88.06±0.73	84.33±0.72	84.22±2.20	NS
CF	34.86^{b}±0.93	36.58^{b}±0.93	35.27^{b}±0.99	37.07^{b}±1.25	40.65^{a}±0.32	38.52^{b}±0.55	36.77^{b}±0.87	**
NFE	79.28±2.18	79.80±1.10	79.36±0.73	80.95±1.77	83.41±2.47	81.10±2.10	80.54±0.50	NS

Means within the same row with different superscripts are significantly different, Sig. = Significance NS = Not significant, * (P≤0.05), ** (P≤0.01).

Table (7): Effect of dietary supplementation with graded levels of fenugreek and fennel seeds on relative weight of some internal organs of broiler chicks.

Characteristics	Control	Fenugreek Seeds (%) 0.50	1.0	1.5	Fennel Seeds (%) 0.50	1.0	1.5	Sig.
Liver weight (%)	2.49 0.11	2.27±0.05	2.48±0.16	2.51±0.15	2.32±0.07	2.44±0.07	2.56±0.11	NS
Heart weight (%)	0.52±0.03	0.48±0.02	0.45±0.01	0.51±0.02	0.53±0.02	0.55±0.02	0.57±0.06	NS
Spleen weight (%)	0.19±0.01	0.20±0.004	0.17±0.01	0.22±0.02	0.21±0.03	0.21±0.02	0.20±0.01	NS
Bursa weight (%)	0.18±0.02	0.15±0.01	0.19±0.02	0.19±0.05	0.18±0.02	0.20±0.01	0.22±0.02	NS
Pancreas weight (%)	0.22±0.02	0.19±0.02	0.21±0.01	0.28±0.02	0.23±0.02	0.23±0.03	0.23±0.03	NS

Means within the same row with different superscripts are significantly different, Sig. = Significance, NS = Not significant.

found that, fenugreek diets (1% and 1.5%) significantly increased plasma total protein, albumin and globulin of broilers. Conversely, Rashwan (1998) found that, New Zealand doe rabbit fed on control diet supplemented with fenugreek at a level of 12g/Kg diet caused decrease in serum total protein.

The obtained results are in harmony with the conclusion reported by Abdel-Latif *et al.* (2002) who found that, the maximum level of blood total protein, albumin and globulin in Japanese quail were observed with diets containing fennel at a level of 1000g/ton. The results of this study indicating the metabolic functions of fennel and fenugreek, which may have role in treating diseases of respiratory passages and digestive disorders. Similar trends were observed by Abdel-Malak et al (1995) and Abdel-Latif *et al.* (2002). Moreover, these positive effects may be due to the inclusion of some vitamins especially vitamin E which enhance the total protein and globulin (Franchini *et al.*, 1990 and Abdel-Latif, 1999). Also, fatty acids which present in these additives may affect muscle protein synthesis and protein deposition through a prostaglandin-depend mechanism (Palmer, 1993). Similarly, Abdel Malak, et al. (1995) and Ibrahim, *et al.* (1998) stated that adding fennel to diets enhanced plasma total protein synthesis as well as albumin and globulin. Increase globulin may be due to the immuno-stimulant effect of fennel. Chicks fed Bio-tonic had significantly decreased averages of blood and tissues creatinine levels and affected the pathway of protein metabolic processes which may be affected by the amount of dietary fed Bio-tonic in supplemented diets compared with other treatments applied (El-Gendi, 1996).

Broiler chicks fed 1.5% FL diet significantly ($P \leq 0.05$) lowered A/G ratio than those of the other experimental diets, this may be related to a higher globulin level in1.5% FL diet group.

