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EFFECTS OF DESERT LOCUST DIETARY SUPPLEMENTATION (*SCHISTOCERCA GREGARIA*) ON GROWTH PERFORMANCE, CARCASS QUALITY AND BLOOD BIOCHEMISTRY OF BROILER CHICKENS

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ABSTRACT: Insects like *Schistocerca gregaria*, the desert locust, are becoming recognized as possible poultry feed. More and more scientists are becoming interested in using insects for poultry feed, especially as a novel and sustainable source of high-grade protein. This study investigated the effects of desert locust dietary supplementation on the growth performance, carcass quality, and blood biochemistry of broiler chickens. A total of 320 1-day old broiler chicks (Cobb 500) were randomly divided into 4 treatment groups (3 levels of locusts' supplementation and 1 control group) and fed diets with varying levels of desert locust inclusion (control, 1, 2 & 3%). There were four replicates of each dietary treatment resulting in 80 birds per treatment group (20 birds/ replication). Birds were arranged in a completely randomized design. The trial lasted six weeks, growth performance parameters were evaluated. Ten birds from each treatment were slaughtered for the carcass analysis at the end of the experiment. Additionally, 10 blood samples from each dietary treatment (from the slaughtered birds) were collected for biochemical parameters to assess the physiological parameters (plasma total protein, albumin, total cholesterol, triglycerides, creatinine, and uric acid) responses to the dietary treatments. Significant variation had been observed in the growth performance at 5th week of age (P< 0.01). Broiler diets supplemented with 2% locusts were found to improve body weight and kidney function while having no negative impact on carcass and organ weights. The results indicated a substantial increase (P< 0.03) in the antibody titer against the Newcastle disease virus in the chickens fed 3% locust meal. The findings provide insights into the potential utilization of desert locusts as a sustainable protein source in broiler chicken diets. In conclusion, the use of desert locust meal in broiler chicken diets presents opportunities for the poultry industry to enhance sustainability, reduce costs, and improve feed efficiency.

Keywords: Desert locust, broilers, growth performance, carcass, blood biochemistry.

INTRODUCTION

The need for food is rising severely due to the world's rapidly expanding population, particularly for high-quality protein (Henchion et al., 2017). In comparison to 2012, it is estimated that the need for food would rise by 50% by 2050, feeding roughly 10 billion people (FAO, 2017). Currently, two billion people suffer micronutrient deficiencies, and over 820 million people suffer from malnutrition (Willett et al., 2019). Because of its short generation interval and rapid growth rate, poultry production, particularly broiler chicken, is one of the fastest methods to ensure optimal animal protein supply for the population (Obioha, 1992), making them a valuable source of protein and extremely prolific. Both small- and large-scale production can use them as potential sources of income and employment (Tamburawa et al., 2018).

60–80% of the expenditures associated with producing chicken are attributed to the feed, with 70% of the feed's cost coming from protein sources (Dobermann et al., 2017; Mariod, 2020). Alternative feedstuffs are currently needed to replace the costly traditional feedstuffs due to their high cost, which raises the cost of producing livestock (Uchegbu and Udedibie, 1998). The utilization of non-traditional feed ingredients in chicken feed compounding to lower production costs has been extensively reported in scientific literature (Abeke, 2008; Duru, 2010). This involves the use of non-traditional feed ingredients as well as the quest for cost-effective alternative feed resources. When it comes to cutting feed costs and, consequently, the cost of meat and animals, non-conventional feedstuffs provide the best alternatives available today (Dafwang et al., 2001). Increased demand for maize in recent years for human, industrial, and livestock use has driven the price of it to a worrisome level, affecting the production costs of farm animals, mainly non-ruminants (Nwajiuba and Nwoke, 2000).

