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Effects of Early Feed Restriction and Dietary Inclusion of Some Spices on Performance of Broiler Chickens

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Abstract
A 3×4 factorial experiment was conducted with three early feed restriction regimens (F0 without feed restriction, F1 feed restriction for 12 hr and F2 feed restriction for 24 hr) and four dietary inclusion of spices [G0 without inclusion of spices, G1 garlic (*Allium sativum* L.), G2 red hot pepper (*Capsicum annuum* L.) and G3 Moleita baladi (*Sonchus oleraceus*)] to study the effect of early feed restriction and dietary incorporation of some spices on broiler performance. A total of 12 treatments were employed and each treatment was replicated three times with 10 chicks each (Ross 308). Feed consumption (FC), weight gain (WG) and feed conversion ratio (FCR) were recorded. Carcass weight, weights of some internal organs and cuts were measured. Some blood constituents were determined. The results showed that FC, WG and FCR were affected by experimental treatments ($p \leq 0.01$). The greatest FC was reported with birds exposed to F0 regimen. The birds fed on diets containing hot pepper had the greatest value of feed consumption, while the birds fed on diets without spices had the lowest value. The same pattern of results was observed with WG. Birds exposed to early feed restriction for 24 hr (F2) had the heaviest WG. Feed conversion ratio was improved when birds exposed to early feed restriction. The best FCR was reported with birds fed on diets without spices. Carcass weights were influenced by early feed restriction ($p \leq 0.05$). Internal organs weights (liver, spleen, pancreas and gizzard) were not affected by experimental treatments. There was no significant effect ($p \geq 0.05$) of feed restriction on blood protein. However, the dietary spices affected the blood protein. Blood triglyceride was influenced only by spices. These results indicate that dietary inclusion of hot red pepper and adoption of F2 regimen for broiler chicks improved the weight gain and FCR, while F1 had the best carcass relative weight when compared with their counterparts of treatments.

Keywords: Spices, feed withdrawal, carcass characteristics

Introduction
European countries banned the usage of antibiotics as growth promoters to reduce the risk of antibiotic resistant pathogens which are extremely dangerous to human health. The ban of supplementation of antibiotics as growth promoters is expanding and adopted by many other countries.

Wierup (2001) reported that animal performance and feed conversion ratio have been negatively affected and the incidence of some bacterial diseases was increased due to removal of antibiotics as growth promoters from animal feed. For those reasons, products such as probiotics, prebiotics, enzymes, organic acids and botanicals (herbs, medicinal plants and spices) are needed to fill this gap. Herbs, medicinal plants and spices are very important when used as alternatives to antibiotic growth promoters in animal feed. The benefits of supplementation of spices are including improvement of gut health and digestibility (Mitsch *et al*., 2004; Kroismayr *et al*., 2008), enhancement of secretions of the digestive tract and maintaining the histology of the gut (Williams and Losa, 2001; Kreydiyyeh *et al.*, 2003; Jamroz *et al.*, 2003). In many tropical countries including Sudan, spices like hot red pepper (*Capsicum annuum* L.), garlic (*Allium sativum* L.) and moleita baladi (*Sonchus oleraceus*) are used in human nutrition. Those spices are characterized by their medicinal and growth promoting properties. Moreover, large amount of those spices are affordable, so they could be used in poultry nutrition. Hot pepper has many bioactive compounds called capsaicinoids. Kozukue (2005) reported that capsaicinoids has antimicrobial properties against *Escherichia coli, Clostridium perfringens,* and *Salmonella enteritidis*. Al-Kassie *et al.* (2012) reported that hot pepper included high level of vitamin C which is very important and effective in alleviating the heat stress. Garlic is widely used in human nutrition as spice and for treatments of many diseases (cardiovascular diseases, metabolic disorders, diabetes, hypertension, thrombosis and cancer (Agarwal, 1996; Konjufca *et al.*, 1997; Amagase *et al.*, 2001). The active compound which gives the odor and taste to the garlic is allicin. Allicin is responsible to hypocholesterolimc effect in human and animal (Silagy and Neil, 1994; Konjufca *et al.*, 1997; Chowdhury *et al.*, 2002). Garlic is an effective antioxidant in several types of meat (Yin and Cheng, 2003; Sallam *et al.*, 2004; Tang and Cronin, 2007). El-Kamali (2009) reported that moleita baladi is commonly used as antimalarial treatment in Africa particularly in Sudan as folk medicine. Also, moleita baladi is used for treatment of gastric irritation. The data concerning the effect of moleita baladi supplementation in poultry diets are lacking. Early feed restriction has been shown to improve feed efficiency (Beane *et al.*, 1979; Mollison *et al.*, 1984; McMurtry *et al.*, 1988; Pinchasov and Jensen, 1989). Feed restriction applied at early age of broiler to alleviate the metabolic disorders (ascites, sudden death syndrome and leg deformities) which could be happen during the fast growth (Ozkan *et al.*, 2010). There were discrepancies of performance results when the birds exposed to feed restriction. The current study has been conducted to investigate the response of broiler chickens when subjected to early feed restriction and some spices incorporation under arid hot climate.