With respect to the better livability, addition of either FK or FL to broiler diets resulted in decreases ($P \leq 0.05$ or 0.01) in plasma total lipids, total cholesterol, uric acid, GPT and GOT when compared to broiler chicks received control diet. The decreasing of enzyme activity and uric acid concentration exhibit healthy, non-pathological and non-toxic effect of FK or FL on liver or kidney function. Generally, these findings are in agreement with those of Azouz (2001) who indicated that, there was a significant decrease in plasma total lipids and total cholesterol due to increasing the level of FK in broiler diets. Similar results were observed by El-Gendi *et al.* (2000) who indicated that, feeding chicks on the diet with Bio-tonic significantly ($p<0.01$) decreased average cholesterol content. El-Gendi (1996) attributed the decrease in blood total lipids and cholesterol levels, when Egg-Plus was applied as herbal feed additives to the decrease in the rate of total lipids and cholesterol absorption through the intestinal villi. Such reduction is often related to the mode of action of fenugreek in bird metabolism which includes competition with cholesterol at binding sites or interferes with cholesterol biosynthesis in the liver. Also, soluble fibers like gums, pectin and mucilage in fenugreek seed may block cholesterol absorption from intestine, and then stimulates bile flow (Lanksy *et al.* 1993). Hypocholesterolaemic effects of

Table (8): Effect of dietary supplementation with graded levels of fenugreek and fennel seeds on blood constituents of broiler chicks.

		Fenugreek Seeds (%)			Fennel Seeds (%)			Sig.
Items	Control	0.50	1.0	1.5	0.50	1.0	1.5	
Total protein (g/dl)	$5.25^{bc}\pm0.27$	$4.77^{c}\pm0.19$	$5.51^{b}\pm0.17$	$5.97^{b}\pm0.26$	$5.83^{b}\pm0.29$	$5.83^{b}\pm0.23$	$6.90^{a}\pm0.31$	**
Albumin (g/dl)	$2.69^{b}\pm0.12$	$2.48^{b}\pm0.08$	$2.72^{b}\pm0.11$	$3.15^{a}\pm0.19$	$2.90^{ab}\pm0.23$	$2.82^{ab}\pm0.16$	$3.00^{a}\pm0.18$	*
Globulin (g/dl)	$2.55^{bc}\pm0.18$	$2.29^{c}\pm0.16$	$2.78^{b}\pm0.11$	$2.81^{b}\pm0.12$	$2.94^{b}\pm0.13$	$3.03^{b}\pm0.17$	$3.90^{a}\pm0.24$	**
A/G ratio	$1.08^{a}\pm0.05$	$1.11^{a}\pm0.08$	$0.97^{ab}\pm0.05$	$1.13^{a}\pm0.06$	$1.00^{a}\pm0.09$	$0.95^{ab}\pm0.08$	$0.78^{b}\pm0.06$	*
Total lipids (mg/dl)	$545.7^{a}\pm27.4$	$402.0^{b}\pm66.2$	$364.0^{b}\pm33.8$	$417.7^{b}\pm40.0$	$370.8^{b}\pm13.1$	$378.0^{b}\pm23.5$	$338.3^{b}\pm48.5$	*
Total cholesterol (mg/dl)	$184.1^{a}\pm5.7$	$121.0^{c}\pm3.9$	$140.5^{bc}\pm9.3$	$138.6^{bc}\pm15.9$	$155.6^{b}\pm8.2$	$142.5^{bc}\pm10.1$	$155.4^{b}\pm12.2$	**
Uric acid (mg/dl)	$5.03^{a}\pm0.31$	$3.73^{b}\pm0.53$	$3.16^{b}\pm0.44$	$4.09^{b}\pm0.44$	$3.86^{b}\pm0.30$	$3.00^{b}\pm0.34$	$3.41^{b}\pm0.24$	**
GPT (μ/L)	$75.44^{a}\pm4.73$	$69.89^{ab}\pm1.29$	$65.43^{b}\pm3.00$	$64.67^{b}\pm1.80$	$61.33^{b}\pm4.09$	$60.60^{b}\pm2.23$	$63.40^{b}\pm4.30$	**
GOT(μ/L)	$87.92^{a}\pm12.0$	$53.71^{b}\pm6.45$	$58.67^{b}\pm8.21$	$38.23^{b}\pm6.25$	$55.43^{b}\pm3.17$	$48.67^{b}\pm5.46$	$46.17^{b}\pm3.70$	**
Calcium (mg/dl)	$8.18^{b}\pm0.33$	$10.40^{a}\pm0.29$	$8.61^{b}\pm0.26$	$8.40^{b}\pm0.10$	$9.26^{ab}\pm0.71$	$8.40^{b}\pm0.05$	$9.87^{ab}\pm0.63$	*
Phosphorous (mg/dl)	$6.28^{a}\pm0.38$	$4.43^{b}\pm0.15$	$6.08^{a}\pm0.08$	$5.28^{a}\pm0.36$	$6.37^{a}\pm0.32$	$5.62^{a}\pm0.44$	$6.16^{a}\pm0.39$	**
Haemoglobin (g/dl)	7.52 ± 0.31	7.35 ± 0.21	7.63 ± 0.21	7.75 ± 0.28	7.77 ± 0.17	7.34 ± 0.15	7.62 ± 0.35	NS
Hematocrit %	$46.17^{ab}\pm1.83$	$50.40^{a}\pm0.98$	$43.00^{b}\pm1.32$	$44.30^{b}\pm0.47$	$48.00^{ab}\pm1.22$	$45.17^{b}\pm1.83$	$47.83^{ab}\pm2.77$	*