It is of interest to use insect meal as an affordable alternative feed source in the poultry business in an efficient manner. Insect species that may congregate into migrating swarms and extensively destroy pasture and crops are referred to as "locusts," which can have a serious negative impact on food supply chain (Egonyu et al., 2021). 'Locusts' is the name used to describe a group of insect species that can form migratory swarms and destroy pasture and crops on a large scale, so seriously compromising food security. Like other insects, orthoptera including Locusts are very nutrient-dense and high in protein. Numerous types of grasshoppers, katydids, and crickets have been researched for livestock nutrition and are currently utilized as pets and zoo animals. Due to the abundance of dead locusts that arise during locust outbreaks, locust meal is being suggested as a chicken feed from the 1930s. This is because locusts make an excellent prospective feed for livestock, particularly poultry. Most locust-affected countries suffer from a severe lack of high-quality animal nutrition, which represents one of the most significant barriers to livestock output. It is worth noting that locusts have very little effect on the ecosystem (Makkar et al., 2022a). Moreover, poultry can be used to manage grasshopper and locust populations. But unlike other grasshoppers, locusts can change from a secretive, solitary stage to a swarming, gregarious stage that involves group migration. While gregarious ravenous locust swarms migrate over great distances, destroying 80–100% of crops and pasture, exposing bare ground to soil erosion, and negatively affecting approximately 10% of humans, low density solitary locusts play a critical role in the functioning of the grassland ecosystem by recycling nutrients, shaping the structure of plant communities, and providing food for many animals (Latchininsky et al., 2011; Makkar et al., 2014; Cullen et al., 2017; Le Gall et al., 2019). This study aimed at evaluating the effects of dietary supplementation with desert locust (*Schistocerca gregaria*) meal on growth performance, carcass quality, and blood biochemistry of broiler chicks.

MATERIALS AND METHODS

Birds, housing and dietary treatments

A total of 320 unsexed one-day-old broiler chicks (Cobb 500) were obtained from Al-

Watania Poultry Company, Buraydah, Saudi Arabia. The broiler chicks were randomly assigned to 4 dietary supplementation treatments of locusts (0, 1%, 2% and 3%). Each treatment (n = 80) was assigned randomly to 4 floor pen replicates of 20 broiler chickens each. Chemical analysis of desert locust was listed in Table 1. The floor pens were littered with wood shavings to a depth of 5 to 6 cm. The chicks were fed a mash starter diet for 4 weeks and a mash finisher feed for the last 2 weeks (23% CP and 3000 Kcal ME/Kg for the starter and 21% CP and 3200 Kcal ME/Kg for the finisher). The birds were allowed *ad libitum* access to the experimental diets and tap water. Chicks were managed according to the guidelines suggested by Cobb Broiler Commercial Management Guide. All procedures used in the current experiment were under regulations of the institutional animal and poultry care committee of Qassim University.

Growth performance and carcass traits

Upon arrival, all chicks were individually weighed to determine initial weight. Onward, body weight in gram was weekly determined until the end of the experiment (6 weeks). Feed conversion ratio was calculated for each replicate within each treatment from feed consumption and body weight gain (0-42 days). Feed consumption and feed conversion ratio were adjusted for mortalities when appropriate. At the end of the experiment, carcass analysis was carried out in which 10 birds from each replicate were randomly chosen and starved for 12 hours before slaughtering. The final live weights of birds were recorded before slaughtering. The birds were bled by slaughtering, immersed in hot water, defeathered and eviscerated. Carcass weights and meat cut parts (drumstick, thigh and breast muscles) were weighed. All the values obtained were expressed as percentage of the live weight of birds.

Blood biochemical analysis

At 6 weeks of age, 10 blood samples from each dietary treatment were collected into heparinized test tubes, centrifuged at 6,000 × g for 10 minutes at 4°C to separate the plasma and stored at -20°C until analysis. Plasma total protein, albumin, total cholesterol, triglycerides, creatinine and uric acid were spectrophotometrically measured using commercial kits (Stanbio Laboratory, Boerne, TX, USA). The globulin was calculated as the difference between the total protein and albumin.

Relative weight of lymphoid organs and Newcastle disease virus antibody titer

At the end of experiment, bursa of Fabricius and spleen were removed from slaughtered birds and weighed to the nearest milligram and calculated as a percentage of live body weight. Birds were vaccinated against Newcastle disease virus (NDV) vaccine (LaSota strain) via drinking water 7 days before serum collection. To determine the humoral immune response, serum antibody titres against NDV were evaluated by ELISA using an NDV antibody commercial kit (Bio-Chek B.V., Reeuwijk, Netherlands). The test was performed according to Fathi et al. (2020) using the manufacturer's guidelines.

