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Using Different Types of Yeast Cell Extract, Probiotic and Abiotic to Improve Growth Performance, Carcass Characteristics and Antioxidant Activities of Broiler Chickens

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Abstract

THE PURPOSE of this study was to investigate the effect of yeast probiotic, abiotic, and extract on the growth, carcass characteristics and antioxidant activity of broiler chickens. a total of 210 day-old chicks (Ross-308) , were used in this experiment and were randomly assigned to 7 treatments .Each treatment involved 3 replicates and were housed in 21 pens with 10 birds per pen (replicate). The following treatments were: T1 is the control treatment; while T2 and T3 added with yeast extract, T4 and T5 added with probiotic yeast while,T6 and T7 having abiotic yeast. All of previous treatments added in drinking water with two concentrates 1 and 2% , respectively during 1st 3 days of age . Broilers having yeast extract and probiotic causing significantly higher body weight gain (BWG) during growing period and also it has lower feed intake (FI) and better feed conversion rate (FCR) than others in different groups during all periods of experiment. Carcass weight , dressing and spleen % in probiotic yeast groups tended to be heavier than birds in other treated groups and also when compared with the control group . Total antioxidants capacity (TAC) , catalase activity (CAT) and Superoxide dismutase (SOD) levels were significantly higher in all treated groups compared with control group. Also, malondialdehyde (MDA) value was significantly ($p > 0.05$) reduced in groups receiving yeast and lowest value recorded in yeast extract compared to control group. It is concluded that adding yeast extract and probiotic yeast during 1st 3 days of age could improve growth performance , carcass characteristics and total antioxidant capacity of broiler chicks .

Keywords: yeast cells, body weight, carcass, antioxidant activities and broilers**.**

Introduction

Nowadays, oxidative and immunologic stress which harms biological tissues and cells are direct environmental stressors for broiler chickens raised in intensive breeding conditions [1].One of the types of stress that day- old chicks are exposed to stress resulting from the process of transporting and housing the birds. And it has been considered as one of the important factors influencing broiler physiological and metabolic change. An imbalance between the system that generates free radicals and the antioxidant defence system causes oxidative damage [2].This interferes with redox signalling and regulation, underscoring the significance of the redox ratio as an essential tool for oxidative stress measurement. Oxidative stress in chickens can negatively impact on their nutrient absorption and digestion and leading to diseases or even death [3].Furthermore, the production of reactive oxygen species (ROS) as a result of cellular division and death is a crucial aspect of early life growth processes. This is because (ROS) are thought to be the primary mediators of oxygen cytotoxicity and to be significant messengers that promote cell division and exhibit cellular signalling effects [4]. As a result, increasing the intestinal antioxidant capacity and immunological function through nutrition is essential to enhancing the growth and overall health of broiler chickens.

Probiotics, which are live microorganisms or a combination of microorganisms, have shown beneficial effects by improving the properties of the existing microflora in the host [5-6]. Their effectiveness in animals has been extensively reviewed, and they have been evaluated as a potential substitute for antibiotics in both humans and animals [7-8]. Probiotics are important for maintaining the microbiome's balance and fostering health throughout a range of age groups. Yeast addition to poultry diets, however, has shown inconsistent outcomes [9] ,It has been demonstrated that adding live yeast probiotics to animal feed enhances both the

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nutritional value of the diet and the performance of the animals. [10-11]. A variety of vital nutrients, including vitamins and minerals, are found in yeast. The yeast Saccharomyces cerevisiae (SC) is known for its biologically valuable proteins, vitamin B complex and vital trace minerals. Many other positive traits have also been identified, including the ability to increase the availability of phosphorus [12], increase animal use [13], and lower the number of cases of disease infection [14] enhanced feed efficiency as well [15]. There are also other types of Yeast-derived products such as yeast extracts [16].Yeast extract is a protein source, which is derived from the cells of living yeast. Nucleotides, inositol and glutamic acid are abundant in it. Nucleotides have an impact on intestinal flora maintenance, immune system function and gastrointestinal development in humans. They are mostly utilised in infant meals. Uauy et al. [17] found that giving young rats 0.8% nucleotide supplements aided in their intestinal development and maturation, as evidenced by increases in crypt depth and villus height. In their evaluation of the impact of yeast extract on chicken performance, Silva et al. [18] found that there was an improvement in food conversion between one and twenty-one days.