Means within the same row with different superscripts are significantly different, NS = Not significant, Sig. = Significance, * ($P\leq0.05$), ** ($P\leq0.01$).

Trigonella Foenum graecum was due to increase of the conversion of hepatic cholesterol to bile salts due to loss in the faeces complexes of these substances with fenugreek fiber and steroidal saponins (the steroidal saponins account for many of the beneficial effects of fenugreek, particularly the inhibition of cholesterol absorption and synthesis). Trigonella Foenum graecum treatment selectively reduces low-density lipoprotein (LDL) and VLDL fractions of total cholesterol (Al-Habori and Raman, 1998).

Plasma level of calcium was increased, while plasma level of phosphorous was decreased in general in broiler chicks receiving FK or FL. The effect of FK or FL addition on haematocrit percentage was detected with 0.50% of either FK or FL, where it gave the highest values. Supplementation of FK or FL into broiler diets had no effect on the hemoglobin level. Abdel-Azeem (2002) found that, there was insignificant effect on haematocrit percentage and haemoglobin when used Digeston as a herbal feed additive at level of 1gm/ kg diet in broiler diets.

These results are in harmony with Tolliba (2003) who found that, adding 1.0% thyme or fennel to broiler diets increased significantly plasma total protein as well as albumin and globulin, while decreased significantly plasma cholesterol, total lipids, activities of GOT and GPT enzymes comparing to un-supplemented control groups under normal or high temperature conditions. These results are disagreement with those reported by Nakhla *et al.* (1991) who found that GOT activity was elevated by fenugreek seed saponins diets, when fed to boiler chicks. Triglycerides and total cholesterol of birds treated with fenugreek seeds up to 1.5% were significantly ($P<0.05$) lower than those of control groups. These results were supported by several investigators, who reported that fenugreek seed has hypocholesterolemic and hypoglycemic effect (Madar and Shomer, 1990 and Rashwan, 1998).

CONCLUSION

It appears that, using fenugreek and fennel seeds as natural feed additives, especially at 0.50% can improve the productive performance, nutrients digestibility coefficients, blood components and the economic efficiency in broiler chicks.

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تأثير استخدام بذور الحلبة والشمر كإضافات غذائية طبيعية علي أداء كتاكيت اللحم.