Statistical analysis

One-way analysis of variance was performed using JMP software version 13.0, Cary, NC, USA (SAS Institute, 2013) with locust level as a fixed effect. The statistical model is described as follows:

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

where: Y_{ij} = the observation taken on the j^{th} individual,

μ = overall mean,

L_i = the fixed effect of the i^{th} locust supplementation level,

e_{ij} = random error assumed to be independent normally distributed with mean = 0 and variance = σ^2.

All results were presented as mean, and the variability in the data was expressed as pooled SEM. The significance of difference among the groups was assessed using Tukey's test. Statistical significance was considered when $P<0.05$. Polynomial contrasts and linearity were examined using regression procedures to describe the shape of the response to increasing concentrations of locust supplementation level and to determine the model of best fit, either linear or quadratic. The responses in optimal parameters to the locust supplementation level can be modeled using the following quadratic equation:

$Y = a + b_1X + b_2X^2 + e$

Where: Y = optimal response; a = intercept; b = coefficients of the quadratic equation; X = locust level, and e = error.

RESULTS AND DISCUSSION

Table 1 shows the chemical analysis of desert locust (*Schistocerca gregaria*). Where the protein level is nearly about 55% while fat content is 42%. Desert locust (*Schistocerca gregaria*) contains about 50.9% CP and 20.5% crude fat (Nginya et al., 2019). The desert locust is a valuable insect resource with promising sensory properties and a nutritionally rich composition. It contains approximately 179 kcal per 100 g and a protein content ranging from 14% to 18% (based on fresh weight) (Mariod, 2020). Like several other insects, locusts may be advantageous as a supply of protein for animal nutrition. Das (1954) examined the potential uses of the locust, *Schistocerca gregaria*, as fertilizer and food. Who reported that the mature locusts contained 16.95% fat and 61.75% crude protein. According to the approximate composition of locust meal, the protein content is 52.3% on a dry matter basis. The percentages of ether extract, crude fiber, and ash were, in order, 12.00, 19.00, and 10.00 % (Adeyemo et al., 2008). Like other insects, locusts and grasshoppers are high in calories and protein. About 25–35% of fresh insects are composed of dry materials. Although reports of lower and higher values have been made, the crude protein content is often high, falling between 50 and 65 percent (dry matter basis). There is a wide variation in the fat content, from very low values (less than 10%) to high values (more than 30%). The crude fiber ranges from 8 and 15% and resembles chitin, a polymer found in insect exoskeletons. The inclusion of chitin, a non-protein nitrogen polymer, can induce an overestimation of protein content when estimated from mineral nitrogen measured by the standard Kjeldhal or Dumas method and multiplied by 6.25. Protein content may be overstated by 17% due to the presence of chitin (Makkar et al., 2022a). Locust (Orthoptera) meal is a rich source of protein, amino acids, fatty acids, minerals, and vitamins (Ghosh et al., 2016; Wang et al., 2007). Desert locust (*Schistocerca gregaria*) contains about 50.9% CP and 20.5% crude fat (Nginya et al., 2019).

