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EFFECT OF GRAPE SEED POWDER OR GRAPE SEED OIL EXTRACT ON PRODUCTIVE PERFORMANCE, CARCASS CHARACTERISTICS AND ECONOMIC EFFICIENCY OF BROILER CHICKS

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ABSTRACT

The aim of the present study is to evaluate the effect of grape seeds powder or its oil extract addition to the broiler diets on productive performance, carcass characteristics and economic efficiency. A total number of 150 seven day old of broiler chicks (Arbor Acres) were randomly divided into five equal experimental groups with 3 replicates of 10 birds in each for 35 day of age. The first group was served as control group without any supplementation while birds of the 2nd and 3rd groups were fed diets contained 10 and 20 g grape seed powder/ kg diet, respectively, the 4th and 5th groups were fed diets contained 100 and 200 mg grape seed oil/ kg diet, respectively. Chicks fed basal diet containing grape seed oil at 100mg/ kg had significantly highest body weight and body weight gain during experimental period compared to the control group. Chicks fed basal diet supplemented grape seed powder or grape seed oil had a significantly lower feed consumption and improved feed conversion ratio than the control group during 7-35 days of age. The highest values of net revenue, economic efficiency, relative economic efficiency and European production efficiency factor were observed with broiler chickens feed diets supplemented with low level grape seed oil group than the other experimental groups. It was concluded from the present study that grape seed powder

and grape seed oil could be used as good natural alternatives for growth promoters for growth promoters and improved the growth performance and European production efficiency factor of broiler chickens during 7-35 days of age.

Keywords: grape; Productive performance; economic efficiency; Broilers

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INTRODUCTION

Broiler production is a rapidly growing industry that faces numerous challenges such as disease outbreaks, feed costs, and environmental concerns. To address these issues, various strategies have been employed, including dietary supplementation of natural additives, such as grape seed powder and its oil extract. Grape seed powder and its oil extract have been shown to possess numerous bioactive compounds, including antioxidants, anti-inflammatory agents, and anti-microbial compounds. These compounds are known to have beneficial effects on animal health, growth, and productivity **(Chen *et al.*, 2019; Jia *et al.*, 2019; Alagawany *et al.*, 2020)**.

The primary constituents of grape seed powder and its oil extract are proanthocyanidins, catechins, quercetin, polyphenols, flavonoids, and tannins. Various studies have demonstrated that grape seed possesses antibacterial **(Ahn *et al.*, 2004)**, antioxidant **(Luther *et al.*, 2007)**, anti-inflammatory **(Carini *et al.*, 2001)**, and anticancer **(Cheah *et al.*, 2014)** properties. Dietary supplementation of grape seed powder improved the growth performance, feed efficiency, serum antioxidant capacity and immune response of broiler chickens **(Alagawany *et al.*, 2018),** improvement in the immune response, as evidenced by an increase in the serum level of immunoglobulins **(Abdel-Daim *et al.*, 2021)**. Also, grape seed oil extract or grape seed powder improved the feed conversion ratio, body weight gain and the immune response of broiler chickens **(Al-Mamun *et al.*, 2021; Mahmoud *et al.*, 2021)**. In addition, grape seed oil improvement in the meat quality of broiler chickens, including tenderness, juiciness, and flavor **(Mohammadi *et al.*, 2019)**.

Research has demonstrated that incorporating grape seed or grape pomace into broiler feed at a maximum of 3% has a beneficial impact on the growth performance, increased final body weight and average daily gain **(Gungor *et al.*, 2021)**. Similarly, the inclusion of 2% grape seed extract (GSE) in the feed also resulted in comparable outcomes, along with a reduction in feed conversion ratio (FCR) **(Abu Hafsa and Ibrahim, 2018)**. Furthermore, when broilers were given 1.5% fermented grape pomace, their final body weight increased **(Gungor *et al.*, 2021)**. In another study, the inclusion of 2.5% grape pomace led to an increase in average daily gain during the initial two weeks of the trial, although no overall effect was observed **(Erinle *et al.*, 2022)**.

Thus, the aim of this study; investigate the potential benefits of using grape seed powder or its oil extract as a dietary supplement for broiler chickens, such as improving growth performance and economic efficiency.

MATERIALS AND METHODS

The study described in this report was conducted at Privet farm located in El-Beheira Governorate, Egypt. The research was carried out in collaboration with the Department of Animal and Poultry Production at the Faculty of Agriculture, Damanhour University. The study was conducted between June to July 2021. The experiment was approved by the scientific committee of the Animal and Poultry Production Department at the Faculty of Agriculture, Damanhour University.