Materials and Methods

Ethical Approval

The authors confirm that the ethical policies of the journal have been adhered to and the appropriate ethical review committee approval has been received. The authors followed EU standards for the protection of animals used for scientific purposes. The study was conducted at the Agricultural Research and Production Station of National Research Centre, Al-Nubaria, Al- Beheira Governorate, Egypt.

Preparation of different types of yeast

Probiotic live yeast: Commercial fresh baker's yeast, were used in this study. *Saccharomyces cerevisiae*, at 4.125 × 106 CFU per 100 mL, are present in this single culture probiotic. To achieve abiotic yeast : yeast sample tube was heated at 100°C for 30 min in a water bath but yeast extract produce by adding sugar to a dough and allow it to rise in a warm place so-called fermenters, so that the yeast can grow in the best possible way. After this, the yeast is concentrated and washed in centrifuges in order to remove the residual sugar. The result is a viscous, creamy yeast mass.

Experimental Design

Total number of 210 Ross-308 broiler chicks, aged 1 day, were obtained from a hatchery and used in this treatment involved experiment and randomly assigned to seven treatments. Each 3 replicates and were housed in 21 pens with 10 birds per pen (replicate). The body weight (BW) of all chicks was similar at the start of the experiment. These were the treatments that were administered: T1: (control treatment), while T2 and T3 added the yeast extract , T4 and T5 added the probiotic yeast, T6 and T7 having abiotic yeast. All of previous treatments were added in drinking water with two concentrates 1 and 2% ,respectively during 1st 3 days of age. The NationalResearchCouncil's recommendation [22] for the nutritional needs of broilers was taken into consideration when creating the basal diet (Table 1). During the trial period, all chicks were exposed to 23 hours of light and 1 hour of darkness. The housing temperature was maintained at 32°C for the first week, then dropped by 3°C each week until it stabilised at 22°C.The composition and analysis of the experimental diet are shown in Table (1).

Growth performance

The body weight of birds was recorded weekly from the 1st day until 5th week of age. The body weight gain (BWG) was calculated by this equation, Bw =Final Bw – Initial Bw. The weekly feed intake was recorded and feed conversion ratio (FCR) was also calculated using the following equation: FCR= FI (g)/ BWG (g).

Carcass traits

At the end of experiment (5th week of age), four birds per each treatment were fasted for 8 hours before slaughter. The individual body weight was recorded as live body weight . Then birds were slaughtered and when bleeding was completed, the slaughter weight was recorded and birds were scalded and plucked to remove the feather, after that the carcass was opened and edible and non-edible organs were removed to obtain the edible organs weight and calculate the dressing % from live body weight. Also the weight of liver, spleen heart and gizzard were recorded.

Biochemical analysis of blood samples

During slaughter, blood samples from 5 chicks per treatment were collected in weatherman tubes, centrifuged at 4000 rpm for 15 min and serum samples were stored at -20°C until analysis. Commercial Kits (Biuret Method, Chemelex, SA, Barcelona) were used to analyse the total proteins in plasma and the same spectrophotometer was used to measure the triglycerides (Triglyceride-GPO method, Biolabosa, France). Following lipase enzymatic hydrolysis, triglyceride was measured.

Antioxidant capacity

Plasmasuperoxide dismutase (SOD, U/L) and total antioxidant capacity (TAC) were determined according to the ability of SOD to inhibit the reduction of nitroblue tetrazolium superoxide [23-24] and malondialdehyde (MDA) in serum were individually determined using the protein or MDA enzyme-linked immunosorbent assay (ELISA)kits

(Nanjing Jiancheng Bioengineering Institute, Nanjing, China).

Statistical analysis

Statistical analysis of experimental data wasperformed using one-way analysis of variance (ANOVA) with the SPSS 11.0 Statistical software[25].Differences between means were determined using Duncan's Multiple Range Test [26].

Results and Discussions

Productive performance

The results of the productive performance as influenced by yeast (*Saccharomyces cerevisiae*) feeding are shown in Table (2) there were no significantly differences in both initial and final BW of broilers in all groups.

Broilers having probiotic and abiotic yeast (1%) in drinking water during 1st 3 days of age causing significantly higher (BWG) during growing period but higher(FI) and FCR were observed in abiotic yeast (1 and 2 %) than others in different groups during all periods of experiment (starter , growth and overall periods).

