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EFFECT OF INCLUSION OF SUGAR BEET PULP IN THE DIETS ON THE PERFORMANCE OF BROILER CHICKENS

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ABSTRACT: The current research aimed to study the effect of adding sugar beet pulp (SBP) to the diet on Cobb broiler chickens performance. A total number of 252 unsexed five day old Cobb chicks, which were first fed the control diet from 0 to 4 days were used. The birds were banded in the wing, weighed individually in gram at 5 days, randomly distributed equally into 7 dietary treatment groups (0.0, 2.5, 5.0, 7.5, 10.0, 12.5 and 15.0% SBP), 36 birds each (3 replicates /12 birds each).

Birds fed diet containing 5.0% SBP showed significantly higher value of LBW at 42 days and BWG through the period 5-42 days, but, birds fed 0.0% SBP (control diet) had lower values. With noting that all treatments were significantly higher LBW and BWG at the same ages compared to control. Cobb broiler chicks fed 0.0% SBP (control diet) showed significantly lower FI during the period 5-42 days, while, birds fed 12.5% SBP had significantly higher value, moreover, insignificant effects were noticed in FCR, CPC and CCR over the period from 5 to 42 days. Birds fed 5% SBP had higher GR over the period from 5 to 42 days (differences in GR between birds fed 5.0, 7.5, 10.0, 12.5 and 15.0% SBP were not significant). Blood parameters% were insignificantly affected except, mean corpuscular hemoglobin concentration%.

Insignificant effects were noticed in slaughter parameters%, except, gizzard%. Birds fed 10.0% SBP had higher gizzard%, but, those fed 0.0% SBP had the lower value. The mortality rate was 2.78% in chicks fed control diet or 2.5% SBP, but, it was 0.0% in the other groups during the total period. Economical and relative efficiency values improved over the total period in birds fed all experimental diets except those fed 2.5% SBP, as compared to birds fed a control diet.

Key words: Sugar beet pulp, blood parameters, broiler performance, diet.

INTRODUCTION

Yellow corn constitutes about 60-70% of the feed for various types of poultry. Most of Egypt's domestic corn production is used up for human consumption. This created a gap between locally available feed materials and the increasing requirements of feed for poultry production in Egypt. Also, the devaluation of the Egyptian currency in recent years, led to a negative impact on the prices of all imported raw materials, especially corn and soybeans. Therefore, there was a serious effort to find alternative local feed materials that meet nutritional requirements. The waste of locally agricultural and industrial products was the drive force to find partial alternatives to reduce the cost of production and reduce imports.

Low crude protein (CP), digestibility, energy and palatability with high crude fiber (CF) contents compared to the conventional feeds they replace are the major limitations to the use of these agricultural or industrial by-products as poultry feed.

Sugar beets (*Beta vulgaris L.*) are considered one of the main agriculturally and industrially important crops for sugar production in the world, especially temperate regions (about one third of the total sugar prodution in the world). The global production of sugar beets reached 281194600 tons in 2023 according to FAO (2025), and the production of the African continent is 14370000 tons harvested in 2023 (FAO, 2025), while Egypt’s production amounts was 12794000 million tons in 2023 (FAO, 2025), which represents 4.55% of global production and 89.03% of the total product from the African continent.

The process of manufacturing sugar from beets produces a by-product, sugar beet pulp (SBP), which is dried immediately after manufacturing. Supposing that every 100 kg of processed sugar beets produces 5.5% (55 kg/ton) of SBP (dried) according to Mirzaei-Aghsaghali and Maheri-Sis (2008). Accordingly, there are approximately 703670 tons of Egyptian SBP production (dried) are available for livestock feeding in 2023.

Sugar beet pulp is an inexpensive and high-quality feed material for animals and poultry (Nobakht and Hamedi, 2014). As a result of its nutrient availability, palatability, and high nutritional value, SBP is frequently used by nutritionists and poultry producers in production areas. Sugar beet pulp is available in many forms, including wet or dry. It can also be served in mash form or in pelleted form. Koschayev et al. (2019) supplemented 2–5% of dry SBP to broiler diet and noticed positive effects on growth performance and meat quality. The leftover SBP which contains approximately 8% protein, 18% pectin, 19% cellulose and 28% hemicelluloses (Joanna et al., 2018).

Sugar beet pulp contains complex substances, most of which are insoluble, such as cellulose and hemicellulose, and a small amount of soluble compounds, such as lignin (Agar et al., 2016). Castle et al. (1981) reported that SBP contains about 8.21% CP (mostly true protein); Ca, 0.77%; P, 0.09%; Mg, 0.3%; Fe, 0.03%; reducing sugars, 0.29%; sucrose, 2.99% and B-carotene 0.21 mg/kg on dry matter basis. Moreover, Minarovicova et al. (2018) stated that the raw proteins of SBP has a digestibility of up to 75% with enclose vital amino acids such as methionine, lysine, cysteine and threonine. Hagstrom (2008) showed that the ME in SBP is very low being 646 kcal/kg and CF is very high being 19.0%, although, being excellent digestible fiber source. The same authors that also added, SBP contain about 10.5% CP. Likewise, it is comparatively high in Ca, with very low levels of Vit. B, Se and P, but, contains nearly no Vit. D or the precursor of Vit. A.

Therefore, the aim of the current research was to study the effects of SBP inclusion on the growth performance of Cobb broiler chickens.

MATERIALS AND METHODS

The current research aimed to study the effect of adding SBP to the diet on the performance of Cobb broiler chickens. Samples of air-dried SBP (a by-product of the sugar industry) were randomly collected from the Fayoum Sugar Industry Company (Sugar Factory in Atsa, Fayoum Governorate) either in mash form (ground using hammer mill for feeding), as dried SBP is available in mash or pellet form.

The total number of experimental birds was 252 five day old unsexed Cobb chicks, which were first fed a control diet from 0 to 4 days of age. The birds were banded in the wing, weighed individually in gram at 5 days of age (beginning of the experiment), randomly divided equally into 7 dietary treatment groups (36 birds per treatment), and each treatment equally sub-divided into 3 replicates of 12 birds.

The nutritional treatments used in this study were as follows:

1-Birds were fed control diet (D1).

2- 2.5% from D1 was substituted by SBP.

3- 5% from D1 was substituted by SBP.

4- 7.5% from D1 was substituted by SBP.

5-10%from D1 was substituted by SBP.

6-12.5% from D1 was substituted by SBP.

7-15%from D1 was substituted by SBP.

The birds were then transferred to electrically heated batteries (open system) through raised mesh floors. The treatments consisted of seven levels of SBP (0.0, 2.5, 5.0, 7.5, 10.0, 12.5 and 15.0%). The experimental birds were raised under similar environmental conditions (open system), and were fed starter (5-11 days), grower (12-23 days), and finisher diet (24 days until the finale of the experiment (42 days)).