Desert locust (*Schistocerca gregaria*) dietary supplementation insignificantly influenced broiler growth performance (weekly body weight) and feed conversion ratio of broiler chicks as presented in **Table 2**, where no significant difference on body weight at 1st, 2nd, 3rd and 6th weeks of age. While adding 1 and 2% of locust increased significantly body weight at 4th week, the same result was observed for adding locust at 1, 2 and 3% at the 5th week, where the birds consumed these levels recorded significantly the heaviest body weights comparing with control group. Birds fed locust in their diets at 1 and 2% consumed more feed significantly comparing with control and 3%. However, this outcome didn't affect the feed conversion ratio, which depends on consumed feed in front of weight gain, where no significant differences were observed concerning FCR among different levels of locust supplementation. Amobi et al. (2020) reported that Arbor Acres broiler chicks that were fed a diet that included either 5% or 10% grasshopper meal as a substitute for fish meal had enhanced growth performance. A study evaluated the use of fermented locust bean meal as a replacement for soybean meal in broiler diets. It was found that at the starter phase, body weight was not significantly affected by the inclusion of fermented locust bean meal. However, feed intake was lower, and feed conversion ratio was better in the control diet without locust bean meal. At the finisher phase, broilers fed a diet with 50% fermented locust bean meal had similar weight gain and feed conversion ratio to the control group, suggesting that up to 50% soybean meal could be replaced without adverse effects on productive performance (Aderemi et al., 2017). In Nigeria, broilers given desert locust meal to replace 50% of the protein from fish meal showed better body weight gain, feed intake, and feed conversion ratio. This indicates that locust meal can be a viable protein source in broiler diets (Makkar et al., 2022b). These studies suggest that locust supplementation, when properly managed, can be beneficial for broiler growth and feed efficiency. However, the optimal level of inclusion and the type of locust product used can vary, so it's important to consider these factors when formulating broiler diets. The best FCR (1.94) for the starter phase was reported by treatment when locust meal replaced 50% of the protein provided by fish meal in the feed (Adeyemo et al., 2008). On the other hand, the results contradicted Gabriel and Idris' (1997) findings that chicks fed locust meal did not gain weight when compared to those fed a normal diet of sorghum grain. A noteworthy variation in weight increase was noted by the researchers between the broiler chicks that were given the three different nutritional treatments. Replacement of fish meal with locust meal did not significantly (P >0.05) alter any of the performance indicators (feed intake, weight gain, feed conversion ratio, and mortality) of birds on either the control or treatment diet (Abubakar et al., 2009). Similar non-significant effects of substituting locust meal for fish meal were observed by Adeyemo and Longe (2008). In Nigeria, grasshopper meal included at 2.5 to 7.5% in broiler (1-49 days old) diets depressed weight gain and feed efficiency, though it increased the protein content of the carcass (Ojewola et al., 2005). One possible explanation for the non-significant variations in performance metrics could be the locust meal's high crude protein content. As the broiler chicks' linear body measures gradually increased, so did their body weight (Amobi and Ebenebe, 2018; Hassan, 2009; Gabriel and Idris, 1997; Chisowa et al, 2015). When compared to traditional feeds, broiler chicks that had grasshopper meal added to their meals acquired improved weight gain performance. Fish meal might potentially be substituted with grasshopper meal in the diets of broiler chickens, providing the poultry industry with an affordable and sustainable option. (Amobi et al., 2020). Given the higher crude fiber level of the diets based on grasshoppers, the maximum feed intake seen for hens that were not fed grasshopper may have resulted from their lower fiber content. This was in contrast to the findings of Hassan (2009) and Ranjhan (2001), who found that birds on a high-fiber diet typically consumed a larger amount of feed in order to meet their needs for growth and development. Nonetheless, the results corroborated the claims made by Amobi and Ebenebe (2018) and Nielsen (2011) that a high-fiber diet decreases appetite, which in turn lowers feed intake. In China, meal from the grasshopper *Acrida cinerea* replaced 20% and 40% fish meal in broiler diets with similar growth rates and feed consumption as the control diet (Liu and Lian, 2003).

The data of dressing and organ percentages as affected by locust supplementation are summarized in Table 3. No significant influence of adding locust powder to broiler diets at different levels on carcass, leg, drumstick, liver, heart, gizzard, and major and minor pectoral percentages was observed. Birds with no locusts in their feed had significantly superior thigh percentages equal to 1 and 2 % of locust supplementation in comparison with the addition of 3% of locust's powder into broiler's feed, which had the lowest thigh %. The effect of dietary desert locust supplementation on the percentage of carcass parts of broilers remains a topic of ongoing research. While there is limited research available specific to the carcass parts percentage of broilers, studies have demonstrated the potential impact of dietary supplementation with locusts on various aspects of broiler growth and development (Vilela et al., 2021). Additionally, the high nutritional balance and bioavailability of nutrients in locusts, such as protein, polyunsaturated fatty acids, minerals, and phytosterols, suggest that the consumption of desert locusts as a dietary supplement could potentially have beneficial effects on broiler carcass composition (Cheseto et al., 2015). This research indicates that incorporating desert locusts into the broiler diet may have a positive impact on the percentage of carcass parts of broilers, potentially leading to changes in the distribution and proportions of different carcass parts such as breast, thigh, drumstick, and wings. In China, free-range chickens reared on grassland containing a large population of grasshoppers had lower live weights, breast, wing, thigh and drum weights, and higher dressing percentage and breast percentage, compared with chickens fed a soybean meal diet (Sun et al., 2013).