The treatments administered to the birds and the care procedures followed in this study were approved by the Institutional Animal Care and Use Committee at AU-IACUC (Animal Use Institutional Animal Care and Use Committee), Damanhour University, Egypt. The authors of the study affirm that the procedures conducted on the birds were in accordance with the guidelines outlined in Directive 2010/63/EU of the European Parliament and the Council of 22 September 2010, which addresses the protection of animals and birds used for scientific purposes.

Grape seed powder and grape seed oils extract

The Grape seed as a powder and grape seed oils extract were purchased commercially as dry powder was obtained from a local commercial market at Damanhour city, Egypt. This experimental diet was destined weekly and stored in airtight containers.

Broiler and experimental design

A total of 150 unsexed seven day old of broiler chicks (Arbor Acres) were acquired from a commercial hatchery (Cairo Poultry Company), wing banded and randomly divided keeping similar initial body weight with a mean body weight of 201.98±2.22g, were used in the current study. Broiler chicks were divided into 5 experimental groups (treatments) in a straight run experimental design in 15 pens with 3 replicates of 10 birds in each for a 28-day feeding trial (from 7 to 35 days of age). Each replicate was kept on floor brooders. Birds of the first group served as the control group and was fed the basal diet without any addition, while the 2nd and the 3rd groups were fed diets containing 10 and 20g grape seed as a powder, respectively, the 4th and 5th groups were fed diets containing 100 and 200mg grape seed oils extract, respectively.

All diets were formed to meet or exceed **NRC (1994)** nutrient recommendations of chickens for starter (7-21 days) and finisher (22-35 days) periods. The basal starter (Metabolizable energy 3035 Kcal/kg and crude protein 22.9%) and finisher (Metabolizable energy 3135 Kcal/kg and crude protein 20.8%) diets were formulated in Table (1).

Birds' management

In the preliminary period (1-7 days of age), all chicks obtained from a commercial hatchery were raised in one house of environmental control under thermos-neutral conditions. All chicks were housed on floor brooders, a gas heater was utilized to supply the chickens with the heat needed for brooding, in a semi-opened room and remained under the same managerial, hygienic and environmental conditions. Birds of all experimental groups were vaccinated against Newcastle and Gumboro as shown in Table (2). Ambient temperature reached 30-32ºC during the 1st week, and weekly decreased by 3ºC for the following three weeks. During the 4th and the 5th week, the temperature was maintained at 22-24ºC. A similar light schedule to commercial condition was used; 23h light from one until 7 day old, pursued by 20h light from 8 days of age to the end of the experiment at 35 days of age.

Table 1. Composition and calculated analyses of the experimental diets.

Ingredients	Starter diet, 1-21 d of age	Finisher diet, 22-35 d of age
Yellow corn, kg	490	550
Soybean meal 48% CP, kg	420	358
Di-calcium phosphate, kg	20	15
Limestone, kg	10	12.5
NaCl, kg	3	3
Vitamin+ mineral premix[1], kg	3	3
Dl-Methionine, kg	2.5	2.5
L- Lysine, kg	1.5	2.0
Vegetable oil[2], kg	50	54
Total	**1000**	**1000**
ME	3035	3135
CP	229	208
Ca	9.5	9.1
Available P	5.2	4.2
Methionine	6.0	5.6
TSAA	9.6	9.1
Lysine	13.7	12.6
Ether extra	47	48
Crude fiber	33	38
Ash	55	52
Dry matter	901	912

[1]Vit+Min mixture provides per kg of the diet: vitamin A (retinyl acetate) 24mg, vitamin E (dl-α-tocopheryl acetate) 20mg, menadione 2.3mg, Vitamin D_3 (cholecalciferol) 0.05mg, riboflavin 5.5mg, calcium pantothenate 12mg, nicotinic acid 50mg, choline chloride 600mg, vitamin B12 10μg, vitamin B6 3mg, thiamine 3mg, folic acid 1mg, d-biotin 0.50mg. Trace mineral (mg per kg of diet): Mn 80 Zn 60, Fe 35, Cu 8, Se 0.60. [2] A mixture of soybean oil, cotton seed oil and sunflower at 33.33% of each. ME, metabolic energy; CP, crude protein; Ca, calcium; TSAA, total sulfur amino acids

All birds were fed the experimental diets, *ad libtium,* and given free access to fresh water. Ingredients and chemical composition of the basal diets (% as fed basis) fed during the two phases are offered in Table 1. The average minimum, maximum temperature degree as °C and relative humidity as % during 22-35 days of age were 22 to 24°C and 53.2 to 64.5%, respectively.