Materials and methods

Experimental location and duration:

This study was carried out in Extension and Rural Development Centre, Faculty of Animal Production, University of Gezira, Elmanagil, Gezira State, Sudan. This area is characterized by arid hot climatic conditions. The study lasted for six weeks during the period from January to February 2018.

Preparations of the spices (hot red pepper, garlic and moleita baladi):

Hot red pepper, garlic and moleita baladi were purchased from the local market of Elmanagil town in the central of the Sudan. Those spices were firstly blended, exposed to air drying for 48 hours using plastic sheets and kept away from direct solar radiation. After air-drying those spices were ground to powder to be included in the experimental diets. The spices mash was tightly packaged in polythene plastic bags, sealed and kept at room temperature until included in the diets.

Birds' management and dietary treatments:

A (3×4) factorial experiment was conducted with three early feed restriction programs (F0 without feed restriction, F1 feed restriction for 12 hr and F2 feed restriction for 24 hr) and four dietary inclusion of spices (G0 without inclusion of spices, G1 garlic, G2 red hot pepper and G3 Moleita baladi) to study the effect of early feed restriction and dietary incorporation of some spices on broiler performance. A total of 12 treatments were employed and each treatment was replicated three times with ten birds each. The feed restriction treatments were started immediately after chicks' arrival to the experimental house. All birds were fed iso-energetic and iso-nitrogenous basal starter and finisher diets to meet or exceed the broiler nutrient requirements according to (NRC, 1994). A total of 360 un-sexed one-day broiler chicks (Ross 308) were distributed to 36 pens that were randomly assigned to 12 treatments. Each treatment was replicated three times (10 birds per pen). The treatment F0G0 including no spices and no feed restriction was considered as control. Compositions of experimental diets are shown in Table 1. The birds were housed in open sided deep litter house situated on East –West direction which the long axis facing North and South wind. The house dimensions were (3 meters) width and (12 meters) length, and the height for each longitudinal side was (3meters) with brick wall (80 centimeters height). The height of the ridge was 3 meters. The roof was made of corrugated iron sheets and the floor was made of concrete. The house contained 36 pens. The dimensions of each pen were (100 cm) length, (100 cm) width and the height was (100 cm). Each pen was supplied with tubular feeder, plastic drinker and incandescent bulb lamp of 60 watts. The bulbs were hanged one meter height. The lighting program adopted was 24 hours lighting (naturally and artificially). Fresh water and feed were offered *ad libitum*.

Parameters measured:

Feed consumption and weight gain were measured. Feed conversion ratio (FCR) was calculated. At day 42, two birds per replicate were selected according to their average weight and slaughtered to measure the carcass and organs weights. Internal organs were weighed and expressed as the organ weight as a percentage of live body weight. Blood samples were collected for determination of cholesterol, triglycerides and protein. Blood samples were obtained via wing-vein using 0 -5ml insulin syringe and drawn into vacuumed capillary tubes, centrifuged for 10 minutes (Hettich EBA 20 – Germany) at 2000 rpm at room temperature, and then serum was collected and stored at −20°C for later analysis. Blood cholesterol, triglyceride and total protein levels were determined spectrophotometrically by using commercial kits. Blood parameter values were expressed as milligrams per 100 m L.