At the same ages, feed intake (FI) was recorded, body weight gain (BWG, g), feed conversion ratio (FCR, g feed/g gain), calorie conversion ratio (CCR), crude protein conversion (CPC) and growth rate were calculated.

The performance index% (PI%) was estimated according to the formula developed by North (1981) as follows, PI% = (LBW, Kg /FC) x100. The cumulative mortality rate was also recorded during the trial period. Birds that died throughout the experimental period were weighed, and the data were used to adjust FI and FCR calculations.

Experimental diets were supplemented with DL-methionine, L-Lysine HCl and mixture of minerals and vitamins according to the catalog recommendations of Cobb strain to agree with the recommended requirements and were formulated to be iso-caloric and iso-nitrogenous. The composition and calculated analysis for the experimental diets are shown in Tables 2a, 2b and 2c. Experimental diets were complemented with broiler concentrate contains: crude protein, 45%; crude fiber, 2.96%; ether extract, 1.94%; calcium, 2.5%; available phosphorus, 3.3%; methionine, 1.77%; methionine + cystine ,2.5%; lysine, 3%; sodium, 1.84% and 2530 K Cal ME/kg. Also, supplemented with vitamin (Vit.) and mineral (Min.) mixture (each 3.0 Kg of the Vit. and Min. premix contains: Vit. A 10050000 IU; Vit. D_3 2280000 IU; Vit. E 20100 IU; Vit. K_3 1005 mg; Vit. B1 1002 mg; Vit. B_2 5010 mg; Vit. B6 1500 mg; Vit. B12 10.2 mg; biotin 50.1 mg; folic acid 1002 mg; niacin 30000 mg; pantothenic acid 10002 mg; Zn 50100 mg; Cu 10005 mg; Fe 40050 mg; Co 252 mg; Se 300 mg; I 1500 mg; Mn 75000 mg, Ethoxyquin 1800 mg and complete to 3.0 Kg by calcium carbonate.

Fresh water was provided from nipple drinkers [one teat/cage] and mach feeds were supplied *ad libitum* during the experiment. Heating, lighting and vaccination program were provided according to standard protocols for incubation and rearing. Chemical analyzes were performed at laboratories of Poult. Dept., Fac. of Agric., Fayoum Univ., Egypt, according to the methods specified by A.O.A.C. (2016).

At 42 days (end of the experiment), slaughter tests were performed using 42 birds (six chicks from each treatment) around average live body weight. Birds were fasted for 12 hours before slaughter. Then, the chicks were weighed to the nearest gram individually, slaughtered by cutting the jugular vein to get a blood sample (3 ml per chick). The fresh blood samples were taken to determine total count of red blood cells (RBCs), hemoglobin (Hb), hematocrit (Ht) total count of white blood cells (WBCs) and mean corpuscular volume (μ^2) and calculate mean corpuscular hemoglobin (µµg) and mean corpuscular hemoglobin concentration% (MCHC%).

After two minutes of bleeding time, each chick was immersed in a water bath for 45 seconds at a temperature of 70°C, and the feathers were removed by hand. After removing the head, the carcasses were manually disemboweled, and their weights were obtained to determine carcass traits, dressing% (eviscerated carcass without head, neck and thighs) and total giblets or viscera% (empty gizzard, liver, heart and spleen). The eviscerated weight included the front part with wing and rear part. Abdominal fat is manually removed from the parts surrounding the viscera and gizzard then weighed to the nearest gram. The front and back bones were separated and weighed to calculate the meat percentage. The meat from each part was weighed and blended using a kitchen blender.

To calculate the economic efficiency of the various nutritional treatments, the amount of feed consumed during the total experimental period was obtained and multiplied by the cost of one kilogram for each treatment, which was estimated based upon local market prices at the experimental time. Statistical analysis of the results were be conducted using the General Linear Modeling procedure in the SPSS program (SPSS, 2007) according to the following general model:

$Y_{ij}= \mu +L_i +e_{ij}$

Where: Y_{ij}: observed value.

μ: overall mean.

L_i: level of SBP effect (i: 0.0, 2.5, 5.0, 7.5, 10.0, 12.5 and 15.0% SBP).

e_{ij}: experimental random error.

Treatment means that indicate significant differences ($P\leq0.01$ and $P\leq0.05$) were tested using Duncan's multiple range test (Duncan, 1955).

RESULTS AND DISCUSSION

Productive performance: Effect of inserting different levels of SBP in Cobb broiler diets on LBW and BWG are shown in Table 4. Inclusion of SBP at different levels in Cobb broiler chicks diets significantly affected ($P\leq0.001$) LBW at 23 and 42 days. Birds fed 5% SBP in the diet had significantly higher value of LBW at 42 days of age (noting that all groups fed on SBP significantly outperformed the control group, except for those fed on 2.5% SBP) but birds fed 0.0% SBP (control) had lower value of LBW at 42 days. Insignificant effects were noticed in LBW at 5 and 11 days (Table 4).

Inclusion of SBP at different levels in the Cobb broiler chicks diets significantly affected ($P\leq0.001$) BWG over all periods studied. Chicks fed 5% SBP had significantly higher value of BWG over periods from 12 to 23, 24 to 42 and 5 to 42 days, but birds fed control diet (0.0% SBP) had lower value of BWG through 5-42 days of age. Similarly, all treatments were significantly ($P\leq0.001$) higher in BWG during the periods 24-42 and 5-42 days compared to birds fed diet containing 0.0%SBP, although there wasn't significant difference between the weight of the chicks fed the 0.0% SBP and those fed a diet containing 2.5% SBP.

Results obtained herein corroborates with Gonzalez-Alvarado et al. (2007) and Jimenez-Moreno et al. (2009) who found that increasing level of sugar beet , oat or pea hulls in the diets of broilers improved WG and FCR, and therefore, the increase of CF level at moderate amounts especially from soluble fiber source in young chicks diets may improve nutrient digestion and performance.

The current results are not consistent with the results of Emam (2018), who reported that Gimmizah chicks fed control (0.0% SBP) diet had higher values of LBW and BWG, but, those fed 20% SBP had lower values during the period from 3-8 weeks of age. Also, in this respect, Abdel-Hafeez et al. (2018) demonstrated that broiler chicks fed 7.5% SBP in the diet had lower values of LBW and WG than those fed 0.0% SBP (control) in the diet. Moreover, Sklan et al. (2003) and Jimenez-Moreno et al. (2011) demonstrated that this may be partly due to the birds' response to increasing level of pea hulls in the diet and may vary depending on the type and level of fiber used.

