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Research

Welfare Score of Fayoumi Chickens Supplemented with Dietary Feed Additives: Physical and Physiological Indicators

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ABSTRACT

Background

Nowadays, the search for better welfare conditions is a global tendency in animal production.

Objective

This study was done to evaluate the dietary feed additives supplementation for six weeks on physical and physiological welfare indicators.

Subjects and Methods

One hundred and twenty month old male Fayoumi chickens were equally divided into 4 groups each of 3 replicates. Control group (G1) was fed a basal diet with no supplementation, treated groups (G2, G3, and G4) fed basal diet supplemented with 1% seeds powder of garden cress (Lepidium sativum L.), turmeric (curcuma longa), and fennel (Shamar or Foenicum vulgre) respectively. The average weekly body weight, weight gain, Feed intake and feed conversion rate (FCR) were calculated as performance or physical indicators at the end of experiment serum glucose, cholesterol, triglycerides, and corticosterone hormone as physiological parameters of welfare was recorded results. Data obtained in this experiment revealed that physical indicators were significantly improved by dietary feed additive treatments. While birds fed control diet had the highest overall mean of physiological parameters of welfare than the treated groups.

Conclusion

An increase in treated groups (G2, G3, and G4) welfare score in a compartment with a control group (G1). Recommendation: used of treatment, a substance in broiler diet.

Keywords: *Fayoumi Chickens; Fennel Garden Cress; Indicators; Turmeric; Welfare Score.*

INTRODUCTION

The term well-being or welfare it is as a state or condition of an animal, which mainly depends on if, and how the animal deals with different situations and is able to satisfy its needs. It is becoming well when all needs associated with the maintenance of good health and needs to show that certain behaviors are met.[1] Nowadays, the search for better welfare conditions is a global tendency in animal production.[2]

Poultry welfare is associated with several indicators as behavior, health, mortality, and physiology.[3] In general, minimum mortality, low morbidity, little or no risk of injury, good body condition, lack of physiological signs of stress, including alterations of immune responses, indicate better welfare and absence of welfare problems.[4] While, the increase in physiological indicators as blood corticosterone, total cholesterol, blood glucose[5,6] , and triglycerides are accompanied by poor welfare.[7,8] Beside that, Welfare assessment score was calculated according to the system of[9,10] It included the so-called "*five freedoms*" guaranteeing poultry welfare, which are given a specific score: 3; 2; 1and 0, depending on the expression of a particular behavior, plasma corticosterone concentrations and some blood biochemical indices which depending mainly on 5 freedoms as Freedom from hunger or thirst; discomfort; pain, injury, or disease, expresses normal behavior, and freedom from fear or distress.[11,12] The freedom of pain, injury and disease (F3) considered the important part of welfare score assessment.

The final score was obtained as a sum of numerical expressions of all freedoms and compared to the maximum possible score of 15, expressed in percentage. Moreover, Physical welfare indicators as body weight, body gain, feed intake and feed conversion ratio were used.

Local or native chicken represents an important genes source for research purposes and future breeding. They have more ability to adapt in a local environment; with a natural resistance to some diseases and stressful effects.[13]

Fayoumi chicken breed was the most important Egyptian native type and spread to many countries worldwide. It was found mainly in Fayoumi city known as the first man-made agricultural oasis in ancient Egypt[14] the origin of this breed is not definitely known. Concerning this situation, different theories are attended; the first is that it was introduced to Egypt from a village called "Biga" in Turkey during the period of Mohamed Ali Pasha. The second one was it originates from the Silver Camping breed and was introduced at the time of Napoleon's Occupation of Egypt[15] it very good foragers, can live on a free-range basis but it is not meat producer due of small body size.[16]

Over the last 20 years, there are improvements in genetics and nutrition leading to growth rates increasing which consume feed ad libitum which associated with a negative impact on broiler welfare as increased body fat deposition, high mortality and skeletal disorders.[17] So, there is a critical need to reduce some of these problems and also decreasing feed cost which ranged from 60-70% without compromising the final product.[18] One possible nutritional strategy of reducing feed cost is using feed additives.