Table 2. Vaccination program for broiler chickens

Vaccination	Day	Methods
Hitchiner B1 + IB	7	Water
Gumboro	14 and 24	Water
Newcastle disease virus (NDV) via Lasota	14, 20 and 30	Water

Data collection for Productive performance

During the trial period chicks were weighed (g) individually at 7, 14, 21, 28 and 35d of age and body weight gain (g/chick) was calculated. Feed consumption (FC, g/chick) was recorded for each pen and calculated for the 28 days of the experimental period from 7 to 35 days. Feed conversion ratio (FCR, g feed/ g gain) was calculated as the average of feed consumption per unit of body weight gain during the same periods.

Body weight (BW): The body weight of the growing chicks was measured at the start of the experiment (7 days old). Subsequently, their BW was recorded on a weekly basis until they reached five weeks of age. Prior to each weighing session, the chicks were deprived of feed for a period of 12 to 14 hours. However, they had continuous access to water throughout this period.

Body weight gain (BWG): To calculate the BWG of the chicks, the weight at the beginning of each period (BW_1) was subtracted from the weight at the end of the same period (BW_2) using individual records for each bird. The average BWG was determined using the following equation: $\mathbf{BWG = BW_2 - BW_1}$. In this equation, $\mathbf{W_1}$ represents the BW at the start of a specific week, and $\mathbf{W_2}$ represents the BW at the end of the same week.

Feed consumption (FC): The feed consumption of the chicks was measured on a weekly basis during specific intervals: 7-14 days, 15-21 days, 22-28 days, and 29-35 days. Additionally, the overall FC for the entire experimental period (7-35 days) was recorded for each replicate. At the beginning of the experimental period, the feed was weighed in the morning. Subsequently, the remaining feed was collected and weighed at the end of each week to determine the amount of feed consumed by each group. The average FC per chick per week was estimated using the following equation:

Average FC/ chick/ week = (Total feed consumed during the week)/ (Number of chicks in the group)

Feed conversion ratio (FCR): Feed conversion ratio (FCR) was calculated as FC/LBWG ratio in the form of units of FC required to produce one unit of LBWG, according to the following equation:

$$FCR = \frac{\text{FC (g / chick / week)}}{\text{LBWG (g / chick during the same period)}}$$

Carcass characteristics: At day 35 of age, six broiler chicks were randomly selected from each treatment group, with an equal number of males and females. These selected chicks had body weights similar to the mean BW of their respective treatment group. The purpose of this selection was to assess carcass characteristics. Before slaughter, the live BW of each bird was measured in grams. The chosen chicks were then fasted by withholding feed overnight for approximately 12 hours. After fasting, each bird was individually weighed to the nearest gram and slaughtered using the Islamic method, which involved severing the jugular veins of the neck with a sharp knife. Once bleeding was complete, the birds were scalded to facilitate feather removal. Afterward, the feathers were manually plucked, and the birds were eviscerated.

Following the removal of the head and legs, the carcasses were manually eviscerated, and their weights were recorded following the protocol outlined by **Blasco and Ouhayoun (1996)**. Afterward, the carcass was opened, and all internal organs were removed. The empty carcass and individual organs such as the liver, heart, proventriculus, gizzard, pancreas, abdominal fat and small intestine were weighed separately. Each of these components was then proportioned relative to the live weight of the bird before slaughter.

Dressing percentage included relative weights of carcass and giblet parts were estimated as a percentage of live body weight (**Attia *et al*., 2012**).

Economic efficiency

The economic efficiency of production was determined through an input-output analysis considering both the growth rate and feeding costs. It involved assessing the monetary differences in these factors. The calculation of economic efficiency involved determining the net revenue per unit of total feed costs. To determine the net revenue, the prices of the experimental diets and live BW were taken into account. These prices were based on the prevailing market prices in the local Egyptian pound (EP) market at the time of the experiment, specifically in July of the year 2021. European production efficiency factor (EPEF), profitability and cost benefit ratio were calculated by using the following formulas:

Broiler performance was evaluated using European production efficiency factor (EPEF) according to **Hubbard broiler management guide (1999)**. The equations used to calculate EPEI is as follows:

$$EPEF = \frac{(\text{Average grams gained/day} \times \text{\% survival rate}) \times 100}{\text{Feed conversion ratio} \times \text{age at the end period (day)}}$$

Statistical analysis

The statistical analysis of the data was conducted using the Generalized Linear Model (GLM) procedure in the statistical analysis software SAS Institute (Version 9.2, **SAS® 2009**). One-way analysis of variance (ANOVA) was employed to analyze the data. The statistical model used for analysis is represented by the following formula: **Yij = µ + Ti + eij**

In this formula, Yij represents the observation of the statistical measured, µ represents the overall mean, Ti represents the effect of the treatment, and eij represents the random error term associated with each observation.