From the previous results , broilers in probiotic yeast groups (1and 2%) having better FCR than other groups during growth and overall periods . This might be interpreted as one of the advantageous effects of yeast probiotics in fostering a healthy environment in the gastrointestinal system by providing nourishment to the enterocytes, enhancing the development of the ileal mucosa and strengthening the function of the mucosal barrier by preserving the integrity of the epithelium.

This result is consistent with the one reported by Zhang *et al*. [1], who found that supplementing male broiler chickens with *S. cerevisiae* improved their growth rate. Furthermore, this conclusion is consistent with the outcomes of investigations conducted by other authors [27-28] using broiler chickens. A probiotic improves digestion by balancing the intestinal bacteria of the animal and lowers the FCR, which increases the daily live weight gain [29]. This is accomplished in a natural physiological approach. Similar to the earlier findings of Chen *et al*. [30], the favourable effects of yeast extract on FCR were likely caused by an improvement in BWG. According to these findings, a lower concentration of yeast extract would be sufficient to enhance broiler chicken growth performance by improving immune responses enhancing health responses and having anti-inflammatory effects on animals [31]. It also promotes the growth of good bacteria in the gut and inhibits the growth of harmful bacteria [32]. Thus, it leads to better utilization of the feed.

Carcass and organ weights of broiler chickens.The results of carcass traits are presented in Table (3). showed that dressing % was significantly improved for birds received probiotic yeast treatment (1and 2%) compared with control and other treated groups. in addition , smiler trend was observed in carcass weight .However, there were no significant difference ($P > 0.05$) in other carcass traits could be detected except for spleen% which recorded significant increase for probiotic yeast treatment compared with control and other treated groups. This result was agreed with Bozkurt *et al*. [33] and Lecewicz *et al.* [34] who found that addition of probiotics did not affect the weights of the gizzard, liver, and bursa of fabricius On the other hand, Paryad and Mahmoudi [35] found that adding 1.5 and 2% of probiotic can improved the carcass and meat yield of broiler chickens at d 42. The reason for the rise in the carcass weights of broiler chickens could be attributed to an improvement in FCR and FI. Additionally, the use of *Saccharomyces cerevisiae* extract and live cells in the digestive tract of the chickens may have improved the digestion and absorption of nutrients [36].

Blood constituents

The present results showed that higher total protein value was recorded in broiler chicks having probiotic yeast (1%) in drinking water during 1st 3 days of age than control and other groups Fig (1). This finding is in agreement with El-Naga [37] who found significantly higher total serum protein in broilers fed 0.5% yeast than others in control group. other results were obtained by He *et al.* [38] who found that adding *Saccharomyces cerevisiae* to the diet (0.5 and 1g/kg) did not affect on total protein in serum of broilers.

Although, the control group had higher triglyceride values than any of the treated groups with different forms of yeast, the lowest value was recorded in the group that received yeast extract (2%) (Fig. 2). This observation aligns with several other reports by El-Naga [37], Priya and Babu [39] and Shahir *et al*. [40]. The inhibition of hydroxy methyl glutaryl coenzyme A, an enzyme involved in the cholesterol synthesis pathway, by probiotic microbes is known to reduce cholesterol synthesis [41].

Antioxidant Status

Plasma total antioxidants capacity (TAC), Superoxide dismutase (SOD), catalase activity (CAT) and malondialdehyde (MDA) of hatched chicks were recorded in Table (4). Delicate balance must be maintained in healthy animals between the generation of free radicals, which are necessary for some physiological functions, and the antioxidant defence system's ability to destroy them in order to guard against the damaging effects of free radicals. "The redox balance" refers to this equilibrium. Research has indicated that nutrition plays a crucial role in maintaining the balance between pro- and anti-oxidants [42].

The TAC and SOD levels were significantly higher in all treated groups compared with control group, which birds having probiotic yeast (1%) in water during 1st 3 days of age were significantly higher in (TAC , CAT and SOD) than control and other groups having different types of yeast (abiotic yeast and yeast extract). And also, MDA value was significantly ($P > 0.05$) reduced in groups receiving yeast and lowest value recorded in (1and 2%) of yeast extract compared to control group . This result may be due to mannan-oligosaccharides, which are regarded as prebiotics, can be found in entire yeast cells or in some yeast cell wall components [19]. In contrast, other research has shown that yeast cell wall components including carbohydrates may increase the activity of antioxidant-related enzymes [43–44] while lowering animal lipid peroxidation levels and ROS production [45–46]. According to a related study conducted in turkey, mannan oligosaccharides, used as dietary additive of S. *cerevisiae*, enhance the oxidative defence mechanisms and enhance the growth performance of the birds [47].