The animal's feed additives are used worldwide in animals' diet to cover the needs of essential nutrients and others to improve the health of the animals, feed intake, growth performance and therefore optimize feed utilization.[19]

One of the feed additives was herbs, spices and their extracts which have a long history of use, even prehistoric use, in preventing or treating human and animal diseases, because of their availability, easy usage, and non-side effects. its can regulate feed intake and stimulate digestive secretions, result in optimized digestion capacity and reduced risk of digestive disorders[20] this effect is related to their secondary metabolite content such as phenols, saponins, and essential oils.[21] Such as, Garden cress seeds (Lepidium sativum), Fennel (F. vulgare), and Turmeric (Curcuma longa L.) were popular herbs with a long history of use as a medicine containing a high concentration of antioxidant substance according to[22-26] respectively, and its dietary supplementation for broiler chickens showed increased physical indicators of welfare (body weight, body gain and feed conversion ratio) in line with the finding of [19,26,27] respectively.

The purpose of this paper was to evaluate the welfare of Fayoumi chickens feed, dietary supplementation of Garden Cress, turmeric, and fennel, on the base of the welfare assessment score, Physical (body weight, body gain, feed intake and feed conversion ratio) and physiological (serum glucose, cholesterol, triglycerides, and corticosterone hormone) welfare indicators.

MATERIAL AND METHODS

Birds and Housing

This study was conducted at the research unit of animal behavior and management, at the hospital of Veterinary Medicine Faculty, Assiut University.

30 days old male Fayoumi chicks were purchased from a local hatchery. A finisher diet (21% CP and 3200 kcal/kg Metabolized Energy) was fed for 6 weeks (Table 1).

Table 1. Ingredient and chemical composition of the experimental diets

Misoprostol	Control	Garden Cress	Turmeric	*Fennel*
Yellow corn	57.7	56.4	56.7	56.1
Soybean meal	31	31	31	31
Corn gluten meal	3	3	3	3
Soybean oil	5	5.3	5	5.6
Garden cress	0	1	0	0
Turmeric	0	0	1	0
Fennel	0	0	0	1
Limestone	1.85	1.85	1.85	1.85
Sodium phosphate monobasic	0.85	0.85	0.85	0.85
Common salt	0.3	0.3	0.3	0.3
Premix*	0.3	0.3	0.3	0.3
Calculated analysis (%)				
Crude protein	21.23	21.11	21.18	21.03
Lysine	1.01	1.01	1.01	1.01
Methionine	0.38	0.38	0.38	0.38
Calcium	0.8	0.8	0.8	0.8
Phosphorus, available	0.3	0.3	0.3	0.3
Crude fiber	3.29	3.26	3.29	3.24
Metabolized Energy (kcal/kg)	3218	3203	3202	3206
Per 2.5 kg including Vit. A, 1200000 IU; Vit. D3, 300000 IU; Vit. E, 700 mg; Vit. k3, 500 mg; Vit. B1, 500 mg; Vit. B2, 200 mg; Vit. B6, 600 mg; Vit. B12, 3 mg; Vit. C, 450 mg; Niacin, 3000 mg; Methionine, 3000 mg; Pantothenic acid, 670 mg ; Folic acid 300 mg; Biotin, 6 mg; Choline chloride, 10000 mg; Magnesium sulphate, 3000 mg; Copper sulphate, 3000 mg; Iron sulphate, 10000 mg; Zinc sulphate, 1800 mg; Cobalt sulphate, 300 mg				

The experimental birds were kept on floor litter system, including separate symmetrical pens each of (1 x 1m); pens were thoroughly cleaned, washed and disinfected before chicks' arrival. All pens floor were covered by a uniform and chopped wheat straw. Water and feed were available at all time. All birds were reared at the same management conditions as temperature, relative humidity, ventilation, and light.