Statistical analysis:

Data were statistically analyzed using ANOVA. The software (SPSS, 2001) was used for running the analysis. Differences between mean values of the treatments were determined using Duncan's multiple-range test (Petrie and Watson, 1999).

Results

Growth performance:

Table 2 showed that feed consumption, weight gain and FCR were affected by experimental treatments ($p \leq 0.01$). The greatest feed consumed was reported with birds fed diets without restriction. The birds fed on diets containing hot pepper had the greatest value of feed consumption followed by garlic and moleita, while the birds fed on diets without spices had the lowest value. The same pattern of results was observed with weight gain. Birds subjected to early feed restriction for 24 hr (F2) had the largest weight gain value ($p \leq 0.01$). Feed conversion ratio was improved when birds exposed to early feed restriction. Although the value of feed consumption for birds exposed to early 24 hr restriction of feed was not the greatest one among other treatments, those birds had the greatest weight gain and the best FCR. Interaction effects ($p \leq 0.01$) between spices and early feed restriction were reported. Significant interactions ($p \leq 0.01$) have been observed between early feed restriction and spices for feed consumption, weight gain and FCR.

Slaughter performance:

Table 3 showed that the weight values of last live body, breast, thigh and drumstick were not affected by feed restriction. Carcass weights were influenced by early feed restriction ($p \leq 0.05$). The heaviest carcass weight values were observed with birds exposed to F1 (12 hr) early feed restriction. Last body weight and carcass weight were not affected by dietary spices. However, the weights of breast, thigh and drumstick were influenced by dietary spices. The greatest values of breast, thigh and drumstick were reported with birds fed on diets containing hot pepper ($p \leq 0.05$). Internal organs weights (liver, spleen, pancreas and gizzard) were not affected by experimental treatments. The only exception was observed with proventriculus weights which were affected by dietary inclusion of spices (Table 4).

Blood parameters:

Table 5 showed that there was no significant effect ($p \geq 0.05$) of feed restriction treatments on blood protein. However, the dietary spices treatments affected the blood protein. The highest and the lowest blood protein values were recorded with birds fed on diets containing garlic and moleita, respectively. Blood cholesterol was not affected by different treatments. Blood Triglyceride was influenced only by spices treatments.

Discussion

The current results agreed with Yoshioka et al (1999) who reported that hot pepper contained capsaicin which increased the feed consumption of poultry. Al-Kassie *et al*. (2012) reported that supplementation of hot pepper had highly significant ($p \leq 0.01$) positive effect on weight gain which agreed with current results. Also, he reported that hot pepper contained high level of vitamin C which is very important and effective in alleviating the heat stress. Obviously, the positive effect of vitamin C in alleviating the heat stress appeared in the current study because the experiment was conducted in an open sided house. Moreover, these results were in line with Shahverdi *et al.* (2013) who revealed that the inclusion of red pepper to broiler diets by 1% improved the overall performance. Varmaghany *et al.* (2015) reported that when dietary inclusion of garlic increased up to 10% the weight gain increased. The current study showed that moleita baladi ranked after hot pepper and garlic in their effect on broiler performance. It may be attributed to the bitter taste which decreased the feed consumption and consequently the weight gain. The current results showed that weight gain and feed conversion ratio were improved when birds exposed to early feed restriction. Khajavi *et al.* (2003) reported that early feed restriction improved broiler immunity which could be impaired by heat stress when birds subjected to high temperature later. So, when the birds having high level of immuonocompetence, they will perform well. Early feed restriction has been shown to improve feed efficiency (Beane *et* *al.*, 1979; Mollison *et al.*, 1984; McMurtry *et al.*, 1988; Pinchasov and Jensen, 1989). Feed conversion ratio was improved when broilers were subjected to feed restriction (Pierre *et al.*, 1995; Lee and Leeson, 2001). This result is consistent with the current result.