To normalize the data distribution prior to analysis, an arcsine transformation was used. The Tukey's HSD (honestly significant difference) test was used to evaluate the mean difference at $P \leq 0.05$. The replicate was the experimental unit.

RESULTS AND DISCUSSION

Performance of broiler

Body weight

Table 3 shows the effect of grape seed powder (GSP) and grape seed oil extract (GSOE) on BW of Arbor Acres broilers during experimental periods (7, 14, 21, 28 and 35 days of age). Initial BW at 7 days, 14, 21 and 28 days of age did not differ among different treatment groups, but it has significant differences at 35 days of age. The results indicated that chicks fed basal diet containing GSOE at 100mg/kg had significantly highest BW (10.21%) at 35 days of age compared with the control group, GSP at 10g/ kg and GSOE at 200mg/ kg groups. However, 20g/kg GSP supplementation significantly improved the BW (5.85%) compared to the control group at 35 days of age.

Table (3): Effect of dietary grape seed powder and grape seed oil extract supplementation on body weight (BW) of broiler chicks during 7-35 days of age

Items	Control	grape seed powder		grape seed oil		SEM	P value
		10g/kg	20g/kg	100mg/kg	200mg/kg		
BW at 7 d, g	193.8	203.3	200.6	209.2	203.0	2.22	0.289
BW at 14 d, g	459.2	476.7	475.5	478.8	471.1	4.70	0.701
BW at 21 d, g	932.9	939.0	952.0	967.3	962.0	8.49	0.671
BW at 28 d, g	1532	1552	1556	1599	1598	15.86	0.594
BW at 35 d, g	2136^{c}	2189^{bc}	2261^{ab}	2354^{a}	2209^{bc}	17.30	0.001

SEM = standard error of mean; BW= body weight.

^{a,b,c} Means within a rows with different letter superscripts are significantly different based on statistical analysis (p≤ 0.05).

Body weight gain

Table 4 shows the effect of GSP and GSOE on BWG of Arbor Acres broilers during 7-35 days of age. The results indicated that there was a significant effect of GSP and GSOE supplementations on BWG during 29-35 and 7-37 days of age. The same trend of BW results was observed for BWG. However, the GSOE treatment significantly improved the BWG during 29-35 days of age. supplementation of GSOE at 100mg/ kg followed by 20g GSP/ kg recorded the significantly highest BWG (24.99% and 16.65%, respectively) compared with the other experimental groups at 29-35 d of age, while GSP group at 10g/ kg had a significantly increased BWG compared with the control and 200mg GSOE/ kg group during 29-35 days of age (5.41 and 4.24%, respectively). Meanwhile, the GSOE at 100mg/ kg groups significantly improved the BWG during 7-35 d of age compared with the other experimental groups. Furthermore, 20g/ kg GSP group had a significantly increased BWG during 7-35 d of age compared with the control and 10 g/ kg GSP groups.

Table (4): Effect of dietary grape seed powder and grape seed oil extract supplementation on body weight gain (BWG) of broiler chicks during 7-35 days of age

Items	Control	grape seed powder		grape seed oil		SEM	P value
		10g/kg	20g/kg	100mg/kg	200mg/kg		
BWG (7-14 d, g)	265.4	273.4	274.9	269.7	268.1	2.93	0.863
BWG (15-21 d, g)	473.7	462.3	476.5	488.5	490.9	4.60	0.282
BWG (22-28 d, g)	598.9	612.8	608.8	633.7	635.8	8.78	0.637
BWG (29-35 d, g)	604.2^{d}	636.9^{c}	704.8^{b}	755.2^{a}	611.0^{d}	11.01	0.0001
BWG (7-35 d, g)	1943^{c}	1986^{c}	2059^{b}	2146^{a}	2006^{bc}	16.38	0.0001

SEM = standard error of mean; BWG= body weight gain.
^{a,b,c,d} Means within a rows with different letter superscripts are significantly different based on statistical analysis ($p \leq 0.05$).

These findings align with previous studies conducted by **Pascariu *et al*., (2017), Erişir *et al*., (2018), Gungor *et al*., (2021), Noor *et al*., (2022), and Awad and Abd El-Halim (2023). Pascariu et al., (2017)** observed that the inclusion of grape seeds in the broiler diet resulted in an increase in the final BW of the birds. Similarly, **Erişir *et al*., (2018)** found that Golden quails exhibited higher live BW and BWG when their diet was supplemented with grape seeds at 10 and 20g/kg. **Gungor *et al*., (2021)** reported that the addition of grape seeds to the broiler diet led to a significant increase in BW and BWG throughout the 1-42 day period. **Noor *et al*., (2022)** demonstrated that the inclusion of 2% and 3% GSP in the broiler diet resulted in significant improvements in BW at 42 days of age and cumulative BWG. Furthermore, **Awad and Abd El-Halim (2023)** observed that broiler chicks fed diets containing grape seeds had significantly higher live BW compared to those fed a control diet at 15 and 35 days of age. Among the treated groups, the chicks fed a diet containing 1% GSP exhibited the highest live BW. The improvement in BWG followed a similar trend to the improvement in live BW in the GSP group compared to the control group during different time periods.

