Egyptian Journal of Rabbit Science, 35(1): 85- 109 (2025)

Effect Of Using Olive Pulp Meal on Growth Performance, Nutrient Digestibility and Blood Parameters of Growing Male Rabbits

Ibtesam, A.M. Srour*[1]; Marwa, M. Bahnas[**] and M.S. Refaie[*]
[*]*Department of Poultry Production, Faculty of Agriculture, New Valley University, Egypt.*
[**]*Department of Poultry Production, Faculty of Agriculture, Fayoum University, Egypt.*
Corresponding author:ibtesamadel@gmail.com, mms15@fayoum.edu.eg; rafay1990@Yahoo.com

ABSTRACT:

The study investigated the effects of partially replacing barley with olive pulp (OP) and enzyme supplementation on the growth performance, nutrient digestibility, and economic efficiency of New Zealand White rabbits (NZW) of growing rabbits. A total of 120 male NZW rabbits, aged 4 weeks, with an average body weight of 445.7 ± 22.87 g, as experimental design followed a factorial (3 × 2) arrangement, which was randomly, divided into three groups (40 rabbits in each group): a control group (basal diet without OP) and two experimental groups receiving 5% and 10% OP, with each group further split into two sub-groups with or without enzyme supplementation (20 male rabbits in each sub group). Each sub-treatment group included five replicates, with four rabbits per replicate

The results showed that increasing OP levels negatively impacted body weight, daily weight gain, feed intake, and feed conversion ratio (FCR), particularly at 10% OP. However, enzyme supplementation improved significantly growth performance, nutrient digestibility, and feed efficiency, mitigating some of the negative effects of OP inclusion. Higher OP levels also reduced total protein, albumin, and glucose levels, while enzyme supplementation improved these parameters without affecting cholesterol levels. Additionally, OP and enzyme supplementation had no adverse effects on kidney and liver function. In terms of carcass characteristics, 5% OP showed a higher dressing percentage than 10% OP, but no significant differences were found between the control and 5% OP groups. Economic efficiency and production index declined with increasing OP levels, but enzyme supplementation enhanced nutrient utilization, leading to better economic returns.

***Conclusively,** from these results could be concluded that high OP levels negatively affected growth and digestion, enzyme supplementation improved performance, making 5% OP with enzymes a more suitable option for rabbit diets.*

***Keywords**: olive pulp, enzymes, performance, blood parameters, rabbits*

INTRODUCTION

The greatest expense in any poultry production system is feed, which can account for up to 70% of total production costs. In order to reduce feeding costs, attempts have been made to use agricultural and industrial by-products as feed ingredients. Enhanced utilization of crop residues and by-products for animal feeding deserves more attention (Zarei *et al.*, 2011).

The shortage of feed ingredients and the lack of sufficient feeds to meet the nutritional requirements of the current animal population have caused a critical problem in animal production in Egypt (Youssef *et al.*, 2001), especially nowadays as some ingredients are being used for bio-energy production. This has led to a significant problem in animal production, particularly in developing countries, including Egypt. There are some by-products that can be used as alternative feed ingredients. Olive pulp is one of these by-products, which may serve as a nutritive source.

Olive pulp is the residue of olive cake (the raw material resulting from the extraction of olive oil) after the removal of the seed fractions (Abd El-Ghani, 2000; Sadeghi *et al.*, 2009). This can be achieved by sieving the dry olive cake to separate most of the seeds, which improves its chemical composition and nutritional value (Rabayaa *et al.*, 2001). The chemical composition of olive pulp (OP) on a dry matter basis is as follows: dry matter (DM) 93.90%; crude protein 8.00%; crude fat 23.82%; crude fiber 44.23%; nitrogen-free extract 12.44%; and ash 5.41% (Farahat *et al.*, 2022). Due to its high fiber content, olive pulp is primarily suitable for ruminants. However, positive results have also been observed in non-ruminants, such as pigs and poultry (Abo Omar, 2000; Rabayaa, 2001).

