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The Impact of Glucose Oxidase on the Productivity and Economic Efficiency in Broiler Chickens

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Abstract

THE non-traditional dietary supplement glucose oxidase (treatment enzyme) works in broiler diets. The effects of dietary glucose oxidase supplementation on growth performance, carcass features, serum biochemical and immunological markers, and economic efficiency as a non-traditional therapy enzyme were studied in Arbor Acres plus unsexed one-day old broiler chicks (n = 1000). Twenty replicates of 200 chicks per treatment (ten chicks per replicate) were randomly assigned to five treatments. The experimental chicks were fed isoenergetic and isonitrogenous diets containing 0 (control), 100, 150, 200, and 250 ppm glucose oxidase for 5 weeks according to strain management. Weekly and stage-end growth performance metrics were monitored. The carcass dressing and internal organ weight percentages were measured on day 35 by slaughtering 25 broilers from each treatment. Different blood parameters were measured. Compared to the control diet, meals with glucose oxidase did not significantly affect final body weight, average body weight growth, feed consumption, or FCR ($P<0.05$). However, glucose oxidase supplementation did not affect relative organ weights and carcass dressing was seen among dietary regimens. In this investigation, serum biochemical indicators showed that dietary glucose oxidase does not harm broiler chickens. The control group had the greatest MDA, TAC, WBCS, and phagocytic %, while G5 had the lowest in most parameters except TCA, WBCS, and phagocytic %. Compared to control one, group 5 fed GOX diets had the highest return, while groups 3, 4, and 5 had the highest net profit values. In conclusion, optimal glucose oxidase supplementation may boost performance.

Keywords: Glucose oxidase; broilers; performance; immunity; economic.

Introduction

The chicken industry uses antibiotics to boost output [1]. Miles et al. [2] mentioned that antibiotics treat bacteria, prevent disease, and promote animal growth. The overuse of antibiotics as growth promoters has increased antibiotic resistance (ABR), which may have been transferred from animal to human microbiota [3]. Antimicrobial-resistant pathogens will kill 10 million people a year by 2050 [4], emphasizing the need to limit antibiotic use in agriculture. Non-antibiotic growth enhancers for animal production include probiotics, prebiotics, and organic acids [5].

A novel green feed ingredient called glucose oxidase (GOX) improves intestinal health, nutritional absorption and digestion, mycotoxin inhibition, toxin elimination, and poultry and cow productivity [6]. It converts b-D-glucose into 2-d-gluconolactone and hydrogen peroxide, making it antibacterial and antifungal [7, 8]. Also non-toxic and low-residue [6]. GOX supplementation improves grill chickens' cecal microbiota and intestinal barrier function [7, 8].

Optimal glucose oxidase inclusion in broiler feeds requires numerous trials. This research assessed broiler growth, carcass features, blood and immunological markers, and economic efficiency on feeds supplemented with different grades of glucose oxidase.

Material and Methods

Animals and Experimental Design:

The experiment was carried out in the Poultry Research Farm, Faculty of Veterinary Medicine, Zagazig University, Egypt, with the use of animals for testing purposes. From a nearby hatchery, we chose one thousand Arbor Acres plus chicks that

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were one day old and unsexed, with a weight of 42±1 g. There were five different experimental treatments for the broilers, and each treatment had twenty-five replicates (two hundred chicks total; ten chicks each duplicate). Feeding experimental treatments with glucose oxidase at different rates in meals for 35 days: control, 100 ppm, 150 ppm, 200 ppm, and 250 ppm. The illnesses of Newcastle and Gamboro were injected into their systems. During their five weeks of feeding, the broilers were housed in individual pens with the right temperature and lighting conditions. The Arbor Acres plus were fed mash-based isocaloric and isonitrogenous diets that were produced to meet their nutritional requirements [8]. Table 1 shows that the diet over the different periods of time: starter (0-10 days), grower (11-24 days), and finisher (25-35 days)–contains 23% CP and 3005 kcal/kg diet ME, 21% CP, and 3200 kcal/kg diet ME, respectively. The broilers were given unlimited access to water and food. The DM, CP, and EE diets were reviewed according to the AOAC [9].

Growth performance parameters:

The chicks' live body weight (LBW) was determined by weighing them both before and after 6 weeks of feeding. Following the same pattern, BWG was determined by subtracting the starting and ending weights from the total body mass. The reduction in feed weight, measured in grams, was used to calculate the average feed intake (FI). Mortality rates were factored into the calculations of the feed conversion ratio (FCR).