Furthermore, increasing level of soluble CF to moderate amounts in the diet improves gastric HCl secretion, nutrient digestibility, which leads to improve growth performance in chickens fed these diets (Jimenez-Moreno et al., 2009). It also, improve productivity in the lack of growth promoters (Gonzalez-Alvarado et al., 2007).

Effect of presence of SBP at different levels in Cobb diets on FI and FCR are presented in Table 5. Addition of SBP at different levels in the Cobb broiler chicks diets significantly affected ($P\leq0.001$) FI over all periods studied.

Cobb broiler chicks fed 0.0% SBP had lower FI over the period 5-42 days of age, while, there was no significant difference between the FI of the birds fed control diet and those fed a diet containing 2.5% SBP (the lower FI value over the period 24-42 days). Birds fed 12.5% SBP in the diet had significantly higher value of FI over the periods from 12-23, 24-42 and 5-42 days of age.

In general, FI increased significantly with SBP inclusion in the diets by 2.5 to 15% over the period from 5 to 42 days, as compared with those fed 0.0% SBP (this may be as a result of the high LBW and BWG values noted during this period).

On the contrary to our results, Jimenez-Moreno et al. (2011) found that chicks fed 7.5% SBP had significantly lower FI than chicks fed the control diet (0.0% SBP) over the period from 1 to 12 days. Also, Emam (2018) revealed that FI decreased significantly with increasing of SBP in the diets of Gimmizah chicks from 5 to 20% during the periods from 3-6, 7-8 and 3-8 weeks when compared with those fed 0.0% SBP (control diet). Moreover, Abdel-Hafeez et al. (2018) found FI of chicks fed 7.5% SBP in the diets was insignificantly lower than those fed 0.0% SBP (control) at starter, grower and over all periods.

Concerning FCR, CPC (Tables 5 and 6), results indicated that addition of SBP at different levels in broiler chicks diets significantly affected ($P \leq 0.05$ and $P \leq 0.001$) FCR and CPC during the periods 12-23 and 24-42 days of age, also, caused a significant ($P \leq 0.05$) changes in CCR over period from 12 to 23 days. However, insignificant ($P > 0.05$) effects were noticed in FCR, CPC and CCR over the other periods (Tables 5 and 6).

Chicks fed diet containing 2.5% recorded the best values of FCR, CPC and CCR than those fed other groups over the period from 12 to 23 days. Inclusion of 12.5% SBP in the Cobb broiler diets gave the worst values of FCR and CPC over the period from 24 to 42 days (differences are not significant between 0.0 and 12.5% SBP). But, those fed 7.5% SBP had the worst values of FCR, CPC and CCR during the period 12-23 days (differences are not significant between 0.0 and 7.5% SBP for CPC and CCR during the same period). In practice, there was no significant effect of SBP treatments during the total period (5-42 days).

Such results are partly similar with that of Guzman et al. (2015) who reported that LBW was not affected, but, FI increased by 3.6% and BWG enhanced by 4.1% as a result of increasing CF level in the dietary pullets over the period from 0 to 5 weeks, so, FCR was not affected. Consequently, raising CF level may be more beneficial for young broilers than for young pullets, under practical conditions.

In this respect, Emam (2018) found that over the period from 3 to 6 weeks, Gimmizah chicks fed 0.0% SBP recorded best values of FCR, CPC and CCR, while, over the period from 3 to 8 weeks, chicks fed 5% SBP recorded best values of FCR, CPC and CCR, however, differences among 0.0, 5.0, 10.0 and 15.0% SBP were not significant, but, chicks fed 20% SBP recorded the worst values. By contrast, Sklan et al. (2003) reported that fiber is generally considered an anti-nutritional factor in poultry as a result of the negative effect on nutrient digestibility and performance. In this connection, inclusion of SBP in broiler diets as the substitute feeds impaired FCR (Abdel-Hafeez et al. 2018).

In a study of Gonzalez-Alvarado et al. (2010) found that FI, feed efficiency, and nutrient digestibility of broiler fed SBP for 42 d were enhanced in the starter period, but, FI was decreased being 5.8% in the finisher period. Also, Jimenez-Moreno et al. (2009) and Gonzalez-Alvarado et al. (2010) demonstrated that this is attributed to the increased fecal volume resulting from the pectin at SBP, which resulted in lower passage rate and FI in older birds. Evidence suggests that fiber may be more beneficial for younger birds, and that SBP could be considered a source of fiber in the formulation of broiler starter diets. Moreover, Abdel-Daim et al. (2020) established that adding 7.5% SBP in the diet with a blend of enzymes improved nutrient digestion, small intestinal development and broiler meat quality in the finisher period. Jorgensen et al. (1996) reported that, a portion of the CF of SBP may be fermented in the digestive tract, providing supplementary energy to the birds. Similarly, Pettersson and Razdan (1993) found that when 2.3% of SBP was added, broiler performance was improved, while, when birds fed diet containing 4.6 or 9.2% recorded opposite effects. The present results disagree with the findings of Jimenez-Moreno et al. (2011) who stated that, an increase in fiber inclusion from 2.5 to 7.5% reduced BWG, therefore, impaired FCR from 1-18 days, but, FCR was similar for birds fed 7.5% fiber in the diet compared to the control group. Inclusion of soluble source of CF at reasonable amounts in broiler diets, had no significant impacts on BWG with high FI of birds (Hetland and Svihus, 2001), high FI and no significant impacts on performances (Tabook et al., 2006) and high viscosity of digesta (Svihus and Hetland, 2001) as well as enhanced digestibility of starch (Hetland and Svihus, 2001 and Svihus and Hetland, 2001).

Results presented in Table 7 show that inclusion of different levels of SBP in the Cobb broiler chicks diets significantly ($P \leq 0.001$) affected GR over all periods studied and PI over the period from 24 to 42 days. Chicks fed 5.0% SBP had higher GR during the periods 12-23 and 5-42 days (differences in GR between birds fed diet containing 5.0, 7.5, 10.0, 12.5 and 15.0% SBP were not significant overall total period) and PI during the period from 24-42 days. However, those fed 2.5% SBP showed the lower GR values over the periods from 24 to 42 and 5 to 42 days and PI over the period from 24 to 42 day (Table 7).

In this respect, Emam (2018) reported that Gimmizah chicks fed 0.0% SBP had higher GR and PI over the period from 3 to 8 weeks (differences between 0.0 and 5.0% SBP were not statistically significant), however, those fed 20% SBP had lower values.

Blood parameters: The data of Table 8 indicated that most of blood parameters were insignificantly ($P>0.05$) affected except, MCHC% which was significantly affected ($P \leq 0.05$). Birds fed 0.0% SBP (control diet) had significantly higher value of MCHC, however, Cobb chicks fed 12.5% SBP in the diet had significantly lower value. Numerically, all the dietary treatments insignificantly decreased ($P>0.05$) hemoglobin, hematocrit, mean corpuscular value and white blood cells count as compared with those fed control diet (Table 8).