Experimental Design

One hundred and twenty-day Fayoumi chicks were equally divided into 4 groups each of 3 replicates. The control group (G1) were fed a basal diet with no supplementation, treated groups (G2, G3, G3) was fed basal diet supplemented with 1% seeds powder of Garden Cress, turmeric, and fennel respectively from 30 to 72 days old. This study was conducted to evaluate the effect of this feed additives supplementation on the score, physical, and physiological welfare indicators of Fayoumi chicks.

Welfare Indicators

Physical indicators: Body weight, weight gain, Feed intake and feed

conversion rate of each pen which act as replicate was taken weekly according to[28]

Welfare assessment score: The welfare assessment score was calculated according to the system of [9,10] the integrated assessment of poultry welfare % (PW) was calculated according to the formula: PW% = {a (F1+F2+F3+F4+F5) x 100} 15as showed in (Table 2)

Table 2. Poultry welfare assessment score

Poultry welfare assessment score	
Freedom	**Degree**
Freedom from thirst and hunger – F1	0 – excessive thirst and hunger
	1 – limited thirst and hunger
	2 – lack of thirst and hunger
	3 – excessive feeding and drinking
Freedom from discomfort – F2	0 – excessive discomfort
	1 – limited discomfort
	2 – limited comfort
	3 – full comfort
Freedom from pain, injury, disease –F3	0– exhausting disease
	1 – limited disease
	2 – occasional pain and injury
	3 – lack of pain and injury
Freedom to express normal behavior –F4	0 – behavior disturbance
	1 – limited behavior expression
	2 – moderate expression
	3 – full expression
Freedom from fear and distress – F5	0 – fear and distress
	1 – limited fear and distress
	2 – partial freedom
	3 – full freedom
Total score of Poultry welfare (PW) % = { a (F1+F2+F3+F4+F5)\15 } x 100	

As F1, F2, F3, F4, and F5 score for each of five freedoms in birds. They can take values of 0, 1, 2 or 3 according to the manifestation of the specific freedom in a specific situation so that totally degree = 5X3 degree = 15 which by divided on it a=1, when (F3≠0) while, a=0 if F3=0 its difficult because welfare is not possible if the organism of the bird could not adapt to the production system and this entails a progressive disease.[29]

Physiological indicators: Blood samples were collected at the end of the experiment at 72 days ago and at the daytime between 1:00 and 2:00 PM for determination of serum glucose, cholesterol, triglycerides, and corticosterone hormone levels. This especially daytime to avoid the influence of the circadian rhythm of corticosterone.[1]

A total of 3 randomly selected chickens from each replicate were gently removed from their pen and blood samples (0.5 ml) were taken into 2 tubes from each bird without anticoagulant let it for 1 hour at room temperature, then centrifuged at 3000 RPM for 10 min and serum was obtained and frozen at – 20°C until the chemical analysis.

Serum glucose, cholesterol, and triglycerides analysis were conducted on an automated spectrophotometer using a standard diagnostic kit. While corticosterone hormone analysis according to[30] by ELIZA kit.

Statistical Analysis

Statistical analysis of the obtained results was conducted by using SPSS program version 16 for windows. Duncan test was used to determine the significant difference between groups. The data were expressed as mean±SE. A level of significance as the minimally acceptable level was assessed at ($p< 0.05$).

RESULTS

Table 3 showed that there are significant increases in physical indicators (body weight, body gain, feed intake, and feed conversion ratio) between control and feed additive groups. Besides that, the welfare assessment score was 33.33, 60, 67, and 60 % for control, garden cress, turmeric, and fennel respectively as shown in Table 4. On the other side, feed additives group has lower levels of physiological indices than control one Table 5