The observed improvement in live BW and BWG could be attributed to the enhanced digestion and absorption of nutrients from the diet. Grape seed, known for its natural antioxidants, has been found to protect intestinal mucosal cells from oxidation and pathogens, thereby reducing digestive disorders **(Kermauner and Laurenčič, 2008; Viveros *et al.*, 2011)**. According to **Aljumaili *et al.*, (2023)**, the significant improvement in production performance, particularly in live BW and BWG, can be attributed to the addition of GSOE. Aromatic oils, such as grape seed oil, are known to enhance feed palatability and stimulate the digestive system by increasing the secretion of enzymes such as trypsin, amylase, and lipase, thereby improving the digestibility of nutrients such as proteins, fats, and complex carbohydrates **(Cabuk *et al.*, 2003; Farahat *et al.*, 2017)**. Grape seed oil, rich in active compounds like phenols, flavonoids, and alkenes **(Al-Bayati, 2018)**, also contains fat-soluble vitamins such as vitamin E **(Assumpção *et al.*, 2016)**. Additionally, it contains unsaturated fatty acids that play a crucial role in growth and the development of muscle cell tissues **(Al-Nadaoui, 2003; Azeem *et al.*, 2014; Abu Hafsa and Ibrahim, 2018; Turcu *et al.*, 2021)**. Moreover, GSOE plays a significant role in regulating immune response, inflammation, and oxidative balance **(Raphael and Sordillo, 2013; Farahat *et al.*, 2017)**. These factors contribute to the overall improvement in bird performance and the observed increase in live BW and BWG. In contrast, **Nardoia (2016)** decided that GSP addition to broilers chick's diets didn't cause any change in growth traits.

Feed consumption

Data for feed consumption (FC) of broiler chicks during the experimental periods are shown in Table 5. The results indicated that there was a significant effect of different supplementations on FC during 7-14, 15-21, 22-28 and all experimental periods (7-35 days of age). However, throughout 7-14 days of age chicks fed diet containing 100mg/ kg GSOE had a significantly lowest FC compared with the other groups except 20g/ kg GSP group. But throughout 15-21 days of age chicks fed diet containing GSP or GSOE had a significantly lowest FC compared to the control group. While feed consumption during 22-

28 days of age was significantly decreased in the 200mg/ kg GSOE in comparison with the control and 20g/ kg GSP supplementation groups, while throughout 7-35 days of age; chicks fed basal diet supplemented GSP or GSOE had a significantly lower FC than the control group.

Table (5): Effect of dietary grape seed powder and grape seed oil extract supplementation on feed consumption (FC) of broiler chicks during 7-35 days of age

Items	Control	grape seed powder		grape seed oil		SEM	P value
		10g/kg	20g/kg	100mg/kg	200mg/kg		
FC (7-14 d, g)	389.3^{a}	375.7^{ab}	344.0^{cd}	325.7^{d}	356.3^{bc}	5.51	0.0001
FC (15-21 d, g)	701.7^{a}	624.0^{b}	619.0^{b}	632.7^{b}	639.7^{b}	6.73	0.0001
FC (22-28 d, g)	966.0^{a}	924.0^{ab}	976.0^{a}	937.7^{ab}	884.3^{b}	9.78	0.014
FC (29-35 d, g)	1025	1037	1032	1057	1046	5.62	0.428
FC (7-35 d, g)	3082^{a}	2961^{b}	2971^{b}	2952^{b}	2926^{b}	16.12	0.014

SEM = standard error of mean; FC= feed consumption.

^{a,b,c} Means within a rows with different letter superscripts are significantly different based on statistical analysis ($p \leq 0.05$).