Carcass characteristics: Table 9 shows that inclusion of different levels of SBP in the Cobb broiler chicks diets had insignificantly affected ($P>0.05$) slaughter parameters%, except, gizzard% which was significantly affected ($P \leq 0.05$). Chicks fed 10.0% SBP had higher value of gizzard%, however, birds fed 0.0% SBP had the lower value. Also, all groups were significantly ($P \leq 0.001$) higher in gizzard at the end of experiment compared to the control group,

although there was no significant difference between the gizzard weight of birds fed the control diet and those fed the diet containing 2.5 and 5% SBP.

These results were in line with findings of Emam et al. (2023) who found, that birds fed diet containing guava waste had significantly higher value of gizzard%. Also, Bahnas et al. (2008) demonstrated that quails fed diet containing peppermint by product had significantly higher gizzard%. Moreover, Lira et al. (2009) reported that the use of guava waste at level 12% caused significant effect for the absolute weight of gizzard, which increased for every 1% of addition in the diet. The increase in weight of gizzard perhaps being defensible via increasing the particle sizes of the diets, resulting from rise in levels of guava waste, which consists mostly of seeds, which can cause higher contractions of the gizzard muscles and promote greater muscular mass.

Mortality rate: It was 2.78% in Cobb chicks fed a diet containing 0.0 or 2.5% SBP, but, it was 0.0% in the other groups over the period from 5 to 42 days or total period (Table 10).

Economical and relative efficiency (EEf):

Data in Table 10 indicated that values of EEf values over the period from 5 to 42 days were improved in birds fed all experimental diets except those fed 2.5% SBP, as compared with birds fed 0.0% SBP. Birds fed 5.0% SBP had the best values of EEf (0.9348 and 119.96%, respectively), followed by 10% SBP (0.8900 and 114.21%, respectively), followed by 7.5% SBP (0.8506 and 109.15%, respectively), then 15.0% SBP (0.7883 and 101.15%, respectively), followed by 12.5% SBP (0.7828 and 100.45%, respectively) as compared with those fed 0.0% SBP over the period from 5 to 42 weeks of age. However, those fed 2.5% SBP had the lowest values of EEf and relative economical efficiency (0.7749 and 99.454%, respectively) In this respect, Emam (2018) showed that over the period from 3 to 8 weeks, Gimmizah chicks fed 5% SBP had the best values of EEf, whereas, those fed diet containing 20% SBP had the lowest values.

CONCLUSION

The obtained results showed that all treatments were better than the control in terms of overall performance, economic and relative efficiency (except for the group fed 2.5% SBP), but the best of them was the group fed 5% SBP. So, SBP could be used at a level of 5% and can reach 15% in the diets of Cobb broiler chicks without any negative effects on the performance depending upon the market and financial conditions. This can assist in improving the chicks production, decrease feeding expenses especially when traditional feed ingredients are unavailable, thus, reducing imports and saving hard currency.

Table (1): Proximate chemical composition of sugar beet pulp%.

Items		**Castle et al. (1981)**	**NRC (1998)**	**Foster et al. (2001)**	**Sauvant *et al.* (2004)**	**Feedstuffs Ingredient Analysis Table, 2017**	**Feedipedia (2018)**	**Minarovicova et al. (2018)**	**Emam and Abdel Wahed (2020)**
Fiber and fiber fractions%	Crude protein	8.60	7-8	8.10	8.00	8.40	10.71	10.31	8.90
	Crude fiber	-	17–22	17.30	21.00	19.01	21.54	69.84	19.40
	Neutral detergent fiber	42.40	-	40.50	-	43.97	-	-	47.10
	Acid detergent fiber	24.30	-	20.60	-	23.38	-	-	23.80
	Acid detergent lignin	-	-	1.90	-	3.91	-	-	2.70
	Hemicelluloses	18.10	45–61	19.9	-	20.59	-	49.91	23.3
	Celluloses	-	20–24	18.7	-	19.46	-	19.93	21.10
	Lignin	-	1–2	-	-	3.28	2.83	-	-
Moisture %		10.48	9.00		10.90	9.00	11.20	6.36	6.20
Fat%		0.64	0.80	0.42	0.90	0.50	0.90	0.42	0.56
Ash%		3.25	-	3.56	6.80	3.80	7.10	3.56	2.10
Energy, Kcal/kg	Gross	-	-	3633.0	-	3962 .0	4164		4087.0
	Metabolizable	2495.0	-	2677.0	2345.0	-	-	646	2700.0
Betaine, g/kg		-	-	-	-	-	-	-	3.98

- Not available.

Table (2a): Composition and calculated analysis of the experimental diets during the starter period.

Item, %		Level of sugar beet pulp%						
		0.00	**2.50**	**5.00**	**7.50**	**10.00**	**12.50**	**15.00**
Feed Ingredients	Yellow corn, ground	59.00	56.05	53.11	50.16	47.23	44.26	41.29
	Sugar beet pulp, ground	0.00	2.50	5.00	7.50	10.00	12.50	15.00
	Soybean meal (44%CP[1])	26.69	26.82	26.93	27.07	27.18	27.32	27.45
	Broiler concentrate[2] (45%CP)	10.00	10.00	10.00	10.00	10.00	10.00	10.00
	Calcium carbonate	1.45	1.40	1.35	1.30	1.25	1.20	1.15
	Sodium chloride	0.05	0.05	0.05	0.05	0.05	0.05	0.05
	Vit. and Min. premix[3]	0.30	0.30	0.30	0.30	0.30	0.30	0.30
	Dicalcium phosphate	0.03	0.04	0.05	0.05	0.06	0.07	0.08
	Vegetable oil (75% soybean oil and 25% sunflower oil)	2.15	2.53	2.91	3.29	3.66	4.05	4.44
	DL–Methionine	0.18	0.18	0.18	0.18	0.18	0.18	0.18
	L-Lysine HCl	0.15	0.13	0.12	0.10	0.09	0.07	0.06
	Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0
Calculated analysis[4]:								
Protein and amino acids	Crude protein	21.50	21.50	21.50	21.50	21.50	21.50	21.51
	Lysine	1.289	1.286	1.290	1.287	1.292	1.289	1.293
	Methionine	0.625	0.625	0.625	0.625	0.625	0.625	0.625
	Methionine+Cystine	0.980	0.979	0.978	0.977	0.975	0.974	0.973
	Arginine	1.244	1.247	1.249	1.253	1.255	1.258	1.261
	Threonine	0.633	0.640	0.647	0.655	0.662	0.670	0.677
	Valine	0.780	0.788	0.795	0.804	0.811	0.819	0.827
Crude fiber and fiber fractions	Crude fiber	3.462	3.882	4.300	4.720	5.139	5.558	5.977
	Neutral detergent fiber	9.214	10.047	10.879	11.713	12.546	13.379	14.210
	Acid detergent fiber	4.161	4.675	5.188	5.703	6.215	6.730	7.243
	Acid detergent lignin	0.402	0.485	0.569	0.652	0.736	0.819	0.903
	Hemicelluloses	5.053	5.372	5.691	6.010	6.331	6.649	6.967
	Celluloses	3.759	4.190	4.619	5.051	5.479	5.911	6.340
	Lignin	0.697	0.750	0.803	0.856	0.909	0.962	1.015
Fat	Ether extract	4.755	5.037	5.321	5.604	5.877	6.169	6.462
	Linoleic acid	2.646	2.797	2.948	3.099	3.244	3.400	3.556
Minerals	Calcium	0.897	0.897	0.898	0.896	0.896	0.897	0.897
	Available phosphorus	0.455	0.455	0.456	0.454	0.455	0.456	0.456
	Potassium	0.700	0.709	0.718	0.727	0.735	0.745	0.753
	Sodium	0.182	0.187	0.191	0.196	0.200	0.204	0.209
	Chloride	0.158	0.159	0.161	0.162	0.163	0.165	0.166
Betaine		0.013	0.022	0.031	0.041	0.050	0.059	0.069
ME, kcal./Kg		3031.71	3031.44	3031.52	3031.47	3031.03	3031.17	3031.58
Cost (£.E./ton)[5]		17460.4	17453.2	17449.1	17441.5	17433.8	17431.0	17432.7
Relative cost[6]		100.00	99.959	99.935	99.892	99.848	99.832	99.841