Recently, the addition of several exogenous enzymes to broiler diets containing these by-products has been used to enhance fiber digestion and reduce the negative effects of phytic acid (Choct, 2006). Furthermore, the inclusion of multi-enzymes in poultry diets can increase nutrient digestibility and utilization, improve gut health, reduce anti-nutritional factors, and enhance growth performance (Cowieson, 2010; Shaw *et al.*, 2010; Attia *et al.*, 2014; El-Kelawy and El-Kelawy, 2016).

Numerous studies have shown that broiler diets containing 60 g/kg of olive pulp increase feed intake but decrease feed efficiency (Abo Omar, 2000). Moreover, the incorporation of enzymes in diets containing OP did not yield positive effects on production or egg quality (Afsari *et al.*, 2013). The addition of enzymes to rabbit diets containing 20% and 25% OP was found to lower cholesterol and increase glucose levels (Alderey *et al.*, 2023). On the other hand, the dietary inclusion of 75 g/kg of OP did not significantly affect weight gain.

Similarly, adding olive cake to broiler diets at levels up to 150 g/kg did not cause significant changes in production performance (Rabayaa, 2001; El Hachemi *et al.*, 2007). A recent study by El-Kelawy and Refaie (2024) indicated that the addition of enzymes to quail diets containing olive pomace at levels of 5% and 10% improved growth performance, nutrient digestibility, economic efficiency, and carcass traits. Additionally, Abd-Alfattah (2024) reported that feeding rabbits diets containing 20% and 25% SOP supplemented with 0.1 g/kg Econase resulted in higher growth performance, dressing percentage, total protein, albumin, globulin, A/G ratio, total antioxidant capacity, and economic efficiency.

Therefore, this study aims to determine the effect of using olive pulp meal on the growth performance, immune response, and blood parameters of growing male rabbits.

MATERIALS AND METHODS

Due to the large availability of olive pulp in the New Valley Governorate and its high nutritive value, this study was conducted to evaluate the effects of multienzyme supplementation with the partial replacement of barley grains by olive pulp in the basal diet on growth performance, blood biochemical parameters, and nutrient digestibility of weaning New Zealand White (NZW) rabbits.

A total of 120 male NZW rabbits, aged 4 weeks, with an average body weight of 445.7 ± 22.87 g, as experimental design followed a factorial (3 × 2) arrangement, which was randomly, divided into three groups (40 rabbits in each group): a control group (basal diet without OP) and two experimental groups receiving 5% and 10% OP, with each group further split into two sub-groups with or without enzyme supplementation (20 male rabbits in each sub group). Each sub-treatment group included five replicates, with four rabbits per replicate and each replicate was housed in one cage. Additionally, each group was further divided into two sub-groups: one receiving an un-supplemented diet (without enzymes) and the other receiving a supplemented diet (with enzymes). The rabbits were housed in wire cages (60 × 55 × 40 cm) equipped with galvanized feeders and automatic nipple drinkers. The experimental diets were offered *ad libitum*, and fresh tap water was available at all times. The rabbits were kept under uniform hygienic and environmental conditions throughout the experimental period. The diets were formulated to meet the nutrient requirements of rabbits according to NRC (1977). The ingredients and chemical composition of the experimental diets are shown in Table 1. During the growing period (from 4 to 12 weeks of age), live body weight,