The findings of the current study showed that the greatest carcass weight values were reported with birds exposed to early feed restriction for 12 hours. These results agreed with Plavnik and Hurwitz (1990), who revealed that the compensatory growth following the feed restriction increased the body weight to be greater than that of birds fed in *ad libitum* basis. The current work indicated that carcass cut parts were not affected by early feed restriction which agreed with findings of many researchers (Leeson *et al.*, 1991; Lippens *et al.*, 2000; Rezaei *et al.*, 2006). In contrast, our results are contradicted with findings of Rezaei and Hajati (2010) who reported that carcass weight was not affected by feed restriction. This contradiction may be attributable to different strains of birds and/or the type of feed restriction regimen adopted. The current research revealed that the internal organs were not significantly influenced by early feed restriction. Corless and Sell (1999) reported that liver weight did not influenced by early feed restriction for 54 hours post-hatching of poults. However, our finding does not concur with Corduk *et al.* (2013) who reported the gizzard relative weights were reduced when broilers subjected to early feed restriction. In addition to that, their findings indicated that the relative weight of liver was increased when birds exposed to 48 hours feed restriction after hatching. The observed discrepancy between results might be due to the time of slaughter processing and data collection which have been done at 21 day of age while in the current study at 42 day of age. The results of the present study are in agreement with the results of Demir *et al.* (2004) who pointed out that total blood protein was not affected by feed restriction. Corduk *et al.* (2013) reported that blood cholesterol, triglyceride and total protein were not affected by post-hatching feed and water restriction. Similar observations have been reported in the present study. Choi *et al.* (2010) reported that low density lipoprotein cholesterol decreased significantly when the dietary level of garlic inclusion was increased. Although in the present study there was no significant effect of dietary garlic inclusion on serum cholesterol level, but numerically garlic treatment reported the lowest value. So, the contrary of the present study may be due to the low level of garlic incorporation. Amagase *et al.* (2001) reported that the effectiveness of garlic to reduce the cholesterol may depend on methods of preparation, stability of its chemical composition and the duration of the treatment. Forty percent of the activities of HMG-CoA reductase and cholesterol 7α-hydroxylase were decreased when dietary incorporation of garlic increased to 3% (Konjufca *et al.*, 1997). These findings are in line with the present study. The present result revealed that triglyceride value was significantly decreased when birds fed on diet containing red pepper which agreed with El-Deek and Al-Harthi (2003) who pointed out that plasma triglyceride was reduced when broilers fed on diets containing 0.1% hot pepper.

Conclusions

These results indicated that dietary inclusion of hot red pepper and early feed restriction for 24 hours for broiler chicks elevated the weight gain and improved FCR, while F1 had the best carcass relative weight when compared with their counterparts of treatments.

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Disclosure statement

No potential conflict of interest was reported by the authors.

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Table 1: The composition and calculated analysis of experimental diets containing spices for starter and finisher periods.

Ingredients (%)	Starter (1-21d)				Finisher (22-42d)			
	Control G0 (%)	Garlic G1 (%)	Hot pepper G2 (%)	Moleita G3 (%)	Control G0 (%)	Garlic G1 (%)	Hot pepper G2 (%)	Moleita G3 (%)
Sorghum	56.00	56.00	55.70	56.00	56.50	56.50	56.50	56.50
Groundnut cake	20.00	20.08	20.30	20.08	12.00	12.00	12.00	12.00
Wheat bran	13.78	12.60	12.50	12.60	21.28	21.28	21.28	21.28
Super concentrate[A]	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00
Di-calcium phosphate	1.02	1.02	1.02	1.02	1.02	1.02	1.02	1.02
Lime stone	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30
Hot pepper	0.00	0.00	1.00	0.00	0.00	0.00	1.00	0.00
Garlic	0.00	1.00	0.00	0.00	0.00	1.00	0.00	0.00
Moleita baladi	0.00	0.00	0.00	1.00	0.00	0.00	0.00	1.00
Vegetable oil	2.60	2.70	2.88	2.70	2.60	2.60	2.60	2.60
Nacl	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30
Lysine	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50
Vitamin-mineral premix[B]	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50
Calculated analysis								
ME[C] (MJ/kg)	13.45	13.41	13.41	13.45	13.51	13.46	13.46	13.50
Protein (%)	23.11	23.01	23.01	23.15	20.4	20.31	20.31	2029