Carcass Traits:

Fifteen broilers per treatment were selected at random after 35 days of feeding, fasted overnight, weighed, and murdered using a sharp knife to stop bleeding. Final weighting after plucking the feather, evisceration, was used to measure the dressing %, which included removing the head, neck, feet, and lower wing. The percentage of LBW for the liver, heart, stomach, intestines, and spleen was also recorded.

Biochemical Analysis:

A sterile glass tube was used to collect blood samples from five broilers per group after slaughter. The samples were then left at room temperature in a slant position for 20 minutes before being centrifuged for 10 minutes at 3000 rpm. No anticoagulant was added to the samples. This was done for biochemical analysis. When not in use, the serum was frozen at -20 °C for future biochemical analysis with a variety of diagnostic kits from Roch Diagnostics, GmbH, USA. We used the method described before [10] to measure serum glucose. Triglycerides, serum total cholesterol, high density lipoprotein concentration, and low-density lipoprotein have all been studied in the past [11, 12]. Albumin and total protein in serum [13], AST [14], ALT [15], and ALP [16], uric acid, creatinine, and blood urea nitrogen levels [17].

Immunological examination:

Different immunological parameters were measured according to the established methods, for total leukocytic count [18], differential and absolute leukocytic counts [19], and phagocytic activity [20].

Economic Efficiency Measurements:

According to Ibrahim et al. [21], the cost factors were divided into two groups: total costs and total variable costs. The net profit was determined by subtracting total costs from total returns, which is equal to the product of the chicks' body weight and the selling price per kilogram (70 LE in May 2023), among other return characteristics.

Statistical analysis:

Statisitx 9© [22] was used to conduct a one-way ANOVA on the acquired results. Least significant difference test separated the means. $P<0.05$ was used to determine statistical significance.

Results

Table (2) showed the effect of glucose oxidase-containing meals on the overall performance of broiler chickens over the whole study period. There was no significant difference ($P<0.05$) in final body weight, total average body weight growth, total feed intake, or total FCR between the control group and the experimental group over the entire study period when comparing the diets that contained glucose oxidase.

Table (3) shows the effects of glucose oxidase-containing diets on broiler chicken carcass quality parameters.

Table 4 shows the effects of various serum biochemical parameters on broiler chicks fed meals containing glucose oxidase. There is a statistically significant relationship between the groups in terms of LDH, urea, uric acid, TC, HDL, and LDL; the control group had the highest values, while G5 had the lowest values, for the majority of measurements. When it comes to LDH, all groups except G3 have non-significant results, with the exception of G4, which has the lowest significant value and also shows non-significant results when compared to G5 and G2. This leaves G1 (control) with the greatest significant value. When looking at LDL and urea levels, the results showed that the control group had the highest significant value, followed by G2 and G3 (which were not significantly different from each other), G4 and finally G5, which had the lowest significant urea value. In contrast, when it came to uric acid, the control group showed no significant difference between G2 and G3, but there was a significant difference between G4 and G5. TC parameter showed a significant decrease starting

from G1 (control) and progressing to G5, which had the lowest value. HDL value showed that G3 and G4 were not significantly different from each other, and lower significant than G1 and G2. G5 also had the lowest value. In MDA value, Control had the highest significant value. G5 was also not significantly different from G4 and G3, as were G2, G3, and G4.

Table (5) shows how different meals containing glucose oxidase affected various blood immunological markers in broiler chickens. With the exception of TCA, WBCS, and phagocytic %, where the control group had the lowest value and G5 had the highest, the data reveal that there is a significant difference between the groups in MDA, TAC, WBCS, and phagocytic %. The other parameters that demonstrated that G5 had a higher significant value compared to the control group revealed the following: firstly, in TAC analysis, G5 was more significant across all groups except G4, which was also non-significant to G3, G2, and the control group. Secondly, in WBCS, the control group was non-significant to G2 and G5, while G4 showed a significantly higher WBCS value from all groups except G3. Lastly, in phagocytic %, the results were similar to those of TAC, with G5 showing a higher significant value across all groups. G4 and G3 had non-significant values, followed by the control group and G2, which had the lowest phagocytic 10%.