Table 1.Ingreadients and chemical composition (%) of the experimental diets

Ingredients (%)	**Control**	5%OP	10%OP
Alfalfa meal	30.12	30.12	30.12
Wheat bran	23.33	23.33	23.33
Soya bean meal (44% CP)	17.33	17.33	17.33
Barley	15	10	5
Maize grain	11.22	11.22	11.22
Olive pulp	0	5	10
Dicalcium Phosphate	1.2	1.2	1.2
Lime Stone	1	1	1
Salt (NaCl)	0.5	0.5	0.5
Premix (Minerals & Vitamins)*	0.3	0.3	0.3
Enzyme**	0	0	0
Total	**100**	**100**	**100**
Calculated analysis ***			
Dry matter, %	87.05	87.29	87.52
Crude ash, %	6.54	6.84	7.15
Crude protein, %	18.06	18.01	17.97
Crude fat, %	2.76	3.28	3.79
Crude fiber (Weende)	12.32	13.42	14.53
NDF, %	28.52	29.97	31.42
ADF, %	15.41	16.82	18.24
ADL, %	3.35	3.3	3.26
Hemicellulose (NDF-ADF), %	13.11	13.14	13.18
Calcium, %	1.19	1.23	1.27
Phosphorus, %	0.74	0.73	0.71
Digestible Protein	13.03	12.69	12.34
Digestible energy, kcal/kg	2542	2500	2457
Metabolizable energy, kcal/kg	2313	2164	2015
Cellulose VS ADF-ADL, %	12.07	11.84	11.61

NDF: neutral detergent fiber; ADF: Acid detergent fiber; ADL: Acid detergent lignin.

*__Each kilogram contains__: Vit. A, 12,000 IU; Vit. D_3, 2,200 IU; Vit. E, 10.0 mg; Vit. K, 2.0 mg; Vit. B_1, 4.0 mg; Vit. B_2, 1.5 mg; Pantothenic acid, 6.3 mg; Vit. B_6, 1.7 mg; Vit. B_{12}, 0.03 mg; Biotin, 3.3 mg; Folic acid, 0.83 mg; Choline chloride, 200 mg; Mn, 5.00 mg; Fe, 12.5 mg; I, 0.33 mg; Se, 0.65 mg and Mg 66.79 mg.

*** The enzyme (Natuzyme P50®, Australia)** contained, per g of product, 1000,000 IU Phytase, 700 IU β-glucanase;700 IU α-amylase; 6,000 UI Cellulase; 700 IU Pectinase;10,000 IU xylanase, 30 IU lipase, and 3,000 IU protease.

***Calculated analysis (As fed basis: NRC, 1977).

(Attia *et al.*, 2012). An economic evaluation of all experimental rations was perf daily weight gain (DWG), feed consumption (FC), and feed conversion ratio (FCR) were recorded weekly. The production index was calculated as cited by formed as described by Zeweil (1996).

At 12 weeks of age, five rabbits from each experimental group were selected for the digestibility trial. A total of 24 male rabbits were individually housed in metabolic cages designed to allow complete faeces collection throughout the trial. Quantitative feces collection began 24 hours after the start of daily feeding. Feces from each rabbit were collected once daily at 9:00 AM for six consecutive days, while feed intake was recorded each morning during this period. Feces samples were stored at -20°C.

At the end of the six-day collection period, feces samples were pooled dried at 65°C for 24 hours, and ground using a 1 mm screen in a Wiley mill. A composite sample (50 g per treatment per rabbit) was prepared for analysis. Both the offered feed and the dried feces samples were chemically analyzed for crude protein (CP), ether extract (EE), crude fiber (CF), and nitrogen-free extract (NFE) according to the method of A.O.A.C. (2004).

At 12 weeks of age, five rabbits from each group were slaughtered after a 12-hour fasting period. The rabbits were then processed, and the carcass and internal organ weights were recorded and expressed as a percentage of live body weight.

During slaughter, five blood samples were collected from each group into heparinized tubes. The samples were centrifuged at 4000 rpm for 10 minutes, after which the plasma was decanted into Eppendorf tubes and stored at -20°C until biochemical analysis.All blood biochemical parameters were determined using commercial kits (Diamond Diagnostics, Egypt) according to the following methods. Plasma total protein (Doumas *et al.*, 1981), albumin (Doumas *et al.*, 1971), Plasma globulin was obtained by subtracting the concentration of albumin from that of plasma total protein. Plasma creatinine (Fabiny and Ertingshausen, 1971), urea (Sampson *et al.*, 1980), total lipids (Chabrol and Charonnat, 1973), total cholesterol (Allain *et al.*, 1974), triglycerides (Bogen and Kaller, 1987), glucose (Hyvarinen and Nikkila, 1962) and ALP (Belfield and Goldberg, 1971) as well as activities of plasma transaminase ALT and AST were measured (Reitman and Frankel, 1957).