Feed conversion ratio

Data for the feed conversion ratio (FCR) of broiler chicks during the experimental periods are shown in Table 6. There was a significant effect of dietary supplementations on FCR of broiler chicks during different experimental periods. During 7-14 days of age, GSOE at 100mg/ kg supplementation significantly improved FCR compared with the other experimental groups except 20g/ kg GSP. 20g/ kg GSP supplementation significantly improved FCR compared with the control and 10g/ kg GSP groups. However, during 15-21 days of age, FCR of the GSP or GSOE groups were better than the control group. Meanwhile, the group supplemented with 200mg/ kg GSOE was significantly improved FCR during 22-28 days of age than that of the control and 20g/ kg GSP groups. while throughout 29-35 days of age; chicks fed basal diet supplemented with 100mg/ kg GSOE and 20g/ kg GSP had a significantly improved FCR than the other groups. 10g/ kg GSP supplementation significantly improved FCR compared to 200mg/ kg GSOE group only during 29-35 days of age.

During 7-35 days of age, 100mg/ kg GSOE supplementation significantly utilized feed more efficiently (13.21%) followed by 20g/

kg GSP, 200mg/ kg GSOE and 10g/ kg GSP than those of the control group.

Table (6): Effect of dietary grape seed powder and grape seed oil extract supplementation on feed conversion ratio of broiler chicks during 7-35 days of age

Items	Control	grape seed powder		grape seed oil		SEM	P-value
		10g/kg	20g/kg	100mg/kg	200mg/kg		
FCR (7-14 d, g/g)	1.47[a]	1.38[ab]	1.25[cd]	1.21[d]	1.34[bc]	0.020	0.0001
FCR (15-21 d, g/g)	1.48[a]	1.36[b]	1.30[b]	1.29[b]	1.31[b]	0.020	0.002
FCR (22-28 d, g/g)	1.62[a]	1.52[abc]	1.60[ab]	1.48[bc]	1.40[c]	0.020	0.003
FCR (29-35 d, g/g)	1.70[ab]	1.63[b]	1.46[c]	1.40[c]	1.71[a]	0.030	0.0001
FCR (7-35 d, g/g)	1.59[a]	1.49[b]	1.44[b]	1.38[c]	1.46[b]	0.020	0.0001

SEM = standard error of mean; FCR= feed conversion ratio.

[a,b,c] Means within a rows with different letter superscripts are significantly different based on statistical analysis ($p \leq 0.05$).

Beneficial effects of grape seed were reported by **Tekeli *et al.*, (2014)** on FCR, with a significant improvement observed when 1.5% GSOE was included in broiler diets. Similarly, **Bander (2017)** found similar results, with improved FCR and a significant increase in average broiler BW when 1% GSOE was used in the diet. On the other hand, **Vlaicu *et al.*, (2017)** observed that supplementation of 2.5% GSOE in diets did not have a significant effect on broiler production performance throughout the entire experimental period.

Similar findings were reported by **El-Kelawy *et al.*, (2018)**, who concluded that the addition of polyphenols as natural antioxidants improved the FCR in broiler chicks. In addition, **Abu Hafsa and Ibrahim (2018)** also observed an improvement in FCR when broiler chicks were fed a diet with the addition of 20g GSP per kg. Also, **Noor *et al.* (2022)** found that FCR in broiler chicks was significantly better when 2% and 3% GSP was included in their diet. Furthermore, **Awad and Abd El-Halim (2023)** reported a reduction in FCR ($P<0.001$) in chicks fed GSP diets compared to the control group throughout the entire experimental period (1-35 days).

The improved FCR observed in this study may be attributed to the enhancement of nutrient absorption, resulting from an increase in the absorption surface area and improved functional state of intestinal cells. Additionally, the presence of natural antioxidants in grape seeds may contribute to slowing down food mass movement and passage through the gastrointestinal tract **(Kermauner and Laurenčič, 2008; Viveros *et al.*, 2011)**.

Improved FCR may be due to improving nutrients absorption as a result of increasing in the absorption surface area by enhancing the cells lining functional state of the intestines, as well as slowing food mass movement and passage through the gastrointestinal tract due to the presence of natural antioxidants in grape seeds **(Kermauner and Laurenčič, 2008; Viveros *et al.*, 2011)**. In contrary, **Aditya *et al.*, (2018)** found that adding 5 to 10g dried grape pomace/ kg broilers diet didn't occurred any changes in FCR.

Carcass characteristics

The results of carcass characteristic of broiler chickens under effect of GSP and GSOE dietary supplementation are summarized in Table 7. Different relative weights of gizzard, pancreas, intestine and abdominal fat were significantly affected at 35 days of age. Broiler chickens fed GSP or GSOE (each level) had a significantly lower gizzard percentage than the control group. Each level of GSOE groups had significantly lower pancreas percentage than the control and each level of GSP groups. Intestine percentage of high level of GSP and each level of GSOE groups decreased significantly compared with the control and low level of GSP groups. Meanwhile, the lowest abdominal fat percentage observed with low level of GSP group.