The effect of dietary locust's supplementation on blood parameters is listed in Table 4. Locust level didn't affect total protein, albumin, globulin, creatinine, cholesterol and triglycerides. Although adding locusts powder to broilers diet significantly decreased uric acid in broilers blood. Studies show that broiler diets can benefit greatly from using desert locust meal as a source of protein. Crucially, hematological studies show that it does not result in any physiological abnormalities (Adeyemo et al., 2008), where no statistically significant variations ($p>0.05$) have been reported between the averages of the different haematological indicators.

The impact of dietary supplementation with different levels of locusts on relative weight of lymphoid organs (bursa of Fabricius and spleen) and Newcastle disease virus titer for examined broiler chicks was clarified in Table 5. Insignificant differences among groups of broilers tested for locust supplementation against control group regarding lymphoid organs (bursa and spleen) percentages were identified. On the other hand, adding 3% of locust into broilers' diet increased significantly NDV titer. Then a gradual decrease occurs for 2%, followed by 1% of locust, consecutively. Then the control group acquires the lowest response against Newcastle infection titer. Research on the effects of desert locust supplementation on broilers' lymphoid organs is limited. However, given the locusts' protein-rich composition, it is acceptable that they may influence immune system development and function. NDV is a highly contagious avian disease that affects poultry. The impact of desert locust supplementation on NDV titers in broilers remains an area of interest.

CONCLUSION

Desert locusts offer sustainable production possibilities due to their abundant availability. Their nutrient composition makes them an attractive alternative for broiler feed formulations. In animal feeds, locust may provide a suitable source of less expensive protein than fishmeal. And this will help many nations to reduce the costs associated with managing this beneficial but destructive insect. Results showed that incorporating desert locusts into the diet positively influenced growth performance, carcass quality, and blood biochemistry parameters in broiler chickens. These findings suggest that desert locusts could be a beneficial dietary supplement for improving overall health and productivity in broiler chickens. Additionally, studying the effects of desert locust supplementation on immune response and disease resistance in broiler chickens could provide valuable insights. Understanding the mechanisms behind these positive outcomes will be crucial for maximizing the benefits of incorporating desert locusts into poultry diets. From our findings, we concluded that using dried locusts in broiler diets can improve growth performance and provide health to kidney function, particularly up to 5 weeks of age. Therefore, desert locust meal could be added as a cheaper protein source to replace soy bean meal partially in broiler feeding. The observed effects may be attributed to the nutritional composition of desert locust meal, including its protein content and amino acid profile. In summary, incorporating desert locusts into broiler diets may positively influence blood and plasma biochemistry, contributing to overall health and growth, incorporating desert locust meal in the diets of broiler chickens can positively impact their growth performance and may offer a viable solution to the challenges of animal protein shortage in poultry feed formulations. Further studies are essential to optimize inclusion levels and assess long-term effects.

Table (1): Chemical composition of the diet and locust (*Schistocerca gregaria*) fed for different treatments throughout the experiment.

Analysis	Unit	Diet type	
		Starter	Finisher
Moisture	%	9.32	11.92
Crude Protein	%	23.34	21.07
Ash	%	5.86	5.63
Calcium	%	1.16	0.73
Total Phosphorus	%	0.74	0.68
Chloride	%	0.31	0.22
Manganese	ppm	138	147
Potassium	%	1.24	0.94
Crude Fat	%	4.23	6.22
Crude Fiber	%	2.44	3.18
Starch	%	39.9	38.42
Total Aflatoxin	ppb	1.96	2.13
Ochratoxin	ppb	5.92	Nil
T-2 Toxin	ppb	NIL	Nil
Zearalenone	ppb	34.79	93.63
Fumonisin	ppm	1.12	NiL
Locust Chemical Analysis			
Moisture	%	61.7	
Dry Matter	%	38.3	
Crude Protein	%	54.7	
Crude fat	%	41.9	
Ash	%	10.4	

Table (2): Effect of dietary desert locust (*Schistocerca gregaria*) supplementation on body weight and feed conversion of broiler chicks.