Statistical analysis

Data were analyzed by the GLM procedure (SPSS system, 2006) using a factorial design (Three types of levels of olive pulp by two enzyme supplementation) according to Snedecor and Cochran (1982). Before analyses, arcsine transformed was done to normalize data distribution. Covariance analysis

was conducted for carcass traits data to account for variations in pre-slaughter weight among the study groups. The differences between means were tested by using Duncan's New Multiple Range test, (Duncan, 1955).

RESULTS AND DISCUSSION

Production performance:

Data growth performance presented in Tables 2 and 3 showed the effects of supplementation of multienzyme to diets contain olive pulp on live body weight and daily weight gain of weaning New Zealand White (NZW) male rabbits.

Live body weight and daily weight gain:

Rabbits in the control group exhibited the highest live body weight at 12 weeks (1756 g), which was significantly ($P<0.01$) higher than those fed diets containing 5% (1672 g) and 10% (1595 g) olive pulp as shown in Table 2. This indicates a negative impact of increasing olive pulp inclusion on final body weight. Similarly, the daily weight gain during all growth phases (4–8 weeks, 8–12 weeks, and 4–12 weeks) was significantly lower in groups receiving olive pulp compared to the control group.

Enzyme supplementation significantly ($P<0.01$) increased live body weight at 8 and 12 weeks, with enzyme-treated rabbits reaching a higher final weight (1725 g) compared to non-supplemented rabbits (1624 g). Additionally, enzyme supplementation improved daily weight gain across all growth periods, highlighting its role in enhancing feed efficiency and nutrient utilization.

A significant interaction ($P<0.01$) was observed between olive pulp levels and enzyme supplementation for all growth parameters. At 12 weeks, rabbits fed 5% olive pulp with enzyme supplementation exhibited the highest final weight (1761 g) compared to those receiving the same level without enzymes (1582 g), suggesting that enzymes mitigated the negative effects of olive pulp. At the 10% olive pulp level, enzyme supplementation improved final body weight (1649 g vs. 1541 g without enzymes), although it did not fully compensate for the negative effects of high fiber content.

Daily feed intake:

Data in Table 2 reported that control rabbits group had the highest feed intake at all stages, while increasing OP levels significantly reduced feed intake ($P<0.01$), particularly at 10% OP.

Enzyme supplementation increased feed intake, with enzyme-treated rabbits consuming significantly ($P<0.01$) more feed than non-supplemented rabbits.

Table 2: Effect of fed diets supplementation with multienzyme to diets containing olive pulp on live body weight and daily weight gain of (NZW) rabbits

Treatment	Live body weight (g) at:			Daily weight gain (g) from:		
	4 weeks	8 weeks	12 weeks	4-8 weeks	8-12 weeks	4-12 weeks
Main effects						
Olive pulp levels (OP)						
Control	447	950a	1756a	17.96a	28.79a	23.38a
5%OP	444	910b	1672b	16.65b	27.20b	21.93b
10%OP	447	865c	1595c	14.96c	26.07c	20.51c
Enzymes supplementation (Enz)						
Without	448	884b	1624b	15.57b	26.42	20.99
With Enz	444	933a	1725a	17.48a	28.29	22.88
Olive pulp levels X Enzymes supplementation						
Control	447	946a	1748a	17.79a	28.64a	23.22a
Control + Enz	447	955a	1765a	18.14a	28.94a	23.54a
5%OP	447	868bc	1582c	15.04bc	25.52c	20.28c
5%OP + Enz	441	953a	1761a	18.26a	28.88a	23.57a
10%OP	450	839c	1541c	13.89c	25.09c	19.49c
10%OP+Enz	443	892b	1649b	16.03b	27.04b	21.54b
SEM	4.890	12.157	21.334	0.420	0.534	0.347
Probabilities						
OP	0.799	0.002	0.009	0.006	0.001	0.002
Enz	0.287	0.003	0.005	0.002	0.004	0.009
OPX Enz.	0.780	0.009	0.001	0.003	0.018	0.002

a,b,c Values within a row with different superscripts differ significantly at P<0.05. Wks= Weeks

Feed conversion ratio (FCR):

Increasing OP levels resulted in poorer FCR (P<0.01), with 10% OP leading to the highest FCR (4.18) as shown in Table 3.