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الهدف من هذه الدراسة تقييم بذور الحلبة والشمر كإضافات غذائية طبيعية في علائق كتاكيت التسمين. استخدم في هذه الدراسة عدد (٢٨٠) كتكوت هابرد عمر يوم غير مجنس. وزعت الكتاكيت عشوائيا إلي سبع معاملات تجريبية اشتملت كل معاملة ٤٠ كتكوت(٤ مكررات - ١٠ كتاكيت لكل مكرر) وكانت المعاملة الأولى هي المجموعة المقارنة (الكنترول)، بينما المعاملات من٢ إلي ٧ أخذت العلائق القاعدية مضاف إليها كل من بذور الحلبة أو الشمر بمستويات مختلفة (٠,٥٠، ١,٠، ١,٥% / كجم عليقة) علي التوالي.متوسط أوزان الجسم للمعاملات التجريبية كان متساوي تقريبيا في بداية التجربة. واستمرت التجربة لمدة ٧ أسابيع. وكانت المقاييس المدروسة هي الأداء الإنتاجي – المعاملات الهضمية للعناصر الغذائية – بعض الأعضاء الداخلية – بعض مكونات الدم – الكفاءة الاقتصادية.

ويمكن تلخيص النتائج المتحصل عليها في النقاط الآتية:-

١. وجدت زيادة معنوية في متوسط وزن الجسم الحي عند عمر ٧ أسابيع والزيادة الوزنية المكتسبة، وتحسن ملحوظ في معدل التحويل الغذائي والكفاءة النسبية للبروتين و الكفاءة الاقتصادية والكفاءة الاقتصادية النسبية ودليل كفاءة النمو للمعاملات التجريبية المضاف إليها كل من بذور الحلبة أو الشمر بمستوي ٠,٥٠% أو ١,٥% عند مقارنتها بمجموعة الكنترول.

٢. سجلت الكتاكيت المغذاة علائق بها ١,٥% حلبة و ١,٠، ١,٥% شمر أعلي متوسط استهلاك للغذاء، بينما علي النقيض كان أقل متوسط استهلاك للغذاء للعلائق التي بها ٠,٥٠، ١,٠% حلبة أو ٠,٥٠% شمر عند مقارنتها بمجموعة الكنترول في نهاية التجربة ككل.

٣. وجد تحسن ملحوظ في قيم كفاءة الاستفادة من الطاقة للكتاكيت المغذاة علي علائق بها حلبة و شمر بمستوي ٠,٥٠، ١,٥% عند مقارنتها بمجموعة الكنترول.

٤. زادت المعاملات الهضمية للعناصر الغذائية بإضافة بذور الحلبة أو الشمر إلي علائق بداري التسمين خاصة عند مستوي ٠,٥٠%. مجموعة الكنترول سجلت أقل القيم الهضمية، بينما المجموعة التي أخذت ٠,٥٠% شمر سجلت أعلي القيم الهضمية.

٥. سجلت الكتاكيت التي غذيت علي علائق مضاف إليها كل من بذور الحلبة أو الشمر خاصة عند مستوي ١,٠% أو ١,٥% أعلي القيم للبروتين الكلي والألبومين والجلوبيولين في بلازما الدم، في حين سجلت أقل القيم للكولسترول والدهون الكلية وحمض اليوريك وكذلك إنزيمات نشاط الكبد (GOT & GPT) إذا ما قورن ذلك بالمجموعة التي غذيت علي علائق الكنترول (بدون بذور الحلبة أو الشمر).

٦. زاد مستوي الكالسيوم، وانخفض مستوي الفوسفور بصفة عامة في بلازما الدم في الكتاكيت المعطاة علائق بها الحلبة أو الشمر.

٧. إضافة بذور الحلبة أو الشمر إلي علائق بداري التسمين لم يؤثر علي مستوي هيموجلوبين الدم أو الوزن النسبي للأعضاء الداخلية (الكبد والقلب والطحال وغدة البرسا والبنكرياس).

وعموما فان النتائج تشير إلي إمكانية استخدام بذور الحلبة والشمر كإضافات غذائية طبيعية في علائق كتاكيت التسمين بمستوي ٠,٥٠% لتحسين الأداء الإنتاجي والمعاملات الهضمية للعناصر الغذائية والكفاءة الاقتصادية وكذلك أيضا تحسين الحالة الفسيولوجية لبداري التسمين.