[A]Super-concentrate provided the following as percentage: 40 CP, 3.9 fat, 1.44 fibre, 10 Ca. 6.4 nonphytate P, 3.0 methionine and 10 lysine. Also supplied 1950 ME kcal/kg.
[B]Vitamin - mineral premix provided the following per kilogram of diet: Vitamin A (retinyle acetate), 10,000 IU; cholecalciferol, 2,500 IU;"-tocopheryl acetate, 60 mg; mendione sodium bisulfite complex, 15 mg; thiamine hydrochloride, 2 mg; riboflavine, 8 gm; pyridoxine hydrochloride, 4 mg; cyanocobalamin, 0.04 mg; pantothenic acid, 15 mg; nicotinic acid, 40 gm; folic acid, 1.5 mg; biotin, 0.2 mg;choline chloride, 200 mg; iron, 50 mg; manganese, 50 mg; copper, 10 mg; zinc, 50 mg; calcium, 352 mg; iodine, 1.46 mg; cobalt, 0.5 mg; selenium, 0.2 mg.
[C]Values of metabolizable energy were calculated according to (Ellis, 1994).

Table 2: Effect of early feed restriction and dietary inclusion of spices on broiler performance during the entire experimental period (6 weeks).

Treatments	Feed consumption (g)	Weight gain (g)	Feed conversion ratio (g:g)
F0G0	555.7	265.3	2.06
F0G1	622.4	263.3	2.32
F0G2	617.5	306.7	2.55
F0G3	612.5	264.4	2.24
F1G0	531.6	269.6	2.94
F1G1	575.6	283.8	2.55
F1G2	601.5	288.6	2.11
F1G3	547.5	260.3	2.16
F2G0	508.8	254.9	1.96
F2G1	562	290.7	1.96
F2G2	608.1	296.2	2.11
F2G3	569.4	283	2.01
SEM.[A]	2.7	2.8	0.019
Early feed restriction effect			
F0 (No restriction)	602[a]	274.9[b]	2.16[c]
F1 (12 hours)	564.1[b]	275.6[b]	2.06[b]
F2 (24 hours)	562.1[b]	281.2[a]	2.01[a]
SEM	1.35	1.4	0.01
Significance	**	**	**
Spices effect			
G0 (Free of Herbs)	532.1[d]	263.2[d]	1.99[a]
G1 (Garlic)	586.7[b]	279.3[b]	2.09[b]
G2 (Hot pepper)	609.1[a]	297.2[a]	2.08[b]
G3 (Molieta)	576.4[c]	269.2[c]	2.14[c]
SEM	1.56	1.6	0.011
Significance	**	**	**
F× G interaction	**	**	**

[a-d]Mean values within a column not sharing the same superscripts are significantly different (p <0.01). NS = not significant. **= (p <0.01).
[A]Pooled standard error of means.

Table 3: Effect of early feed restriction and dietary inclusion of spices on live body weight and relative weights of carcass and component parts of broilers.