Enzyme supplementation significantly (P<0.01) improved FCR across all periods, reducing feed required per unit of weight gain. A significant interaction (P<0.01) was observed, where enzyme supplementation improved FCR even in diets containing 10% OP, although control diets with enzymes exhibited the best FCR.

This indicates that enzyme improved nutrient availability particularly bound in NSP molecules for growth. There was no significant effect of dietary OP (%) inclusion and enzyme supplementation on mortality rate throughout the experimental period (P >0.05).

These results support the conclusions made by Salama *et al.* (2016) who mentioned that rabbits fed diets include 30% OC plus 1% Bentonite best final BW, BWG and FCR compared to control. Furthermore, broiler fed diets containing 5 and 10% of OP plus ENZ improved final BW, BWG and FCR compared to control (Al-Harthi, 2017). Moreover, ELbaz *et al.*, (2020) who reported that inclusion OP at levels 10 and 15% enhance FCR compared with the control. Moreover, Azazi *et al.* (2020) rabbits fed diet supplemented with 10 % olive cake meal plus 0.25 sodium bicarbonate (NaHCO3) increased final body weight, total gain and daily weight gain.

The present data indicated lower feed intake when increased level of OP without ENZ could explained by the higher fiber content in OP beside the poultry´s digestive tract absences the enzymes that can digestion fiber (Petersen *et al.*, 1999). Thus, will lead to the slow movement of feed through the digestive tract leads to less feed intake (Savory& Hodgkiss, 1984).

In present results BW and BWG increased due to addition exogenous enzymes in rabbits diets improved growth performance, protein efficiency ratio, and nutrient digestibility (Abu Hafsa *et al.*, 2022). The enzyme function could contributes to the improvement of the intestinal microbial environment by reduced pH, removing pathogens bacteria, and reducing anti-nutrient contain in OP, all of which improve rabbit health and feed utilization efficiency (Elghandour *et al.*,2020& Abu Hafsa *et al.*,2022& Elghandour, 2024). On the other hand, Aboul-Ela *et al.* (2011) found that inclusion olive cake pulp up to 28% in rabbit's diets had no adverse effects on BW, BWG.

The present results conflicted with Afsari *et al.* (2013) inclusion enzymes to diets containing 100g/kg of OP was not affect on growth performance gains in laying hens. Additionally, rabbits fed diets containing 0, 20, 25 and 30% olive pulp no significant effect on BW, BWG, FC and FCR (Mehrez and Mousa, 2011). Another study by, abdeldayam (2021) found that inclusion OP with NaOH and fungi in broiler diets indicated that there were no significant affected on body weight and gain .

The apparent digestibility of the nutrients

The results for apparent digestibility of nutrients of NZW rabbits as affected by supplementation of multienzymes to diets contain olive pulp are shown in

Table 3: Effect of fed diets supplementation with multienzymes to diets containing olive pulp on daily feed intake and feed conversion ratio of (NZW) rabbits