In vitro antioxidative properties of mannans from *S. cerevisiae* were demonstrated by Krizkova *et al*. [48]. This implies that dietary yeast may offer additional benefits to the gastrointestinal system beyond simply eliminating bad bacteria. Kogan *et al*. [49] also proposed that β-glucans in yeast cell walls could be antioxidants. We concluded that the presence of carbohydrates in yeast extract may also contribute to enhanced antioxidant capacity. The elevated activity of these antioxidant enzymes could be explained by the environmental stressors that birds encounter during their development.

Conclusions

The addition of yeast extract or probiotic yeast to drinking water during the initial three days of life has been found to enhance the growth performance of broiler chickens.

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For all stuff in the department

Conflict of interest

The authors declare that they have no conflict of interest

Authors' statement

WHK: Methodology, Data curation, Writing – Review & editing AS: biochemical and statistical analysis, SAY : Writing – Review, GME: biological study and statistical analysis, GEA: Writing – Review, MGS: Methodology, Data curation

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Ethical of approval

The experimental design and all the research protocols were approved by the Medical Research Ethics Committee (MREC) of the National Research Centre with ethical approval code (07410124).

TABLE 1. Composition and analysis of the experimental diet

Ingredient	%
Yellow Corn	**67.0**
Soybean meal (44%)	**26.3**
Wheat bran	**3.0**
Limestone	**1.0**
Di calcium phosphate	**2.0**
DL-Methionine	**0.1**
NaCl	**l0.3**
Premix*	**0.3**
Total	**100**
Calculated values	
ME (Kcal/Kg	**(2860)**
Crude protein (%)	**19.04**
Crude fiber (%)	**3.43**
Crude fat (%)	**2.65**
Calcium (%)	**0.93**
Available phosphorus (%)	**0.45**
Methionine (%)	**0.42**
Lysine (%)	**0.93**
Sodium (%)	**0.24**
Analyzed values	
Crude protein (%)	**19.39**
Crude fiber (%)	**3.97**
Crude fat (%)	**3.17**
Crude ash (%)	**5.73**

*Each kg of vitamin mineral premix: contains: vitaminA=1200000IU; vitamin D3=300000IU; vitamin E=700mg;vitamin K3=500mg; vitamin B1=500mg; vitamin B2=200mg;vitamin B6=600mg;vitaminB12=3mg;folicacid=300mg;cholinechloride=1000mg;Niacin=3000mg;Biotin=6mg;panathonicacid=670mg;manganesesulphate=3000mg;ironsulphate=10000mg;zincsulphate=1800mg;coppersulphate=3000mg;iodine=1.868mg;cobaltsulphate=300mg;selenium=108mg

TABLE 2. Effect of different types of yeast (extract , probiotic and abiotic) on growth performance of broiler chickens

		Yeast extract		Probiotic yeast		Abiotic yeast			
	Control	1%	2%	1%	2%	1%	2%	SEM	P-value
Initial BW(g)	43.51	42.90	43.79	43.27	43.61	41.78	43.84	0.390	0.854
Final BW(g)	1658.94	1449.260	1600.91	1748.87	1753.59	1736.53	1532.45	38.776	0.238
Starter Period(g)	508.27	500.18	505.26	495.54	522.01	478.00	483.72	8.162	0.859
BWG 1-3 w	882.91^{a}	555.66^{b}	633.07^{b}	611.06^{b}	655.82^{b}	945.40^{a}	881.40^{a}	33.87	0.000
FI 1-3 w	1.7353^{a}	1.11^{b}	1.24^{b}	1.27^{b}	1.29^{b}	1.97^{a}	1.84^{a}	0.07	0.002
FCR 1-3 w									
Growing period(g)	1107.23^{ab}	906.17^{b}	1051.9^{ab}	1210.13^{a}	1188.0^{ab}	1216.73^{a}	1004.9^{ab}	37.06	0.189
BWG 3-5 w	1829.8^{a}	1162.73^{b}	1320.53^{b}		1366.93^{b}	1957.23^{a}	1826.73^{a}	69.05	0.000
FI 3-5 w	1.66^{ab}	1.33^{abc}	1.36^{abc}	1275.6^{b}	1.17^{bc}	1.61^{ab}	1.83^{a}	0.06	0.025
FCR 3-5 w				1.05^{c}					
Over all performa	1615.42	1406.35	1557.11		1709.98	1694.74	1488.61	38.81	0.237
BWG1-5 w	2712.73^{a}	1718.43^{b}	1953.63^{b}	1705.59	2022.73^{b}	2902.63^{a}	2708.13^{a}	102.93	0.000
FI 1-5 w	1.68^{ab}	1.24^{c}	1.29^{bc}	1886.73^{b}	1.19^{c}	1.71^{a}	1.83^{a}	0.07	0.003
FCR 1-5 w				1.11^{c}					