Table 3. Physical indices of welfare

Physical indices of welfare				
Groups / Weeks		**Basal diet + 1% of Feed additives**		
Groups / Weeks	**Control (G1)**	**Garden Cress (G2) (Lepidium sativum L.)**	**Turmeric (G3)** (Curcuma longa)	**Fennel (G4)** (Foenicum vulgre)
Body weight of one bird (gram)				
1st week	326.7±7.3	324.3±3.3	329.3±5.3	330±1.3
2nd week	405.3±4.4 c	441.3±15.3 a	446.3±2.3 a	439.3±6.9 b
3rd week	493±2.1 c	538±9.3 b	562±3.6 a	533±5.2 b
4th week	595±4.4 c	673.3±6.6 b	695±2.3 a	664±9.7b
5th week	720.4±4.1 b	843±13.3 a	858±5.5 a	860.3±18.3 a
6th week	881.6±6.7 b	1020.2±11.5 a	1073.6±8.3 a	1046.6±7.2 a
Over all	570.3±6.7 c	640±6.3 b	660.7±6.5 a	645.3±5.6 b

Body gain of one bird (gram)				
1st week	78.7±9.5 c	117±0.9 a	117±2.9 a	109.3±1.6 b
2nd week	87.7±3.2 b	96.7±1.2	115.7±3.8 a	93.7±4.2
3rd week	102±5.6 b	135.8±2.1a	133±1.4 a	131±2.5 a
4th week	146.4±4.2 c	169.7±2.7 b	163±2.9 b,c	196.3±4.1a
5th week	161.2±4.2 c	177.2±1.4 b,c	215.6±4.9 a	186.3±1.6 a
Over all	115.2±4.1 c	139.3±1.5 b	148.9±2.9 a	143.3±3.2 b
Feed intake of one bird (gram)				
1st week	270.6±2.2 b	274.6±4.4b	324±3.6 a	292.8±6.1 a
2nd week	294±2.8 c	318±7.6 b	360.8±1.7 a	332±3.9 a
3rd week	305±2.4 c	354.6±1.9 a	334±2.9 b,c	343±7.4 b
4th week	387.3±3.7 c	478±2.9 a	432.4±1.4 b	435±1.6 b
5th week	447.3±1.9 c	498±1.4 b	596.8±1.1a	495±2.2 b
Over all	340.8±1.5 c	384.6±3.4 b	409.6±2.4 a	379.6±6.5 b
Feed Conversion Ratio of one bird				
1st week	3.43±0.6 a	2.35±0.2 c	2.77±0.7 b	2.67±0.4 a
2nd week	3.35±0.3 a,b	2.29±0.3 c	3.11±0.3 b	3.54±0.8 a
3rd week	2.99±0.2 a	2.61±0.9 b	2.51±0.1 b,c	2.62±0.4b
4th week	2.65±0.9 b,c	2.82±0.4 a	2.65±0.1 b,c	2.22±0.6 c
5th week	2.77±0.5 b	2.81±0.1 a	2.76±0.4 b	2.66±0.9 c
Over all	3.04±0.4 a	2.6±0.3 b	2.8±0.4 b	2.7±1.8 b

Table 4. Welfare assessment scores of Fayoumi hens supplemented with feed additives

Poultry welfare assessment score				
	Basal diet	**Basal diet + 1% of Feed additives**		
	Control (G1)	**Garden cress (G2)**	**Turmeric (G3)**	**Fennel (G4)**
Freedom from thirst and hunger (F1)				
0 – excessive thirst and hunger				
1 – limited thirst and hunger	1			
2 – lack of thirst and hunger		2		2
3 – excessive feeding and drinking			3	
Freedom from discomfort (F2)				
0 – excessive discomfort				
1 – limited discomfort	1			
2 – limited comfort		2	2	2
3 – full comfort				
Freedom from pain, injury, disease (F3)				
0 – exhausting disease				
1 – limited disease				
2 – occasional pain and injury	2	2	2	2
3 – lack of pain and injury				
Freedom to express normal behavior (F4)				
0 – behavior disturbance				
1 – limited behavior expression	1			
2 – moderate expression		2	2	2
3 – full expression				
Freedom from fear and distress (F5)				
0 – fear and distress	0			
1 – limited fear and distress		1	1	1
2 – partial freedom				
3 – full freedom				
Total score obtained (a)	5	9	10	9
Total score of freedom (b)	15	15	15	15
Poultry welfare, %= (a \ b) x 100	33.33	60	67	60