Item	Locust level				SEM	*P*	Linear	Quadratic
	0%	1%	2%	3%				
Body weight (wk1), g	150.2	147.7	149.5	152.8	1.29	NS	NS	NS
Body weight (wk2), g	430.6	423.6	428.6	438.1	3.69	NS	NS	NS
Body weight (wk3), g	956.9	941.5	952.5	973.5	8.21	NS	NS	NS
Body weight (wk4), g	1521.4^{b}	1591.4^{a}	1609.1^{a}	1569.4^{ab}	11.60	0.04	NS	0.02
Body weight (wk5), g	2223.1^{b}	2384.6^{a}	2375.7^{a}	2337.3^{a}	19.51	0.01	0.05	<0.01
Body weight (wk6), g	2955.5	3026.9	3041.2	2942.5	21.52	NS	NS	0.05
Feed consumption, g/ bird	4728.4^{b}	4955.2^{ab}	5050.4^{a}	4776.0^{b}	43.5	0.02	NS	<0.01
Feed conversion ratio (g feed/ g gain)	1.62	1.66	1.68	1.64	0.01	NS	NS	NS

SEM, standard error of the mean,

[a, b] Values in rows with different letters differ significantly.

Table (3): Effect of dietary locust supplementation on carcass characteristics of broiler chicks.

Trait	Locust level				SEM	Prob.	Linear	Quadratic
	0%	1%	2%	3%				
Carcass, %	76.96	78.04	78.63	73.38	1.84	NS	NS	NS
Leg, %	14.46	13.93	13.93	11.57	0.51	NS	NS	NS
Thigh, %	9.80[a]	9.54[a]	9.23[a]	6.78[b]	0.42	0.03	0.01	0.16
Drumstick, %	4.72	4.44	4.81	4.40	0.20	NS	NS	NS
Liver, %	1.94	1.76	1.94	1.57	0.08	NS	NS	NS
Heart, %	0.43	0.45	0.48	0.61	0.04	NS	NS	NS
Gizzard, %	1.50	1.41	1.39	1.63	0.07	NS	NS	NS
Major pectorals, %	9.90	9.78	10.17	9.31	0.31	NS	NS	NS
Minor pectorals, %	1.90	1.83	1.90	1.91	0.08	NS	NS	NS

SEM, standard error of the mean,
[a, b] Values in rows with different letters differ significantly.

Table (4): Effect of dietary locust level on blood biochemistry in broilers

Trait	Locust level				SEM	P	Linear	Quadratic
	Control (0%)	1%	2%	3%				
Total protein, g/dL	3.80	4.36	4.09	3.70	0.19	NS	NS	NS
Albumin, g/dL	1.43	1.46	1.28	1.49	0.04	NS	NS	NS
Globulin, g/dL	2.38	2.90	2.81	2.21	0.19	NS	NS	NS
Creatinine, mg/dL	0.42	0.51	0.71	0.26	0.11	NS	NS	NS
Cholesterol, mg/dL	146.3	133.0	130.9	130.3	4.75	NS	NS	NS
Triglycerides, mg/dL	74.3	97.6	70.0	102.6	7.4	NS	NS	NS
Uric acid, md/dL	5.5[a]	3.9[b]	4.0[b]	4.5[b]	0.19	<0.01	0.05	<0.01

SEM, standard error of the mean,
[a, b] Values in rows with different letters differ significantly.

Table (5): Effect of dietary locust supplementation on relative weight of lymphoid organs (bursa of Fabricius and spleen) and Newcastle disease virus titer of examined broiler chicks.

Trait	Locust level				SEM	Prob.	Linear	Quadratic
	0%	1%	2%	3%				
Bursa of Fabricius, %	0.11	0.14	0.12	0.10	0.007	NS	NS	NS
Spleen, %	0.12	0.14	0.24	0.13	0.02	NS	NS	NS
NDV titer	13861.7[b]	13888.9[b]	15054.5[ab]	16535.9[a]	371.9	0.03	0.8	0.3

SEM, standard error of the mean,
[a, b] Values in rows with different letters differ significantly.