[1] **Crude protein** [2] **and** [3] **it is detailed in the materials and methods** [4] **According to NRC (1994) and Emam and Abdel Wahed (2020).**
[5] **According to the local market price at the experimental time.** [6] **Assuming the price of the control group equal 100.**

Table (2b): Composition and calculated analysis of the experimental diets during the grower period.

Item, %		Level of sugar beet pulp%						
		0.00	2.50	5.00	7.50	10.00	12.50	15.00
Feed Ingredients	Yellow corn, ground	64.65	61.77	58.77	55.84	52.89	49.97	47.04
	Sugar beet pulp, ground	0.00	2.50	5.00	7.50	10.00	12.50	15.00
	Soybean meal (44%CP[1])	21.00	21.10	21.24	21.34	21.48	21.58	21.71
	Broiler concentrate[2] (45%CP)	10.00	10.00	10.00	10.00	10.00	10.00	10.00
	Calcium carbonate	1.36	1.30	1.28	1.23	1.18	1.14	1.09
	Sodium chloride	0.05	0.05	0.05	0.05	0.05	0.05	0.05
	Vit. and Min. premix[3]	0.30	0.30	0.30	0.30	0.30	0.30	0.30
	Vegetable oil (75% soybean oil and 25% sunflower oil)	2.30	2.65	3.05	3.43	3.81	4.18	4.55
	DL–Methionine	0.14	0.14	0.14	0.15	0.15	0.15	0.15
	L-Lysine HCl	0.20	0.19	0.17	0.16	0.14	0.13	0.11
	Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0
Calculated analysis[4]:								
Protein and amino acids	Crude protein	19.50	19.50	19.50	19.50	19.50	19.50	19.50
	Lysine	1.190	1.194	1.191	1.195	1.192	1.196	1.193
	Methionine	0.561	0.561	0.561	0.570	0.570	0.570	0.570
	Methionine+Cystine	0.889	0.887	0.886	0.894	0.893	0.892	0.891
	Arginine	1.087	1.089	1.092	1.094	1.097	1.099	1.102
	Threonine	0.551	0.558	0.565	0.572	0.580	0.587	0.594
	Valine	0.685	0.692	0.700	0.708	0.716	0.723	0.731
Crude fiber and fiber fractions	Crude fiber	3.188	3.607	4.026	4.444	4.864	5.282	5.702
	Neutral detergent fiber	8.999	9.835	10.665	11.497	12.331	13.164	13.999
	Acid detergent fiber	3.784	4.297	4.811	5.323	5.838	6.350	6.865
	Acid detergent lignin	0.407	0.491	0.574	0.658	0.741	0.825	0.909
	Hemicelluloses	5.215	5.538	5.854	6.174	6.493	6.814	7.134
	Celluloses	3.377	3.806	4.237	4.665	5.097	5.525	5.956
	Lignin	0.731	0.784	0.837	0.890	0.943	0.996	1.049
Fat	Ether extract	5.074	5.329	5.630	5.914	6.197	6.471	6.744
	Linoleic acid	2.833	2.968	3.129	3.280	3.430	3.576	3.721
Minerals	Calcium	0.841	0.835	0.845	0.843	0.841	0.843	0.842
	Available phosphorus	0.438	0.437	0.436	0.435	0.433	0.432	0.431
	Potassium	0.606	0.614	0.623	0.632	0.641	0.649	0.658
	Sodium	0.183	0.187	0.192	0.196	0.200	0.205	0.209
	Chloride	0.157	0.159	0.160	0.162	0.163	0.164	0.166
Betaine		0.014	0.023	0.032	0.042	0.051	0.060	0.070
ME, kcal./Kg		3108.43	3107.59	3107.67	3108.23	3108.18	3107.80	3107.30
Cost (£.E./ton)[5]		17044.1	17026.6	17023.8	17031.4	17023.8	17012.3	16999.7
Relative cost[6]		100.00	99.897	99.881	99.925	99.881	99.813	99.739

[1] Crude protein [2] and [3] it is detailed in the materials and methods [4] According to NRC (1994) and Emam and Abdel Wahed (2020).
[5] According to the local market price at the experimental time. [6] Assuming the price of the control group equal 100.

Table (2c): Composition and calculated analysis of the experimental diets during the finisher period.