Table (6) shows the effect of glucose oxidase-containing meals on the economic efficiency of broiler chickens. The total variable costs (TVC) were found to be significantly higher in the supplemented diets. In groups 2, 3, 4, and 5, the net profit increased significantly ($P<0.05$) when given diets supplemented with glucose oxidase. In groups 2 and 1, there was no significant difference ($P>0.05$). To sum up, when comparing the supplemented and control groups, the latter had the highest return and net profit values, particularly as the inclusion rate of glucose oxidase increased.

Discussion

Glycosidase is a common ingredient in chicken feed because it boosts the chickens' growth rate and antioxidant activity [23, 24]. It also has other beneficial effects, such as improving the composition of the gut microbiota and digestive function [25]. Although there was no statistically significant difference between the control and GOX-containing diets in terms of growth performance indicators, the latter performed numerically better. The preservation of permeability, the prevention of villous disruption, and the improvement of the expression of tight-junction proteins may have shielded the intestine from myotoxicity, which may explain this numerical improvement [7]. Treatment with GOD (1,200 U/kg) has been shown in multiple studies to modulate the gut microbiota, which in turn increases growth performance [26]. From 22 to 42 days of age, broiler chickens can benefit from adding 250 units of GOD per kilogram of feed. This boosts weight gain and increases the apparent ileal digestibility of specific amino acids [27]. However, Jiang et al. [8] found that supplementing broilers with large doses of GOD increased their growth performance and intestinal health without creating any harmful side effects. While some research has shown that GOD improves broiler growth performance, other studies have found no such impact. According to Meng et al. [27], there was no significant change in growth performance measures when 500 or 1,000 units of GOD were added per kilogram of feed. Similarly, according to Wang et al. [6], adding 75 U/kg of GOD to broiler meals did not significantly affect the growth performance of the birds.

According to the results, there were no significant differences among the treatments. This suggests that GOX has good overall performance and might be utilized as an alternative product to promote growth in broilers. In order to produce hydrogen peroxide and create an anaerobic environment in the gut, GOD uses oxygen as an electron acceptor to oxidize β-D-glucose into gluconic acid. This process can kill pathogens (as evidenced by a decrease in secretion of diamine oxidase and D-lactate) and improve gut health (as evidenced by an alleviation of inflammation) [8].

In terms of relative organ weights and carcass dressing, the results demonstrated that feeding the GOX had no effect among the dietary regimens. The results demonstrated that there was no significant difference ($P>0.05$) between the control group and the dietary treatments in terms of the percentage of body weight attributed to the following organs: dressing, crop, intestine, gizzard, proventiculus, liver, lung, spleen, and kidney.

According to Ghazalah et al. [28], blood parameters play a significant role in determining how animals react to their food. According to Jiang et al. [8], serum biochemical measures can be utilized to understand the effects of dietary additives and nutritional factors on an animal's physiological, pathological, and nutritional condition. Generalized data demonstrated that broiler chickens' internal physiology is unaffected by feeding glucose oxidase.

With the exception of TCA, WBCS, and phagocytic %, where the control group had the lowest value and G5 had the highest, the data reveal that there is a significant difference between the groups in MDA, TAC, WBCS, and phagocytic %. Broilers are prone to producing reactive oxygen species (ROS) due to their high lipid content [29]. Antioxidant enzymes were used to mitigate the detrimental effects of reactive molecules and excess ROS [30]. One indicator of oxidative stress is monohydroxyacetone (MDA), a byproduct of lipid peroxidation [31]. In a study conducted by Zhao et

al. [32], it was found that 1,200 U/kg of GOD had a substantial impact on increasing SOD activity and decreasing MDA levels. Wang et al. [6] found similar results, confirming that GOD therapy greatly enhanced GSH-Px activity in the jejunal mucosa. Here, we showed that GOD could successfully reduce ROS-induced oxidative stress, and we confirmed that large dosages of GOD had beneficial effects on animals by showing that 100U/g GOD considerably raised GSH-Px concentration in broilers.

The five groups that received GOX-containing diets had the highest returns and net profit values. When the incorporation rate of glucose oxidase was increased, the supplemented groups exhibited the highest return and net profit values compared to the control group. Improved overall health, gastrointestinal health, and immunity likely contributed to lower mortality rates, which in turn boosted economic efficiency, which grows in tandem with the addition rate.

Conclusion

The research findings indicate that using glucose oxidase did not significantly improve any of the measured parameters ($P<0.05$), but it did outperform the control groups numerically, implying that there might be a noticeable improvement with the right supplementation or inclusion. The use of antibiotics in animal production has social, economic, and health consequences for both producers and consumers. To avoid these problems while still ensuring that consumers have access to safe, high-quality food, it would be helpful to use glucose oxidases as growth promoters in broiler production. These enzymes come from natural sources and have no proven residual effects.