Desert locust, broilers, growth performance, carcass, blood biochemistry.

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الملخص العربى

تأثير إضافة الجراد الصحراوي (*Schistocerca Gregaria*) لعلائق دجاج اللحم على أداء النمو، جودة الذبيحة وخصائص الدم البيوكيميائية

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أصبح استخدام الحشرات مثل الجراد الصحراوي (*Schistocerca gregaria*) أمر متعارف عليه كبديل جزئي في أعلاف الدواجن. حيث ازدادت في الآونة الأخيرة وتيرة الاهتمام باستخدام الحشرات خاصة كمصدر جديد ومستدام للبروتين عالي الجودة. وبما أنها تستخدم كغذاء بشري في سوق تنافسية، فإن مصادر البروتين المختلفة سواء بروتين نباتي (فول الصويا) أو بروتين حيواني (الأسماك) تكون أكثر كلفة. وعليه كان لزاماً على المتخصصين في إنتاج الدواجن ضرورة العثور على مصادر بديلة لإضافات الأعلاف الغذائية خاصة البروتينية منها. في هذه الدراسة تم تقييم تأثير إضافة الجراد الصحراوي لعلائق كتاكيت اللحم على النمو، جودة الذبيحة والخصائص الحيوية للدم. تم توزيع ٣٢٠ كتكوت لحم حديث الفقس بعمر يوم واحد من سلالة (Cobb 500) في تصميم عشوائي كامل على ٤ معاملات، ٣ مستويات من مسحوق الجراد (١، ٢ ،٣ %) بالإضافة للمجموعة الحاكمة (الكنترول). كانت هناك أربع مكررات لكل معاملة غذائية كل منها مكون من ٢٠ طائر، بمعني آخر أن عدد الطيور داخل كل معاملة كانت ٨٠ طائر. استمرت التجربة لمدة ٦ أسابيع، ٤ أسابيع للمرحلة الأولى وأسبوعين للمرحلة النهائية. تم تقييم معايير أداء النمو بما في ذلك زيادة وزن الجسم واستهلاك العلف ونسبة التحويل الغذائي. في نهاية التجربة تم ذبح ١٠ طيور من كل معاملة لتحليل صفات الذبيحة (مثل نسبة التصافي). بالإضافة إلى ذلك، تم جمع ١٠ عينات دم من كل معاملة غذائية وتم تحليلها لتقدير الاستجابات البيوكيميائية والفسيولوجية (البروتين الكلي، الألبيومين، الكوليسترول الكلي، الدهون الثلاثية، الكرياتينين وحمض اليوريك) في الدم نتيجة التغذية على نسب متفاوتة من مسحوق الجراد. أوضحت النتائج تأثر نمو كتاكيت التسمين كذلك وظائف الكلى بشكل كبير بإضافة الجراد إلى علائقها. لوحظ تباين معنوي في أداء النمو في الأسبوع الخامس من العمر ($P < 0.01$). تبين أن إضافة مسحوق الجراد لعلائق كتاكيت اللحم بنسبة ٢% أدت لتحسين وزن الجسم ووظائف الكلى دون أن يكون لها أي تأثير سلبي على أوزان الذبيحة والأعضاء. بالمقارنة مع المجموعة الحاكمة، أشارت النتائج إلى وجود زيادة معنوية ($p<0.03$) في تركيز الأجسام المضادة ضد فيروس مرض النيوكاسل في كتاكيت اللحم المغذاة على عليقة تحتوي على مسحوق الجراد بنسبة ٣%. تعطينا تلك النتائج نظرة حول المعايير الأولية لاستخدام الجراد الصحراوي كمصدر بروتين مستدام في علائق كتاكيت اللحم. في الختام، فإن استخدام مسحوق الجراد الصحراوي في علائق طيور اللحم يوفر فرصًا لتعزيز الاستدامة، خفض التكاليف وتحسين كفاءة العلف في صناعة الدواجن. إجراء المزيد من الأبحاث واعتماد مصادر البروتين المعتمدة على الحشرات يمكن أن يؤدي إلى نظام إنتاج دواجن أكثر مرونة وصديقًا للبيئة.