Treatment groups	Daily feed intake (g/day)			Feed conversion ratio (g feed/g gain)		
	4 weeks	8 weeks	12 weeks	4-8 weeks	8-12 weeks	4-12 weeks
Main effects						
Olive pulp levels (OP)						
Control	57.99a	119a	88.5a	3.25c	4.14b	3.80c
5%OP	55.99b	117ab	86.5b	3.45b	4.42a	3.97b
10%OP	54.74c	116b	85.5b	3.68a	4.48a	4.18a
Enzymes supplementation (Enz)						
Without	55.371b	117b	86.1b	3.63a	4.51a	4.13a
With Enz	57.113a	118a	87.6a	3.29b	4.18b	3.84b
Olive pulp levels X Enzymes supplementation						
Control	57.72a	118a	88.0ab	3.26d	4.14b	3.80d
Control + Enz	58.27a	120a	89.0a	3.23d	4.14b	3.79d
5%OP	53.85b	114c	84.2c	3.69b	4.69a	4.16b
5%OP + Enz	58.14a	120a	88.9a	3.20d	4.15b	3.78d
10%OP	54.55b	118ab	86.2bc	3.93a	4.71a	4.43a
10%OP+Enz	54.93b	115bc	84.9c	3.43c	4.25b	3.94c
SEM	0.430	1.125	0.755	0.058	0.135	0.030
Probabilities						
OP	0.006	0.051	0.001	0.001	0.032	0.001
Enz	0.002	0.208	0.020	0.009	0.003	0.002
OPX Enz.	0.007	0.001	0.004	0.006	0.096	0.003

a,b,c Values within a row with different superscripts differ significantly at $P<0.05$.

Table 4. Increasing OP levels (10%) significantly reduced crude protein (CP), crude fiber (CF), nitrogen-free extract (NFE), total digestible nutrients (TDN), and digestible energy (DE) ($P<0.05$). However, Enzyme supplementation significantly improved CP (72.96% vs. 67.32%), CF (24.56% vs. 21.46%), NFE, TDN (80.38% vs. 77.08%), and DE (2461 kcal/kg vs. 2358 kcal/kg) ($P<0.01$), enhancing overall feed utilization. Also, the best nutrient digestibility and energy efficiency were observed at 5% OP with enzyme supplementation.

This observation is consistent with the findings of Abd El-Galil *et al.* (2017) who found that decreased digestibility coefficients of CP, CF, NFE, DCP, TDN (%) and ME (kcal/kg) in growing hens when addition OPM more than 8% in

Table 4: Effect of fed diets supplementation with multienzyme to diets containing olive pulp on apparent nutrients digestibility of (NZW) rabbits

Treatment	Apparent nutrients digestibility (%):				Nutritive value as		
	CP	EE	CF	NFE	TDN	DE (kcal/kg DM)	DEC
Main effects							
Olive pulp levels (OP)							
Control	71.64a	71.24	25.33a	76.76a	81.02a	2489a	67.94a
5%OP	71.14a	67.53	22.84b	76.32a	78.82ab	2422a	66.24a
10%OP	67.65b	67.62	20.85b	73.31b	76.35b	2319b	63.46b
Enzymes supplementation (Enz)							
Without	67.32b	68.86	21.46b	74.47b	77.08b	2358b	64.45b
With Enz	72.96a	68.73	24.56a	76.45a	80.38a	2461a	67.31a
Olive pulp levels X Enzymes supplementation							
Control	69.50	71.99	25.49a	75.38	79.76	2456	66.95
Control + Enz	73.77	70.49	25.17ab	78.13	82.27	2522	68.93
5%OP	67.11	67.92	19.28c	75.37	76.23	2335	63.77
5%OP + Enz	75.17	67.15	26.40a	77.27	81.42	2509	68.71
10%OP	65.35	66.69	19.60c	72.68	75.25	2284	62.64
10%OP+Enz	69.95	68.55	22.09bc	73.95	77.46	2353	64.28
SEM	1.450	2.784	1.071	0.999	1.559	36.183	0.974
Probabilities							
OP	0.022	0.332	0.001	0.004	0.022	0.004	0.005
Enz	0.000	0.954	0.002	0.023	0.016	0.002	0.001
OPX Enz.	0.366	0.819	0.007	0.761	0.582	0.247	0.197

a,b,c Values within a row with different superscripts differ significantly at P<0.01.
CP= Crude protein; CF= Crude fiber; NFE= Nitrogen free extract; EE= Ether extract; TDN =Total digestible nutrients; DG=Digestible energy; DGC = Digestible energy coefficient