Table 5. Physiological indices of welfare

Groups				
Degree				
Physiological indices of welfare				
Groups	**Basal diet**	**Basal diet + 1% of Feed additives**		
Degree	**Control (G1)**	**Garden cress (G2)**	**Turmeric (G3)**	**Fennel (G4)**
Corticosterone levels (nmo\L)	29 ± 3.2 a	20 ± 2.1 b	19 ± 4.1 b	17 ± 1.8 b
Glucose level (mmo\L)	162.6 ± 3.5 a	149 ± 1.5 b	139 ± 6.5 b	142.3 ± 2.2 b
Cholesterol level (mmo\L)	149 ± 5.1 a	133 ±3.6 b	112 ± 2.5 b	122 ± 4.2 b
Triglycerides level (mmo\L)	52 ± 1.2 a	33 ± 1.3 b	37 ± 2.2 b	41 ± 0.9 b
Poultry welfare, %= (a \ b) x 100	33.33	60	67	60

DISCUSSION

The integrated assessment of Fayoumi chicken welfare % reared on basal diet was 33.33 %. It was based upon statistically significant changes in different physical (lower) and physiological (higher) traits compared to birds fed diet contain seed powder of garden cress, turmeric, and fennel which data were 60; 67; 60 % respectively. Where F1 data come from feed intake data, F2 and F4 data come from comfort data, F5 data come from corticosterone level.

Treatment groups G2, G3, G4 were significantly more feed intake, body weight, body gain, and FCR compared to control group (G1). This confirmed the higher welfare of the birds fed feed additives. In poultry, improved welfare is manifested with lowered blood corticosterone, glucose, total cholesterol, and triglycerides, made us score the freedoms: F2, F3, F4 and F5 with 2 points. The Freedom from thirst and hunger (F1) was scored with a 1 point (Table. 4). The overall welfare assessment in treated groups was 60; 67; 60 % higher than that in control (33.33).

In relation to Physical indices of welfare, in the present study, body weights (BW), body weight gain (BWG) and feed conversion ratio (FCR) was significantly increased by the addition of garden Cress, turmeric, and fennel to the diet (Table 3).

Garden Cress supplementation to the broiler diet has a beneficial effect on body weight, weight gain and feed intake these results are in agreement with that previously reported by [19,31,32] this result may be due to its favorable effect on diet palatability and nutrient assimilation[33] leading to improve nutrient digestibility[34] and its high content of essential fatty acids (Oleic, 30.6% and linoleic, 29.3%) and high fat percent[8-24] large concentration of tocopherols, good amount of lignans and antioxidants and traditionally used to control many clinical problems such as anti-asthmatic, galactagogue, stimulant and control of blood pressure.[35] Besides that, their content of essential nutrients and some unidentified growth factors and enhancing their effect on digestive enzymes.[36] On the other hand, results obtained in fennel group was in line with those of (27), who found an increase in body weight , which back to that some essential oils components of it stimulate secretion of digestive and gastric juices, while reducing stomach and intestinal inflammation, and facilitating nutrient absorption.[37] Also might be due to the active principles in the fennel such as anethole, limonene struggle, which are known to have antioxidant, carminative, anti-flatulent and digestive stimulating and appetizing effect's.[38] Moreover, its laxative, appetite stimulant, antispasmodic and carminative, revels abdominal pain and promote gastrointestinal, liver and kidney health.[39]

Our result in case of turmeric was agreed with data of.[40-43] The improvement in body weight gain may be due to the phytobiotic stimulant property of turmeric. Turmeric has the ability to stimulate digestive enzymes and depress pathogenic microbial flora in the small intestine which competes the host for nutrients[44] it increased the secretion of digestive juices, improved the gastro-intestinal condition[45] and increased the villi length and decreased the intestinal pH which could contribute to the increased nutrient utilization.[46]

Fayoumi welfare in relation to physiological indices, in the control group (G1) the freedoms F1, F2, F4 was scored with 1 point instead of the maximum 3 (table 4). The (F3) score was 2 (i.e. freedoms from pain, injury, and disease). and, The freedom from fear and distress (F5) score was zero, due to high blood corticosterone, glucose, cholesterol, and triglycerides as compared to feed additives groups. That is why the integrated poultry welfare assessment in control birds was 33.33%.