Treatments	Live body wt (g)	Carcass (%)	Breast (%)	Thigh (%)	Drumstick (%)
F0G0	1525.00	62.76	11.38	9.53	7.12
F0G1	1541.67	63.00	11.14	9.83	5.22
F0G2	1491.67	62.12	58.59	16.38	15.56
F0G3	1558.33	69.32	13.88	7.17	5.57
F1G0	1437.67	72.71	14.89	9.82	5.73
F1G1	1541.67	68.62	13.56	8.16	5.79
F1G2	1441.67	76.32	15.83	11.64	8.51
F1G3	1578.33	65.58	14.09	10.14	5.83
F2G0	1533.33	68.92	13.94	10.30	5.71
F2G1	1515.00	56.22	13.69	10.36	5.00
F2G2	1284.17	64.59	12.76	9.35	5.74

SEM.[A]	84.34	4.12	0.83	0.14	0.20
Early feed restriction effect					
F0 (No restriction)	1529.17	64.30[b]	23.75	10.73	8.37
F1 (12 hours)	1499.83	70.81[a]	14.59	9.94	6.47
F2 (24 hours)	1454.58	63.09[b]	12.41	9.84	5.89
SEM	42.17	2.06	0.41	0.72	0.10
Significance	NS	*	NS	NS	NS
Spices effect					
G0 (Free of Herbs)	1498.67	68.13	13.40[b]	9.88[b]	6.19[b]
G1 (Garlic)	1532.78	62.61	12.80[b]	9.45[b]	5.34[b]
G2 (Hot pepper)	1405.83	67.68	29.06[a]	12.46[a]	9.94[a]
G3 (Molieta)	1540.83	65.84	12.41[b]	8.89[b]	6.17[b]
SEM	48.69	2.38	0.48	0.83	0.12
Significance	NS	NS	*	*	*
F× G interaction	NS	NS	*	*	NS

[a,b]Mean values within a column not sharing the same superscripts are significantly different (p <0.05). NS = not significant. *= (p <0.05).
[A]Pooled standard error of means.

Table 4: Effect of early feed restriction and dietary inclusion of spices on relative internal organs of broilers (%).

Treatments	Liver	Spleen	Abdominal fat	Gizzard	Proventriculus	Pancreas
F0G0	1.788	0.066	1.145	1.790	0.337	0.186
F0G1	1.740	0.065	1.112	1.908	0.457	0.173
F0G2	1.754	0.067	1.112	1.756	0.424	0.201
F0G3	1.631	0.074	1.534	2.120	0.407	0.182
F1G0	1.808	0.071	1.433	1.898	0.358	0.191
F1G1	1.696	0.065	1.079	1.685	0.345	0.193
F1G2	1.817	0.073	1.672	1.970	0.441	0.207
F1G3	1.585	0.063	0.995	1.722	0.423	0.180
F2G0	1.663	0.066	1.524	1.633	0.347	0.175
F2G1	1.777	0.067	1.231	2.025	0.374	0.187
F2G2	1.804	0.066	1.129	2.005	0.464	0.221
F2G3	1.676	0.067	1.418	1.637	0.358	0.180
SEM[A]	0.085	0.004	0.181	0.138	0.040	0.018
Early feed restriction effect						
F0 (No restriction)	1.728	0.068	1.226	1.893	0.406	0.186
F1 (12 hours)	1.727	0.068	1.295	1.819	0.392	0.193
F2 (24 hours)	1.730	0.066	1.326	1.825	0.386	0.191
SEM	0.042	0.002	0.091	0.069	0.020	0.009
Significance	NS	NS	NS	NS	NS	NS
Spices effect						
G0 (Free of spices)	1.753	0.068	1.367	1.774	0.347[b]	0.184
G1 (Garlic)	1.739	0.066	1.141	1.873	0.392[ab]	0.184
G2 (Hot pepper)	1.792	0.069	1.304	1.910	0.443[a]	0.210
G3 (Molieta)	1.630	0.068	1.316	1.826	0.396[ab]	0.180
SEM	0.049	0.002	0.105	0.079	0.023	0.010
Significance	NS	NS	NS	NS	**	NS
F× G interaction	NS	NS	**	**	NS	NS

[a,b]Mean values within a column not sharing the same superscripts are significantly different (p <0.01). NS = not significant. **= (p <0.01).
[A]Pooled standard error of means.

Table 5: Effect of early feed restriction and dietary inclusion of spices on blood constituents of broilers.