the diet.in the same trend was found by abdeldayam (2021) found that decrease in CP, CF, NFE, DCP, TDN (%) and ME (kcal/kg).Whereas, Ether extract (%) exhibited increase in broiler fed diets containing OP. The reduction in digestion coefficients in OP without enzyme may be attributed to tannin and lignin content of olive pulp, olive pulp contains 1.4% tannins Martin *et al.* (2003). Moreover, Youssef (2009) and Mehrez and Mousa(2011) indicated that increased level of OP without ENZ in rabbits diets decreased nutrients digestibility may be due to have high content tannins and lignin beside high content of ADL and ADF.

Additionally, Mehrez and Mousa (2011) found that the replacement of olive cake with barley grains (20%, 25%, or 30%) in the rabbit diet led to an increase in EE. The improvement in digestibility of the nutrients may be the addition exogenous enzymes and yeast in rabbit diets might have improved gut health and ecology, which sustained better nitrogen utilization and improved growth performance (Elghandour *et al.*, 2020&Helal *et al.*, 2021). Also, econase enzyme supplementation in diet containing OP higher degradation of CF and decrease in CF content and an increase in CP content (Abid *et al.*,2023).

Another finding supported by Abd-Alfattah, (2024) who found that supplementation econase and yeast in rabbits diet containing sieved olive pulp had improved digestibility of nutrients. Also, supplementing olive cake with enzymes helps in breaking down these antinutritional factors, enhancing the availability of nutrients for digestion and absorption in birds (Brenes *et al.*, 2016).

Blood chemical constituents:

Effect on blood protein and lipid profile

The results for blood parameters of NZW rabbits as affected by supplementation of multienzyme to diets contain olive pulp are shown in Table 5 and 6. Increasing olive pulp levels significantly reduced total protein ($P<0.01$) from 5.86 g/dl in the control to 4.91 g/dl at 10% OP. Also, Albumin levels were also significantly reduced ($P<0.01$), with the lowest value recorded at 10% OP (2.90 mg/dl). On the other hand, Enzyme supplementation improved both parameters, increasing T.P (5.62 g/dl vs. 5.26 g/dl, $P<0.05$) and Alb. (3.41 mg/dl vs. 3.13 mg/dl, $P<0.05$).

Glucose levels decreased with increasing OP levels ($P<0.01$), with the lowest value at 10% OP (97.2 mg/dl). However, Enzyme supplementation significantly improved glucose levels (104.5 mg/dl vs. 100.6 mg/dl, $P<0.01$), suggesting better energy metabolism. On the other hand, no significant differences were observed in cholesterol levels across treatments ($P>0.05$).

Triglyceride levels slightly decreased with increasing OP ($P<0.05$), with the lowest value at 10% OP (122 mg/dl). However, Enzyme supplementation improved triglyceride levels (125 mg/dl vs. 122 mg/dl, $P<0.01$).

Effect on kidney and liver function

Urea levels significantly decreased with higher OP levels ($P<0.05$), with the lowest value recorded at 10% OP (16.3 g/dl). However, Enzyme supplementation slightly increased urea levels (17 g/dl vs. 16.6 g/dl, $P>0.05$), indicating improved nitrogen metabolism. On the other hand, Creatinine levels showed no significant differences across treatments ($P>0.05$), suggesting no adverse effects on kidney function.

Aspartate amino transferase and ALT levels remained stable across treatments (P>0.05), indicating that olive pulp inclusion did not affect liver function. Also, Alkaline phosphatase (Alk.ph.) levels increased slightly with 10% OP, but enzyme supplementation lowered its levels, suggesting improved liver efficiency.

These findings are in harmony with prior research conducted by Bakr *et al*. (2019) reported that including of olive cake pulp in rabbit diets up to 25% resulted in decreased Glucose and triglycerides compared to the control. The decrease in glucose and triglycerides may be linked to the presence of phenolic compounds and saponins in olive cake pulp.