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Declaration of Conflict of Interest

The authors declare that there is no conflict of interest.

Ethical of approval

This study was done according to the ethical guidelines of Zagazig University, Egypt.

TABLE 1. Ingredient composition (%) of the experimental diets used in the starter, grower and finisher stages.

Ingredients	Ingredients (Starter stage)	Ingredients (Grower stage)	Ingredients (Finisher stage)
Yellow corn	50.17	53.84	59.03
Soybean meal, 44%	35.60	32.50	26.00
Corn gluten, 60%	6.00	5.30	6.00
Soybean oil	3.15	4.00	4.50
Calcium carbonate	1.2	0.91	1.20
Calcium dibasic phosphate	2.2	1.90	1.75
Common salt	0.30	0.30	0.30
Sodium bicarbonate	0.15	0.15	0.15
Premix[1]	0.30	0.30	0.30
L-Lysine, Hcl, 78%	0.35	0.30	0.30
DL- Methionine, 98%	0.30	0.25	0.23
L-Threonine, 98.50%	0.10	0.08	0.06
Choline chloride, 60%	0.08	0.07	0.08
Antimycotoxin	0.05	0.05	0.05
Anticoccidial	0.05	0.05	0.05
Calculated composition			
ME, Kcal/Kg	3005.03	3103.83	3200.48
CP, %	23.08	21.56	19.58
EE, %	5.32	7.32	6.89
CF, %	3.70	3.96	3.23
Ca, %	1.13	0.99	0.99
Available phosphorus, %	0.48	0.43	0.39
Lysine, %	1.45	1.32	1.16
Methionine, %	0.69	0.62	0.58
Threonine, %	0.97	0.89	0.80

1 Muvco premix: Each 3 kg contain vit. A (10, 000000 IU), vit. D3 (2, 000000 IU), vit. E (10 g), vit. k3 (1000 mg), vit. B1 (1000 mg), vit. B2 (5 g), vit. B6 (1.5 g), pantothenic acid (10 g), vit. B12 (10 mg), niacin (30 g), folic acid (1000 mg), biotin (50 g), fe (30 g), Mn (60 g), Cu (4 g), I (300 mg), Co (100 mg), Se (100 mg) and Zn (50 g).

TABLE 2. . Overall performance of broiler chickens fed diets contained glucose oxidase (means ±SE).

Trait studied	Control	100 ppm	150 ppm	200 ppm	250 ppm
Initial body weight (g)	39.97±1.04	39.27±0.50	39.33±0.66	39.00±0.57	40.00±0.50
Final body weight (g)	1053.67±6.88	1049.67±5.17	1046.67±1.66	1052.33±2.18	1053.00±1.15
Absolute weight gain (g)	1941.03±51.98	1949.07±35.51	2032.33±41.09	2051.67±11.46	2064.67±17.55
Total feed consumption (g)	2901.50±8.67	2919.33±8.85	2915.67±8.18	2921.50±6.21	2925.00±14.77
Feed conversion ratio	1.50±0.043	1.50±0.03	1.43±0.033	1.43±0.009	1.42±0.003

Mean in a row without letters are not significantly different (P >0.05).

TABLE 3. Carcass traits relative to the live weigh of broiler chickens fed diets contained glucose oxidase (means ±SE).

Trait studied	Control	100 ppm	150 ppm	200 ppm	250 ppm
Live BW, g	2.24±0.02	2.08±0.04	2.16±0.07	2.07±0.04	2.29±0.07
Dressing, %	1.79±0.03	1.7±0.03	1.78±0.06	1.69±0.04	1.88±0.06
Intestine, %	71.74±5.52	85.48±2.25	87.75±15.52	73.57±0.98	94.6±5.34
Gizzard, %	34.50±1.48	38.76±2.03	39.77±1.32	35.43±1.10	45.45±4.53
Proventiculus, %	6.94±0.36	8.26±0.85	7.72±0.96	7.22±1.09	8.65±0.67
Liver, %	48.53±2.95	52.84±3.28	49.72±2.75	47.35±3.004	47.86±2.74
Heart, %	9.16±0.46	9.07±0.82	11.17±0.83	10.25±0.52	9.69±0.91
Lung, %	9.77±1.04	9.13±0.47	9.34±0.38	8.81±1.41	9.49±0.35
Spleen, %	2.66±0.17	2.48±0.10	2.04±0.41	1.78±0.39	2.37±0.14
Crop, %	5.53±0.67	8.05±1.27	6.82±0.61	9.17±0.50	6.70±0.61
Kidney, %	9.37±0.72	9.21±1.16	9.13±1.59	9.41±2.41	9.28±2.83

Mean in a row without letters are not significantly different (P >0.05).