Treatments	Triglyceride (gm/dl)	Cholesterol (gm/dl)	Total protein (g/dl)
Early feed restriction effect			
F0 (No restriction)	56.54	165.4	3.42
F1 (12 hours)	74.33	161.3	3.30
F2 (24 hours)	58.34	155.0	3.37
SEM[A]	5.4	4.2	0.08
Significance	NS	NS	NS
Spices effect			
G0 (Free of Herbs)	93.1^{a}	160.8	3.31^{b}
G1 (Garlic)	23.63^{c}	155.8	3.91^{a}
G2 (Hot pepper)	54.7^{b}	158.3	3.43^{b}
G3 (Molieta)	80.9^{a}	167.3	2.84^{c}
SEM	6.3	4.9	0.096
Significance	**	NS	**
F× G interaction	*	NS	**

[a-d]Mean values within a column not sharing the same superscripts are significantly different (p <0.01). NS = not significant. *= (p <0.05), **= (p <0.01).
[A]Pooled standard error of means.

أثر التقييد الغذائي المبكر والادخال العلفي لبعض التوابل على أداء الدجاج اللاحم

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المستخلص

أجريت التجربة العاملية (4×3) باستخدام ثلاث أنماط مختلفة من التقييد الغذائي بعد فقس الكتاكيت (F0 لم يستخدم فيها أي نمط من التقييد الغذائي، F1 تقييد غذائي لمدة 12 ساعة و F2 تقييد غذائي لمدة 24 ساعة) وأربع ادخالات علفية لبعض التوابل وهي (G0 ليست بها أي نوع من التوابل، G2 الشطة الحمراء الحريفة (*Capsicum annuum* L.) وG3 المولية (*Sonchus oleraceus*). وذلك لدراسة أثارها على أداء الدجاج اللاحم. تم استخدام 12 معاملة بثلاثة تكرارات لكل معاملة وتحتوي كل وحدة تجريبية 10 كتاكيت (روص 308). تم تسجيل استهلاك الغذاء والوزن المكتسب ومعدل التحول الغذائي. تم قياس اوزان الذبيحة وبعض الأعضاء الداخلية. تم قياس بعض مكونات الدم. أظهرت النتائج أن المعاملات لها تأثير معنوي

على استهلاك الغذاء واكتساب الوزن ومعدل التحول الغذائي ($p \leq 0.01$). الطيور التي لم تتعرض لتقييد غذائي مبكر F0 قد استهلكت علفا أكثر. الطيور التي تغذت على علف يحتوي على الشطة استهلكت كمية العلف الأكبر بينما الطيور التي تغذت على علف لا يحتوي توابل كانت الأقل استهلاكا. أخذت النتائج المتعلقة باكتساب الوزن نفس منحى نتائج استهلاك العلف. أعلى قيمة للوزن المكتسب كانت للطيور التي تعرضت لتقييد غذائي لمدة 24 ساعة (F2). الطيور التي تعرضت للتقييد الغذائي المبكر تحسن معدل تحولها الغذائي. أفضل معدل تحول غذائي لوحظ عند الطيور التي استهلكت علف لم يحتوي على توابل. أثر التقييد الغذائي المبكر معنويا على وزن الذبيحة ($p \leq 0.05$). أوزان الأعضاء الداخلية (الكبد والطحال والبنكرياس والقانصة) لم تتأثر معنويا بالمعاملات التجريبية. لم يؤثر التقييد الغذائي المبكر على محتوى الدم من البروتين ($p \geq 0.05$). بروتين الدم تأثر بالتوابل. تأثر محتوى الدم من الكولسترول فقط بمعاملات التوابل. أشارت هذه النتائج الى أن ادخال الشطة في العلف وتطبيق برنامج F2 قد ساهم في تحسين الاوزان المكتسبة ومعدل التحول الغذائي بينما F1 أعطت أفضل الأوزان النسبية للذبيحة عند مقارنتها مع نظيراتها من المعاملات الأخرى.