	Item, %	Level of sugar beet pulp%						
		0.00	**2.50**	**5.00**	**7.50**	**10.00**	**12.50**	**15.00**
Feed Ingredients	Yellow corn, ground	66.67	63.73	60.79	57.82	54.92	51.97	49.03
	Sugar beet pulp, ground	0.00	2.50	5.00	7.50	10.00	12.50	15.00
	Soybean meal (44%CP[1])	18.60	18.71	18.84	18.98	19.07	19.22	19.33
	Broiler concentrate[2] (45%CP)	10.00	10.00	10.00	10.00	10.00	10.00	10.00
	Calcium carbonate	1.17	1.13	1.08	1.04	0.99	0.94	0.90
	Sodium chloride	0.05	0.05	0.05	0.05	0.05	0.05	0.05
	Vit. and Min. premix[3]	0.30	0.30	0.30	0.30	0.30	0.30	0.30
	Vegetable oil (75% soybean oil and 25% sunflower oil)	3.01	3.39	3.77	4.16	4.52	4.90	5.28
	DL–Methionine	0.10	0.10	0.10	0.10	0.10	0.10	0.10
	L-Lysine HCl	0.10	0.09	0.07	0.05	0.05	0.02	0.01
	Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0
Calculated analysis[4]:								
Protein and amino acids	Crude protein	18.50	18.50	18.50	18.50	18.50	18.50	18.50
	Lysine	1.052	1.056	1.053	1.050	1.062	1.052	1.056
	Methionine	0.510	0.510	0.510	0.510	0.510	0.510	0.510
	Methionine+Cystine	0.826	0.825	0.823	0.822	0.821	0.820	0.818
	Arginine	1.020	1.022	1.025	1.028	1.029	1.033	1.035
	Threonine	0.515	0.522	0.530	0.537	0.544	0.552	0.559
	Valine	0.643	0.651	0.659	0.667	0.674	0.682	0.690
Crude fiber and fiber fractions	Crude fiber	3.065	3.483	3.903	4.322	4.740	5.161	5.579
	Neutral detergent fiber	8.875	9.706	10.540	11.373	12.206	13.042	13.873
	Acid detergent fiber	3.616	4.128	4.642	5.157	5.668	6.184	6.697
	Acid detergent lignin	0.408	0.491	0.575	0.658	0.742	0.825	0.909
	Hemicelluloses	5.259	5.578	5.898	6.216	6.538	6.858	7.176
	Celluloses	3.208	3.637	4.067	4.499	4.926	5.359	5.788
	Lignin	0.741	0.794	0.847	0.900	0.953	1.007	1.060
Fat	Ether extract	5.841	6.124	6.408	6.700	6.965	7.248	7.531
	Linoleic acid	3.268	3.419	3.570	3.726	3.866	4.017	4.168
Minerals	Calcium	0.762	0.764	0.762	0.764	0.762	0.761	0.763
	Available phosphorus	0.434	0.432	0.431	0.430	0.428	0.427	0.426
	Potassium	0.565	0.573	0.582	0.591	0.600	0.609	0.617
	Sodium	0.183	0.187	0.192	0.196	0.201	0.205	0.209
	Chloride	0.157	0.158	0.160	0.161	0.163	0.164	0.165
Betaine		0.014	0.023	0.033	0.042	0.051	0.061	0.070
ME, kcal./Kg		3180.41	3180.48	3180.55	3180.73	3180.36	3180.08	3180.15
Cost (£.E./ton)[5]		17071.4	17064.8	17056.4	17051.8	17041.2	17029.7	17023.2
Relative cost[6]		100.00	99.961	99.912	99.885	99.823	99.756	99.718

[1] Crude protein [2] and [3] it is detailed in the materials and methods [4] According to NRC (1994) and Emam and Abdel Wahed (2020).
[5] According to the local market price at the experimental time. [6] Assuming the price of the control group equal 100.

Table (3): Vaccination program throughout the experimental period.

Age (day)	Vaccine	Route of vaccination	Vaccination against
6	Hitchner B1+IB H120	Eye drop	Newcastle disease and Infectious Bronchitis
10	Gumboro D78	Drinking water	Infectious bursal disease
16	ND Clone 30	Eye drop	Newcastle disease
20	Gumboro D78	Drinking water	Infectious bursal disease
26	ND Clone 30	Eye drop	Newcastle disease
36	ND Clone 30	Eye drop	Newcastle disease

Table (4): Effect of inclusion of sugar beet pulp in the diets of broiler on live body weight (LBW) and body weight gain (BWG).

Items	LBW, g (age, days)				BWG, g (age period, days)			
	5	11	23	42	5-11	12-23	24-42	5-42
Level of sugar beet pulp %								
0.00	152.03	284.69	816.83^{abc}	1517.5^{b}	132.67^{b}	532.14^{ab}	659.92^{b}	1362.7^{b}
2.50	153.50	306.06	863.00^{a}	1527.0^{b}	152.56^{a}	556.76^{a}	631.00^{b}	1367.3^{b}
5.00	153.97	284.91	855.71^{ab}	1770.0^{a}	130.94^{b}	570.80^{a}	871.48^{a}	1610.0^{a}
7.50	154.23	283.89	776.23^{c}	1661.1^{a}	129.66^{b}	492.34^{b}	844.81^{a}	1505.3^{a}
10.0	154.64	284.33	850.19^{ab}	1734.1^{a}	129.69^{b}	565.86^{a}	843.37^{a}	1571.2^{a}
12.5	152.64	286.69	844.44^{ab}	1695.1^{a}	134.06^{b}	557.75^{a}	799.46^{a}	1536.7^{a}
15.0	154.85	285.94	800.71^{bc}	1660.3^{a}	131.09^{b}	514.76^{b}	822.36^{a}	1501.0^{a}
SEM[1]	3.40	6.43	18.18	41.78	4.66	13.96	32.49	41.58
P-value	0.997	0.166	0.007	<0.001	0.007	<0.001	<0.001	<0.001

[a–c] Means in a column with different superscripts differ significantly ($P \leq 0.05$) [1] Pooled SEM

Table (5): Effect of inclusion of sugar beet pulp in the diets of broiler on feed intake (FI) and feed conversion ratio (FCR).

Items	FI, g (age period, days)				FCR, g (age period, days)			
	5-11	12-23	24-42	5-42	5-11	12-23	24-42	5-42
Level of sugar beet pulp %								
0.00	206.89^{b}	887.67^{cd}	1500.0^{c}	2594.3^{e}	1.634	1.699^{b}	2.304^{ab}	1.770
2.50	223.72^{a}	926.25^{b}	1480.7^{c}	2630.7^{e}	1.508	1.678^{b}	2.437^{a}	1.830
5.00	206.60^{b}	942.00^{b}	1739.1^{b}	2886.8^{c}	1.624	1.681^{b}	2.043^{b}	1.721
7.50	207.17^{b}	877.66^{d}	1722.2^{b}	2805.4^{d}	1.617	1.842^{a}	2.095^{b}	1.777
10.0	205.61^{bc}	974.44^{a}	1722.1^{b}	2902.2^{bc}	1.637	1.746^{ab}	2.108^{b}	1.770
12.5	202.67^{c}	992.50^{a}	1865.4^{a}	3061.9^{a}	1.571	1.803^{ab}	2.465^{a}	1.879
15.0	206.26^{b}	902.41^{c}	1848.0^{a}	2961.2^{b}	1.615	1.817^{ab}	2.316^{ab}	1.828
SEM[1]	1.05	6.76	16.75	23.45	0.06	0.05	0.10	0.04
P-value	<0.001	<0.001	<0.001	<0.001	0.686	0.042	0.004	0.181

[a–e] Means in a column with different superscripts differ significantly ($P \leq 0.05$) [1] Pooled SEM

Table (6): Effect of inclusion of sugar beet pulp in the diets of broiler on crude protein conversion (CPC) and caloric conversion ratio (CCR).