In this experiment where (G2-G4) which subjected to feed additives supplementation had the lowest mean of blood glucose, triglycerides, total cholesterol, and corticosterone level and a higher score for the freedoms: F1, F2, F3, and F4 with 2 points. The freedom from thirst and hunger (F1) was 2 in (G2 and G3) and 3 (G3) as their enhancing effect of feed intake. The freedom from fear and distress (F5) was scored with 1 because of lower blood levels of corticosterone, glucose, total cholesterol ($P<0.01$) and triglycerides ($P<0.05$) compared to controls.

Glucose is a serum biochemical marker that is widely analyzed. Its reduced plasma level indicates its adequate utilization by tissues, possibly due to a stimulation of glucose transporters, which indicate a better use of energy. Further, glucose is utilized by birds for a variety of functions, mainly for energy production through cellular oxidation, glycogen synthesis in liver and glycolytic muscles, fatty acid synthesis as well as the synthesis of nonessential amino acids, vitamin C and other metabolites.[47]

Lower values of triglycerides and cholesterol in group consumed diet containing garden cress, turmeric and fennel as compared to control one could be an indication of its hypocholesterolemic properties was agreed on with[43,48,49] and [24,50,51] respectively.

Hypocholesterolemic properties of garden cress could be due to the high copper content[52] as it was known to have a blood cholesterol-lowering effect beside ALA content which reduce triglycerides, total cholesterol and improve the lipid profile of rats.[53] While, Hypoglycemic

properties are due to the beneficial effects of flavonoids content which possess insulin-like properties and thereby are able to reduce blood glucose levels[54] also a potent inhibition of renal glucose reabsorption which in turn reduced blood sugar[55] and the presence of oleic (30.6%) and linolenic acids (29.3%).[56] beside that, Hypocholesterolemic properties of Fennel could be due to the main active component in fennel (anethole) is a phytosterol which alters the metabolic pathway in the body of chicks leading to cholesterol and triglyceride reduction[57,58], also, is a great source of fiber, in powder form it acts as a laxative, it also helps to maintain healthy levels of cholesterol in the bloodstream.[59] Moreover, in turmeric group hypocholesterolemic related to the activity of two effective enzymes HMG-CoA reductase and cholesterol 7a-hydroxylase.[60] May be mediated by the stimulation of hepatic cholesterol-7- hydroxylase activity because the digestibility of TG was not affected by curcuminoid supplementation.[61] While, depressed the plasma triglyceride concentration may be due to the lowering hepatic lipogenesis effect.[62] And α-curcumene which one of the active principles exerting triglyceride-lowering activity[63] on the other hand, the hypoglycemic effect of turmeric may be due to it appeared to improve the function of the beta cells that make insulin in the pancreas.[64]

Worsening of poultry welfare can detect by plasma corticosterone level.[65] The decreasing effect on corticosterone concentrations in case of fennel treated groups could be attributed to the antioxidant and anti-stress effect of it[51] its phenolic compounds as caffeoylquinic, Rosmarinicacid, showed antioxidant activities[66] finally, fennel act as excellent nature antioxidants sources.[67] While, in case of turmeric group may due to it's a strong an antioxidant[25,61] it active constituents as curcumin, demethoxycurcumin, beside methoxycurcumin and tetrahydrocurcuminoids[68] and turmeric which acting as antioxidant. Besides that, turmeric enhanced the antioxidant status, improving glutathione peroxidase and superoxide dismutase activity,[69] lipid peroxidation inhibition[70] and malondialdehyde (MDA) concentrations reduction, which indicates an improved antioxidant and detoxifying status of birds.[71]

CONCLUSION

The practice of feeding male Fayoumi chickens on a diet containing 1% seeds powder of garden cress, turmeric, and fennel could be a desirable feeding strategy that might offer a welfare score improvement method

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CONFLICTS OF INTEREST

No potential conflicts of interest.

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