TABLE 4. Some serum biochemical parameters of broiler chickens fed diets contained glucose oxidase (means ±SE).

Parameters	Control	100 ppm	150 ppm	200 ppm	250 ppm
Glucose (mg/dl)	146.33±39.42	149.17±33.19	135.5±14.08	154±16.92	130.67±12.11
Total cholesterol (mg/dl)	200.33±8.96^{a}	172.33±1.45^{b}	138.67±4.37^{c}	120.33±1.85^{d}	93.00±1.15^{e}
Triglyceride (mg/dl)	63.50±11.75	72.50±26.55	39.50±2.64	26.50±2.50	37.50±3.77
HDL (mg/dl)	88.67±4.37^{a}	88.33±0.33^{a}	64.33±3.38^{b}	61.00±4.04^{b}	48.00±2.08^{c}
LDL (mg/dl)	98.97±6.13^{a}	69.50±5.12^{b}	66.43±4.33^{bc}	54.03±2.80^{c}	37.50±1.26^{d}
Total protein (g/dl)	2.00±0.34	2.44±0.14	2.44±0.14	2.57±0.17	2.76±0.20
Albumin (g/dl)	1.12±0.17	1.41±0.09	1.51±0.11	1.55±0.12	1.64±0.06
Globulin (g/dl)	0.88±0.17	1.03±0.08	1.06±0.10	1.21±0.146	1.21±0.146
ALT (U/l)	116.67±7.12	107.00±26.05	96.33±30.23	74.33±21.07	84.00±22.81
AST (U/l)	149.67±30.30	163.00±22.94	139.67±11.09	135.67±4.70	139.00±7.50
ALP (U/l)	133.67±29.06	108.00±19.85	139.33±12.14	111.67±14.09	99.67±16.18
Creatinine (mg/dl)	0.70±0.05	0.78±0.03	0.70±0.02	0.74±0.01	0.71±0.01
Uric acid (mg/dl)	16.00±0.32^{a}	15.63±0.33^{a}	14.67±1.06^{a}	11.37±0.98^{b}	9.90±0.12^{b}
Urea (mg/dl)	51.67±1.45^{a}	44.00±2.00^{b}	40.67±1.20^{bc}	40.67±1.20^{bc}	37.67±1.45^{c}

Mean in a row without letters are not significantly different (P >0.05).

TABLE 5. Some serum immunological parameters, antioxidant status, and total & differential leukocytic count of broiler chickens fed diets contained glucose oxidase (means ±SE).

Parameters	Control	100 ppm	150 ppm	200 ppm	250 ppm
IgM (µg/ml)	1.23±0.07	1.41±0.07	1.65±0.11	1.48±0.09	1.60±0.11
Lysozyme activity (U/ml)	101.00±1.15	118.00±7.81	105.00±1.73	106.33±4.09	121.33±5.45
Nitric oxide (µmol/L)	11.37±0.93	11.18±0.94	10.41±0.49	10.45±0.39	9.76±0.31
MDA (nmol/L)	427.83±21.90^{a}	284.00±51.86^{b}	233.17±50.24^{bc}	223.50±17.821^{bc}	136.50±25.28^{c}
TAC (µmol/L)	654.67±24.78^{c}	677±22.65^{bc}	697±4.50^{bc}	731.33±15.83^{ab}	778.33±23.38^{a}
Hb (g/dl)	10.83±0.03	11.93±0.41	12.30±0.32	11.70±0.17	11.93±0.49
HCT	25.72±0.56	26.49±0.68	28.53±0.86	28.49±0.95	27.51±0.76
RBCs (10^{6}/µL)	2.06±0.03	2.19±0.10	2.36±0.11	2.32±0.01	2.25±0.05
WBCs (10^{3}/µl)	81.29±1.62^{c}	83.79±0.63^{bc}	87.21±1.75^{ab}	89.84±2.05^{a}	82.93±1.21^{bc}
Heterophil, %	15.67±4.37	4.67±0.88	8.00±3.51	9.33±0.66	9.33±0.66
Lymphocytes, %	61.00±8.54	84.00 ±2.51	75.33±7.68	71.33±5.84	82.33±0.33
Phagocytic, %	19.67±1.85^{c}	24.33±3.18^{bc}	26.33±0.88^{b}	30.67±0.88^{ab}	33.67±2.02^{a}
Phagocytic index C	1.12±0.01	1.18±0.03	1.18±0.01	1.17±0.02	1.19±0.01

Mean in a row without letters are not significantly different (P >0.05).