Items	CPC* (age period, days)				CCR** (age period, days)			
	5-11	12-23	24-42	5-42	5-11	12-23	24-42	5-42
Level of sugar beet pulp %								
0.00	0.351	0.331^{ab}	0.426^{ab}	0.348	4.958	5.279^{ab}	8.358	5.962
2.50	0.324	0.327^{b}	0.451^{a}	0.358	4.577	5.216^{b}	7.652	5.680
5.00	0.358	0.328^{b}	0.378^{b}	0.339	5.050	5.223^{b}	6.415	5.334
7.50	0.358	0.359^{a}	0.388^{b}	0.349	5.399	5.726^{a}	6.580	5.507
10.0	0.352	0.340^{ab}	0.390^{b}	0.348	4.968	5.425^{ab}	6.618	5.485
12.5	0.338	0.358^{a}	0.456^{a}	0.368	4.769	5.711^{a}	7.741	5.830
15.0	0.356	0.354^{ab}	0.428^{ab}	0.367	5.030	5.648^{ab}	7.272	5.793
SEM[1]	0.01	0.01	0.02	0.01	0.23	0.15	0.51	0.20
P-value	0.525	0.029	0.004	0.153	0.303	0.029	0.060	0.278

[a–b] Means in a column with different superscripts differ significantly ($P\leq0.05$) [1] Pooled SEM
*CPC = CP consumed (g)/ bird during a certain period **CCR = ME intake (K cal.)/ bird during a certain period
Weight gain (g) / bird during the same period Weight gain (g)/ bird during the same period

Table (7): Effect of inclusion of sugar beet pulp in the diets of broiler on growth rate, g/day (GR) and performance index% (PI).

Items	GR*, g/day (age period, days)				PI% (age period, days)			
	5-11	12-23	24-42	5-42	5-11	12-23	24-42	5-42
Level of sugar beet pulp %								
0.00	0.607^{b}	0.966^{abc}	0.549^{c}	0.718^{bc}	18.70	49.68	71.31^{cd}	49.07
2.50	0.665^{a}	0.954^{bcd}	0.518^{c}	0.712^{c}	21.17	52.17	66.54^{d}	48.44
5.00	0.594^{b}	1.000^{a}	0.651^{ab}	0.752^{a}	18.81	52.69	90.18^{a}	56.17
7.50	0.588^{b}	0.923^{d}	0.680^{a}	0.744^{ab}	19.09	44.57	83.07^{abc}	50.90
10.0	0.591^{b}	0.999^{a}	0.639^{ab}	0.741^{ab}	18.23	49.92	86.20^{ab}	53.48
12.5	0.609^{b}	0.983^{ab}	0.612^{b}	0.741^{ab}	19.39	49.37	74.20^{bcd}	49.83
15.0	0.591^{b}	0.944^{cd}	0.658^{ab}	0.736^{abc}	18.99	46.84	75.25^{bcd}	49.57
SEM[1]	0.02	0.01	0.02	0.01	0.97	2.15	4.87	2.23
P-value	0.008	<0.001	<0.001	0.038	0.465	0.125	0.006	0.155

[a–d] Means in a column with different superscripts differ significantly ($P\leq0.05$) [1] Pooled SEM
*It was calculated for each replicate using the following equation (Brody, 1945): $GR_{5\text{-}42} = (LBW_{42} - LBW_5) / 0.5\,(LBW_{42} + LBW_5)$
Where: BW_5= Initial LBW BW_{42}= Final LBW.

Table (8): Effect of inclusion of sugar beet pulp in the diets of broiler on some blood parameters.

Items	Hemoglobin (g/dL)	Red blood cell count ($10^6/mm^3$)	Hematocrit%	Mean corpuscular volume (μ^2)	Mean corpuscular hemoglobin (µµg)	Mean corpuscular hemoglobin concentration%	White blood cells count ($10^3/mm^3$)
Level of sugar beet pulp %							
0.00	11.37	2.523	34.87	138.03	44.90a	32.57	170.17
2.50	11.03	2.537	32.43	128.03	43.43a	34.00	165.23
5.00	9.967	2.283	30.07	132.23	43.70a	33.10	155.83
7.50	10.53	2.410	31.70	131.67	43.67a	33.17	163.60
10.0	10.70	2.457	31.57	128.60	43.50a	33.87	165.93
12.5	10.50	2.517	31.37	124.80	41.67b	33.43	163.47
15.0	10.70	2.473	31.87	129.30	43.23ab	33.50	164.33
SEM1	0.61	0.13	1.76	2.56	0.54	0.55	0.603
P-value	0.783	0.804	0.658	0.061	0.039	0.579	0.794

[a–b] Means in a column with different superscripts differ significantly ($P \leq 0.05$) [1] Pooled SEM

Table (9): Effect of inclusion of sugar beet pulp in the diets of broiler on slaughter parameters%.

Items	Level of sugar beet pulp %							SEM[1]	P-value
	0	**2.5**	**5.0**	**7.5**	**10.0**	**12.5**	**15.0**		
Live body weight (g)	1480.67	1566.00	1584.67	1611.33	1720.00	1589.33	1652.00	51.33	0.121
Abdominal fat	1.975	1.351	1.242	1.115	1.432	0.749	1.173	0.259	0.124
Gizzard	1.415^{b}	1.416^{b}	1.830^{ab}	2.027^{a}	2.311^{a}	2.209^{a}	2.049^{a}	0.154	0.004
Liver	2.536	2.298	2.465	2.313	2.154	2.167	2.094	0.245	0.829
Heart	0.452	0.377	0.463	0.414	0.348	0.358	0.500	0.049	0.274
Total giblet	4.403	4.091	4.759	4.754	4.813	4.734	4.644	0.333	0.712
Neck	5.088	3.913	4.266	4.728	4.726	5.365	4.321	0.624	0.692
Breast part	38.66	36.07	38.11	34.31	35.02	36.64	36.33	1.74	0.587
Rear part	31.24	27.19	29.88	29.64	27.34	30.79	29.44	1.37	0.32
Breast meat	85.76	86.02	87.90	89.34	88.66	87.28	87.70	0.94	0.148
Rear meat	85.59	83.56	84.21	86.08	85.81	85.00	85.45	1.59	0.912
Carcass weight after evisceration	69.67	64.09	66.67	67.34	65.07	65.68	65.25	2.5	0.767
Dressing	74.07	68.18	71.43	72.09	69.88	70.42	69.90	2.49	0.743

[a–b] Means in a row with different superscripts differ significantly ($P \leq 0.05$) [1] Pooled SEM

Table (10): Effect of inclusion of sugar beet pulp in the diets of broiler on economical efficiency (EEf) and mortality rate%.