a,bc In each row means having different superscripts are significantly different ($p<0.05$)

TABLE 3. Effect of different types of yeast (extract , probiotic and abiotic) on carcass of broiler chickens.

	Control	Yeast extract		Probiotic yeast		Abiotic yeast		SEM	Pvalue
		1%	2%	1%	2%	1%	2%		
Slaughter weight	1375.8^{ab}	1271.33^{b}	1354.58^{ab}	1583.88^{a}	1444.32^{ab}	1229.43^{b}	1318.70^{ab}	33.07	0.100
Dressing %	71.25^{bc}	69.96^{bc}	70.79^{bc}	74.64^{a}	72.28^{ab}	68.79^{c}	70.18^{bc}	0.463	0.009
Liver(g)	2.86	3.30	2.60	2.96	2.73	2.87	2.77	0.096	0.644
heart(g)	0.52	0.48	0.48	0.55	0.53	0.63	0.53	0.019	0.536
spleen(g)	0.14^{b}	0.20^{ab}	0.15^{b}	0.23^{a}	0.19^{ab}	0.18^{ab}	0.19^{ab}	0.009	0.197
Gizard(g)	1.12	1.28	1.25	1.34	1.24	1.24	1.41	0.038	0.611

a,b,c In each row means having different superscripts are significantly different ($p<0.05$)

TABLE 4. Effect of different types of yeast (extract, probiotic and abiotic) on antioxidant activities of broiler chickens.

Control		Yeast extract		probiotic Yeast		abiotic Yeast		SEM	P Value
		1%	2%	1%	2%	1%	2%		
TAC (nmol/mL)	132.09^{e}	263.62^{b}	243.64^{bc}	356.86^{a}	230.32^{c}	133.76^{de}	162.06^{d}	17.11	0.000
SOD (nmol/mL)	120.85^{e}	153.42^{d}	162.52^{d}	266.42^{a}	237.24^{b}	236.07^{b}	205.71^{c}	11.31	0.000
Catalase(nmol/mL)	0.05^{c}	0.08^{ab}	0.08^{ab}	0.09^{a}	0.08^{ab}	0.05^{bc}	0.07^{abc}	0.004	0.011
MDA (nmol/mL)	18.51^{a}	9.9^{d}	9.94^{d}	10.58^{d}	10.36^{d}	15.70^{b}	13.57^{c}	0.73	0.000

a,b,c,d,e In each row means having different superscripts are significantly different ($p<0.05$)

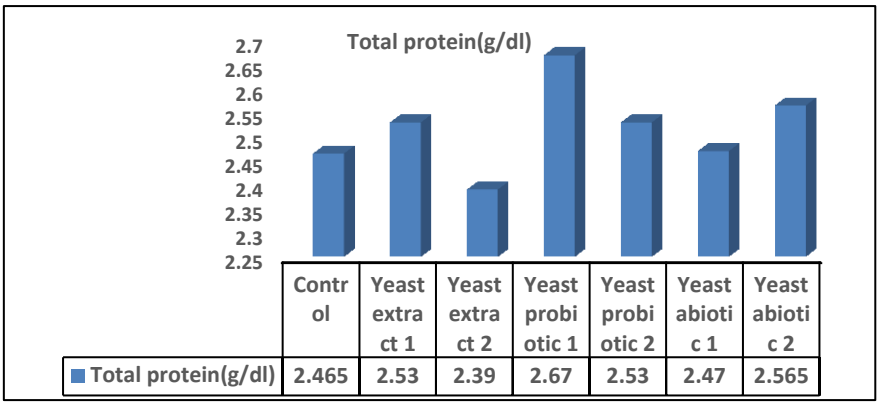

Fig.1. Effect of different types of yeast (extract , probiotic and abiotic) on Total protein of broiler chickens