TABLE 6. Economic efficiency of broiler chickens fed diets contained glucose oxidase (means ±SE).

Parameters	Control	100 ppm	150 ppm	200 ppm	250 ppm
TVC	63.83±0.19^{e}	65.69±0.20^{d}	67.06±0.18^{c}	68.66±0.14^{b}	70.20±0.35^{a}
TC	123.83±0.19^{a}	115.69±0.20^{e}	117.06±0.18^{d}	118.66± 0.14^{c}	120.20±0.35^{b}
Return	135.78±2.8^{b}	136.43±0.87^{ab}	142.26±1.2^{ab}	143.62±1.3^{ab}	144.53±0.98^{a}
Net profit	12.03±0.86^{b}	20.75±0.87^{ac}	25.20±3.4^{a}	24.96±3.20^{a}	24.33±3.40^{a}

Mean in a row without letters are not significantly different (P >0.05).

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تأثير إنزيم الجلوكوز أوكسيديز على الإنتاجية والكفاءة الاقتصادية في دجاج التسمين

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الملخص

يُستخدم إنزيم الجلوكوز أوكسيديز (إنزيم العلاج) كمكمل غذائي غير تقليدي في علائق دجاج التسمين. دُرست آثار إضافة إنزيم الجلوكوز أوكسيديز الغذائي على أداء النمو، وخصائص الذبيحة، والمؤشرات البيوكيميائية والمناعية في المصل، والكفاءة الاقتصادية كإنزيم علاجي غير تقليدي في مزرعة أربور أكريس، بالإضافة إلى كتاكيت دجاج تسمين غير مُحددة الجنس بعمر يوم واحد (عددها 1000). وُزّعت عشرون مكررة، كل منها 200 كتكوت (عشرة كتاكيت لكل مكرر)، عشوائيًا على خمس معاملات. تم تغذية الكتاكيت التجريبية على علائق متساوية الطاقة ومتساوية النيتروجين تحتوي على 0 (مجموعة ضابطة)، و100، و150، و200، و250 جزء في المليون من إنزيم أوكسيديز الجلوكوز لمدة 5 أسابيع وفقًا لإدارة السلالة. تمت مراقبة مقاييس أداء النمو الأسبوعية ونهاية المرحلة. تم قياس نسبة تماسك الذبيحة ووزن الأعضاء الداخلية في اليوم 35 عن طريق ذبح 25 دجاجة لاحم من كل معاملة. تم قياس معايير دم مختلفة. بالمقارنة مع نظام المجموعة الضابطة، لم تؤثر الوجبات التي تحتوي على إنزيم أوكسيديز الجلوكوز بشكل كبير على الوزن النهائي للجسم، أو متوسط نمو وزن الجسم، أو استهلاك العلف، أو معدل تحويل العلف .(P <0.05) ومع ذلك، لم يؤثر مكملات أوكسيديز الجلوكوز على الأوزان النسبية للأعضاء، ولوحظ تماسك الذبيحة بين الأنظمة الغذائية. في هذا البحث، أظهرت المؤشرات البيوكيميائية في المصل أن أوكسيديز الجلوكوز الغذائي لا يضر دجاج اللاحم. حققت المجموعة الضابطة أعلى نسبةMDA ، وTAC، وWBCS، ونسبة البلعمة، بينما سجلت G5 أدنى نسبة في معظم المعايير باستثناءTCA ، وWBCS، ونسبة البلعمة. وبالمقارنة مع المجموعة الضابطة، حققت المجموعة 5 التي تغذت على علائق GOX أعلى عائد، بينما حققت المجموعات 3 و4 و5 أعلى قيم صافي ربح. في الختام، قد يُعزز مُكمل أوكسيديز الجلوكوز الأمثل الأداء.

الكلمات الدالة: أوكسيديز الجلوكوز؛ دجاج التسمين؛ الأداء؛ المناعة؛ الاقتصاد.