Table (7): Effect of dietary grape seed powder and grape seed oil extract supplementation on carcass characteristics of broiler chicks at 35 days of age

Items (%)	Control	grape seed powder		grape seed oil		SEM	P value
		10g/kg	20g/kg	100mg/kg	200mg/kg		
Dressing	75.60	74.53	75.83	73.63	73.40	0.380	0.146
Liver	2.39	2.44	2.15	2.29	2.27	0.051	0.435
Heart	0.356	0.389	0.327	0.343	0.345	0.008	0.179
Proventriculus	0.326	0.374	0.331	0.368	0.344	0.008	0.281
Gizzard	1.420[a]	0.927[b]	0.983[b]	0.970[b]	0.920[b]	0.060	0.028
Pancreas	0.287[a]	0.278[a]	0.276[a]	0.200[b]	0.179[b]	0.011	0.0001
Intestine	5.10[a]	5.40[a]	4.23[b]	4.30[b]	4.37[b]	0.121	0.0001
Abdominal Fat	1.21[a]	0.89[b]	1.23[a]	1.05[ab]	1.32[a]	0.045	0.014

SEM = standard error of mean.

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[a,b,c] Means within a rows with different letter superscripts are significantly different based on statistical analysis ($p \leq 0.05$).

The relative weights of eviscerated carcass and organ parts in chicks fed different GSP diets were found to be comparable to those of the control group. Generally, carcass characteristics in broilers are influenced by their growth performance **(Awad and Abd El-Halim, 2023)**. Broiler chicks that exhibit larger body sizes typically have higher percentages of carcass parts and organs, which can be attributed to their growth under favorable conditions. Studies that have reported improved carcass traits in response to dietary feed additive supplementation in poultry have also observed improvements in growth performance. These findings are consistent with **Brenes *et al.*, (2016)**, who found that adding 15 to 60 g of grape pomace per kg of diet for broilers did not affect carcass weight at 42 days of age. Similarly, the supplementation of grape pomace (5 to 10%) in broiler diets did not result in any changes in the relative weights of carcass and giblets **(Ebrahimzadeh *et al.*, 2018)**. **Hajati *et al.*, (2018)** also reported that adding grape seed extract (GSE) at levels of 150 to 450 mg/kg of diet for broilers did not have any effects on the relative weights of carcass and giblets under normal conditions. Furthermore, **Gungor *et al.*, (2021)** found that adding grape seed powder to broiler diets did not alter the relative carcass weight **(Awad and Abd El-Halim, 2023)**. In this respect, **Tekeli *et al.*, (2014)** reported that liver weight percentage decreased when broiler diets were enriched with 5 and 10 g/kg of grape seed oil.

Economic efficiency

The effect of supplementation of GSP and GSOE on final body weight, total Cost, total revenue, net revenue, economic efficiency (EE) relative economic efficiency (REF) and European production efficiency factor (EPEF) were presented in Table 8. Results indicated that the low level of GSOE group significantly improved the final body weight and total revenue during 7-35 days of age compared with the other experimental groups. Chicks fed basal diet with 20g/ kg GSP supplementation had a significantly higher total cost than the other experimental groups.

The highest values of net revenue, EE, REE and EPEF were observed with broiler chickens feed diets supplemented with low level GSOE group than the other experimental groups.

Table (8): Effect of dietary grape seed powder and grape seed oil extract supplementation on economic efficiency of broiler chicks at 35 days of age

Items	Control	grape seed powder		grape seed oil		SEM	P value
		10g/kg	20g/kg	100mg/kg	200mg/kg		
TBW, kg	2.14^{c}	2.19^{bc}	2.26^{b}	2.36^{a}	2.21^{bc}	0.02	0.0001
Total Revenue, LE	70.50^{c}	72.23^{bc}	74.53^{b}	77.77^{a}	72.87^{bc}	0.57	0.0001
Total Cost, LE	39.77^{c}	41.60^{b}	44.67^{a}	39.47^{c}	40.10^{c}	0.38	0.0001
Net Revenue, LE	30.77^{bc}	30.60^{bc}	29.87^{c}	38.33^{a}	32.83^{b}	0.67	0.0001
EE, %	77.33^{bc}	73.67^{c}	66.67^{d}	97.00^{a}	82.00^{b}	2.10	0.0001
REE, %	100.00^{bc}	95.67^{c}	86.93^{d}	126.03^{a}	106.33^{b}	2.69	0.0001
EPEF	385.0^{c}	419.7^{b}	447.7^{b}	489.7^{a}	433.7^{b}	7.66	0.0001

SEM = standard error of mean; EE= economic efficiency; REE= relative economic efficiency; EPEF= European production efficiency factor.