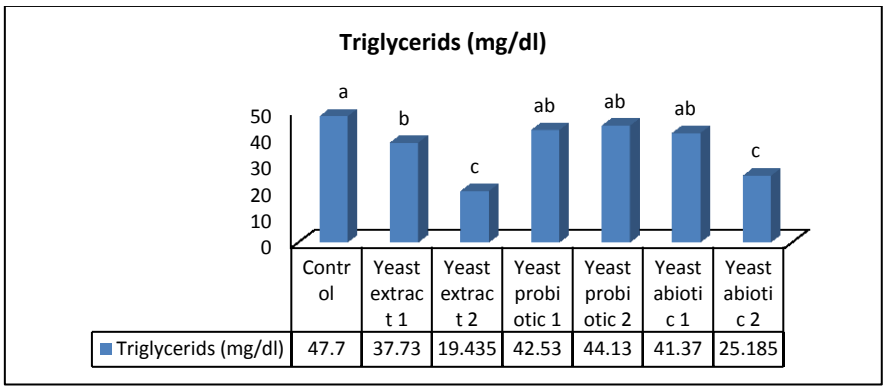

Fig. 2. Effect of different types of yeast (extract , probiotic and abiotic) on Triglyceride of broiler chickens

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تأثير إضافة خلايا الخميرة (المستخلص والبروبيوتيك والغير حيه) على معدل النمو وخصائص الذبيحة ونشاط مضادات الأكسدة في دجاج اللحم

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الملخص

تهدف هذه الدراسة إلى تحديد تأثير أنواع مختلفة من الخميرة (مستخلص الخميره و البروبيوتيك والخميره الغير حية) على النمو والذبيحة ونشاط مضادات الأكسدة في دجاج اللحم. أجريت التجربة على أفراخ فروج اللحم روس 308 تم توزيع 210 كتكوت بعمر يوم عشوائيا على سبع معاملات -. تضمنت كل معاملة 3 مكررات وتم إيواءها في 21 عين بطاريه بواقع 10 طيور لكل (مكرر) وكانت جميع الأفراخ متشابهة في بداية التجربة (44+1.11).وكانت المعاملات على النحو التالي المعامله الأولى - معاملة السيطرة و المعاملة الثانية والثالثة اضافه مستخلص الخميرة والمعامله الرابعه والخامسه أضيفت خميرة البروبيوتيك اما المعامله السادسه والسابعه تم اضافه الخميره غير الحيه حيث تم اضافه كل المعاملات السابقه في ماء الشرب بتركيزين 1 و 2% على التوالي خلال الثلاثة أيام الأولى من العمر ولوحظ ان الطيور في كلا من مجموعه المستخلص والبر وبيوتيك (1 و 2٪) أظهرت زيادة ملحوظة في وزن الجسم خلال فتره النموعن غيرها في المجموعات المختلفة كما انها كانت اقل المجاميع استهلاكا للعليقه وكانت افضل المجاميع في معامل التحويل الغذائي في كل مراحل التجربه كما اظهرت الطيور التي تلقت خميرة البر وبيوتيك (1 و 2٪) في ماء الشرب خلال الأيام الثلاثة الأولى من العمر تحسن معنوى في كلا من وزن الذبيحه ونسبة التصاقي ووزن الطحال مقارنه بالطيور في مجموعات المعاملات الأخرى وكذلك عند مقارنتها بالمجموعة الضابطة كما ان مستويات TAC,SOD and CAT كانت أعلى بشكل ملحوظ في جميع المجموعات المعامله كما انخفضت قيمه انزيم MDA في جميع المعاملات كما سجلت اقل قيمه في المجموعه المعامله بمستخلص الخميره (1 و 2%) مقارنة بالمجموعة الضابطة ونستنتج من ذلك أن إضافة مستخلص الخميرة وخميرة البروبيوتيك خلال الأيام الثلاثة الأولى من العمر يمكن أن تحسن أداء النمو وخصائص الذبيحة والقدرة الكلية لمضادات الأكسدة في دجاج اللحم

الكلمات المفتاحية: خلية الخميرة ، وزن الجسم ، صفات الذبيحة ، نشاط مضادات الأكسدة ، دجاج اللحم.