Items	Level of sugar beet pulp %						
	0.00	**2.50**	**5.00**	**7.50**	**10.00**	**12.50**	**15.00**
Economical efficiency(EEf)							
a_1	0.20689	0.22372	0.20660	0.20717	0.20561	0.20267	0.20626
b_1	17.4604	17.4532	17.4491	17.4415	17.4338	17.4310	17.4327
a_1 x b_1=c_1	3.61238	3.90463	3.60498	3.61336	3.58456	3.53274	3.59567
a_2	0.88767	0.92625	0.94200	0.87766	0.97444	0.99250	0.90241
b_2	17.0441	17.0266	17.0238	17.0314	17.0238	17.0123	16.9997
a_2 x b_2=c_2	15.1295	15.7709	16.0364	14.9478	16.5887	16.8847	15.3407
a_3	1.5000	1.4807	1.7391	1.7222	1.7221	1.8654	1.8480
b_3	17.0714	17.0648	17.0564	17.0518	17.0412	17.0297	17.0232
a_3 x b_3=c_3	25.6071	25.2678	29.6628	29.3666	29.3467	31.7672	31.4589
$c_1+c_2+c_3=c_{total}$	44.3490	44.9434	49.3042	47.9277	49.5199	52.1847	50.3952
d	23.8802	23.8802	23.8802	23.8802	23.8802	23.8802	23.8802
e	68.2293	68.8236	73.1844	71.8080	73.4001	76.0649	74.2755
f	1.5175	1.5270	1.7700	1.6611	1.7341	1.6951	1.6603
g	80.00	80.00	80.00	80.00	80.00	80.00	80.00
h	121.400	122.160	141.600	132.888	138.728	135.608	132.824
i	53.1707	53.3364	68.4156	61.0800	65.3279	59.5431	58.5485
i / e	0.77930	0.77497	0.93484	0.85060	0.89002	0.78279	0.78826
r	100.00	99.45	119.96	109.15	114.21	100.45	101.15
Mortality rate%							
Total number of chicks at the beginning of experiment	36	36	36	36	36	36	36
Number of dead birds	1	1	0	0	0	0	0
Mortality rate%	2.78	2.78	0.00	0.00	0.00	0.00	0.00

a_1, a_2 and a_3 ……….average feed intake (Kg/bird) during the periods of starter, grower and finisher, respectively.
b_1, b_2 and b_3 …..…. price/Kg feed (L.E.) during the periods of starter, grower and finisher, respectively (based on average local market price of diets during the experimental time).
c_1, c_2 and c_3 ……... Feed cost (L.E.) during the periods of starter, grower and finisher, respectively.
Total feed cost (L.E.) = $c_{total} = c_1+c_2+c_3$
Other costs d (other management costs)
Total cost = c_{total} + d = e
Average LBW (Kg/ bird) f
Price / Kg live weight (P.T.) g…….…(according to the local market price at the experimental time).
Total (L.E.) = f x g = h
Net revenue (L.E.) = h – e = i
Economical efficiency = (i / e) ……(net revenue per unit feed cost).
Relative efficiency r……..(assuming that economical efficiency of the control group (1) equals 100).

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الملخص العربى

تأثير احتواء العليقة على تفل بنجر السكر على أداء بداري التسمين

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كان الهدف من هذا البحث دراسة تأثير إضافة لب بنجر السكر إلى العليقة على أداء كتاكيت اللحم كب. تم استخدام 252 كتكوت كب غير مجنس بعمر خمسة أيام، والتي تم تغذيتها أولاً على نظام غذائي ضابط من عمر 0 - 4 أيام. تم ترقيم الكتاكيت بالجناح، ووزنها بشكل فردي لأقرب جرام في عمر 5 أيام، وتم توزيعها عشوائيًا بالتساوي على سبع معاملات (0.0، 2.5، 5.0، 7.5، 10.0، 12.5 و15.0٪ لب بنجر سكر، 36 طائرًا في كل مجموعة وكل منها تحتوي على ثلاث مكررات بكل مكرر 12 طائرًا.
سجلت الطيور التي تغذت على عليقة تحتوي على 5٪ لب بنجر السكر أعلى قيمة لوزن الجسم عند 42 يومًا ووزن الجسم المكتسب خلال الفترة من 5 - 42 يومًا، بينما الكتاكيت التي تغذت على عليقة تحتوي على 0.0٪ لب بنجر السكر (العليقة الضابطة) كانت لها أقل القيم. مع ملاحظة أن جميع المعاملات كانت أعلى بشكل معنوي في قيم وزن الجسم و ووزن الجسم المكتسب في نفس الأعمار مقارنة بالكنترول. سجلت كتاكيت دجاج اللحم كب التي تغذت على عليقة تحتوي على 0.0٪ لب بنجر السكر (العليقة الضابطة) أقل قيمة معنويه لمعدل استهلاك العلف خلال الفترة من 5 إلى 42 يوم، بينما سجلت الطيور التي تغذت على 12.5٪ لب بنجر السكر أعلى قيمة معنوية. لوحظ تأثيرات غير معنوية في معدل تحويل الغذاء، البروتين والطاقة خلال نفس الفترة. سجلت الكتاكيت التي تغذت على 5٪ لب بنجر السكر في العليقة أعلى معدل للنمو خلال الفترة من 5 - 42 يومًا (لم تكن الاختلافات في معدل النمو بين الطيور التي تغذت على علائق تحتوي على 5، 7.5، 10، 12.5 و 15.0 لب بنجر السكر ذات دلالة إحصائية). لم تتأثر النسبة المئوية لبعض معايير الدم بشكل معنوي باستثناء متوسط تركيز الهيموجلوبين الكروي.
لوحظ تأثر غير معنوي في النسبة المئوية لقياسات الذبيحة باستثناء القانصة٪. سجلت الطيور التي تغذت على علائق تحتوي على 10٪ من لب بنجر السكر أعلى نسبة للقانصة٪، بينما سجلت الطيور التي تغذت على علائق المقارنة أقل نسبة. بلغ معدل النفوق 2.78٪ في الكتاكيت التي تغذت على علائق تحتوي على 0.0 أو 2.5٪ من لب بنجر السكر، بينما بلغ 0.0٪ في المجموعات الأخرى خلال الفترة الكلية. وقد تحسنت قيم الكفاءة الاقتصادية والنسبية خلال الفترة الكلية في الطيور التي تغذت على جميع العلائق التجريبية، باستثناء تلك التي تغذت على علائق تحتوي على 2.5٪ من لب بنجر السكر، مقارنةً بتلك التي تغذت على علائق المقارنة.