^{a,b,c} Means within a rows with different letter superscripts are significantly different based on statistical analysis ($p \leq 0.05$).

This result is in accordance with the previous studies of **Iqbal *et al*., (2014 and 2015)** who claimed replacement of Vit. E with GS resulted in reduced feed cost. The highest economic returns were observed in group fed high GS diet which indicated that its use is beneficial for economical broiler production. Additionally, **El-Kelawy *et al*., (2018)** demonstrated that broilers fed diets with different supplements with different levels of GS had significantly better economic efficiency and production index compared the control group. Furthermore, broilers fed diet with GS with different levels had significantly higher economic efficiency and production index than control group.

In addition, **Tag El-Din *et al*., (2019)** observed that the inclusion of grape seed (GS) in the diet at levels of 1% or 1.5% led to a decrease in total cost. Total return at 35 days of age was improved by different levels of GS compared to the control group. Overall, the net return and economic efficiency values were higher in broilers fed diets containing different levels of GS compared to the control group. Economic efficiency values were improved by 12.83%, 23.81%, and 10.90% in broilers fed diets containing 0.50%, 1%, and 1.5% GS, respectively, compared to those fed the control diet. It is evident that the addition of 1% GS to the broiler diet resulted in the highest economic efficiency throughout the entire experimental period.

Furthermore, **Awad and Abd El-Halim (2023)** noted a significant decrease in feed cost per chick by incorporating GSP in broiler diets compared to the control group, resulting in a reduction in the total cost of chicks at the end of the experiment. Feeding GSP diets led to a significant improvement in chick sales compared to the control group, and total sales followed the same trend, reflecting an improvement in net revenue for these groups throughout the experimental period. Additionally, the economic efficiency was significantly enhanced by adding GSP or GSOE to broiler diets compared to the control group, with the best economic efficiency value observed in the group fed a diet containing 100mg of GSOE. These findings can be attributed to the decrease in both feed price and feed consumption with the addition of GSOE, as well as the improvement in the final BW of the chicks.

CONCLUSIONS

It is concluded from the present study that GSP and GSOE an improved production performance and economic efficiency in broiler chicks specially GSOE at 100mg/ kg diet. Thus, GSP and GSOE are considered safe due to having no acute toxic side effects as reported through the experimental period. According to our results, GEOE could be used as a good natural alternative for growth promoters.

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الملخص العربي

تأثير مسحوق بذور العنب أو مستخلص زيت بذور العنب على الأداء الإنتاجي وصفات الذبيحة والكفاءة الاقتصادية لكتاكيت اللحم

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الهدف من هذه الدراسة هو دراسة تأثير مسحوق بذور العنب أو مستخلص زيت بذور العنب المضاف لعليقة بدارى اللحم على الأداء الإنتاجي وصفات الذبيحة والكفاءة الاقتصادية. تم توزيع عدد 150 كتكوتاً عمر سبعة أيام (أبور ايكرز) بشكل عشوائي إلى خمس معاملات متساوية بكل معاملة 3 مكررات متماثلة وبكل مكررة 10 كتاكيت لمدة 35 يوماً. المجموعة الأولى الكنترول بدون أي اضافات بينما تم تغذية الكتاكيت بالمجموعتين 2 و3 على علائق تحتوي على 10 و20جم من مسحوق بذور العنب/ كجم علف، على التوالي، وتم تغذية المجموعتين 4 و5 على علائق تحتوي على 100 و200 ملجم من زيت بذور العنب/ كجم علف، على التوالي. الكتاكيت التي تغذت على علائق تحتوي على زيت بذور العنب بمعدل 100 ملجم/ كجم علف كانت أعلى وزن للجسم وزيادة في وزن الجسم خلال الفترة التجريبية مقارنة بالكنترول. والكتاكيت التي تغذت على عليقة تحتوي على مسحوق بذور العنب أو زيت بذور العنب استهلاكت علف أقل بكثير وتحسن معدل تحويل العلف مقارنة بالكنترول خلال الفترة من 7-35 يوماً من العمر. وقد لوحظت أعلى قيم لصافي الإيرادات والكفاءة الاقتصادية والكفاءة الاقتصادية النسبية ومعامل كفاءة الإنتاج الأوروبي مع المعاملات التي تغذت على علائق تحتوي على مستوى أقل من زيت بذور العنب مقارنة بالمعاملات الأخرى. نستنتج من هذه الدراسة أنه يمكن استخدام مسحوق بذور العنب وزيت بذور العنب كبدائل طبيعية جيدة كمنشطات للنمو وتحسين الأداء الإنتاجي ومعامل كفاءة الإنتاج الأوروبي لبدارى اللحم خلال الفترة من 7-35 يوماً من العمر.