The same trend was found by Azazi *et al*. (2018) illustrated that growing rabbits fed a diet containing 10% olive cake without or with 0.1% citric acid had lower triglyceride levels than the other treatment. According to Mousa and Abd El- Samee (2002), the inclusion of olive pulp in growing rabbit 'diets had no significant influence on the experimental groups' serum globulin, creatinine, AST, and ALT concentrations. The same trend was noticed by Mehrez and Mousa (2011), who found that concentrations of G, cholesterol, urea-N, AST and ALT did not differ significantly with olive pulp inclusion in rabbit diets at levels up to 30%. Hassan *et al.* (2016) cited that ALT, AST, and urea concentrations were not affected by feeding Mamora cocks olive cake was used up to 16%. According to Al-Harthi *et al*. (2020), plasma triglycerides were significantly reduced by adding phytase to 10% and 15% olive cake in broiler chicken diets. Also, El-Kelawy and El-Shafey (2017), found that kemzyme supplementation to rabbits diets did not significantly affect cholesterol, creatinine, AST and ALT.

Another study by El-Katcha *et al*. (2017) noted that addition enzyme to broiler diets had no significant effect on blood serum AST and ALT beside cholesterol and triglyceride.

The Improvement in hematological parameters due to exogenous enzymes could be increased digestibility different of feed components, including fiber, phytate, protein, non-starch polysaccharides (NSP) and broken dawn to smaller polymers to reduce their anti-nutritive effects (Choct and Annison 1992).

Table 5: Effect of fed diets supplementation with multienzyme to diets containing olive pulp on blood protein and lipid profile parameters of (NZW) rabbits.

Treatment	T.P (g/dl)	Alb. (mg/dl)	Globulin (mg/dl)	A/G ratio	Glucose (mg/dl)	Cho. (mg/dl)	Tri.
Main effects							
Olive pulp levels (OP)							
Control	5.86a	3.60a	2.27	1.65	107.7a	97.2	125a
5%OP	5.56a	3.30b	2.25	1.6	102.8b	96.2	123ab
10%OP	4.91b	2.90c	2.01	1.53	97.2c	96.5	122b
Enzymes supplementation (Enz)							
Without	5.26b	3.13b	2.14	1.53	100.6b	97	122b
With Enz	5.62a	3.41a	2.22	1.65	104.5a	96.2	125a
Olive pulp levels X Enzymes supplementation							
Control	5.78	3.56	2.22	1.63	107.9a	98.2	123b
Control + Enz	5.94	3.65	2.32	1.66	107.4a	96.3	127a
5%OP	5.18	2.96	2.22	1.4	98.8b	96.3	121b
5%OP + Enz	5.93	3.64	2.29	1.79	106.9a	96	125ab
10%OP	4.82	2.86	1.96	1.56	95.2c	96.6	121b
10%OP+Enz	4.99	2.94	2.05	1.51	99.3b	96.4	122b
SEM	0.175	0.102	0.269	0.274	6.03	4.66	7.44
Probabilities							
OP	0.001	0.002	0.465	0.892	0.008	0.533	0.04
Enz	0.028	0.025	0.663	0.53	0.002	0.31	0.009
OP X Enz.	0.22	0.075	0.998	0.618	0.003	0.602	0.39

a,b,c Means in the same row followed by different letters are significantly different at($P \leq 0.05$); Sig.= Significantly; SEM= Standard error of mean; T.P=Total Protein; Alb= Albumin; Glo=Globulin; Cho.=Cholesterol; Tri.= Triglycerides;

Table 6: Effect of fed diets supplementation with multienzyme to diets containing olive pulp on kidney and liver function of (NZW) rabbits

Treatment	Urea (g/dl)	Creatinine (g/dl)	AST (IU/L)	ALT (IU/L)	AST/ALT ratio	Alk.ph. (IU/L)
Main effects						
Olive pulp levels (OP)						
Control	17.1a	0.896	54.7	66.2	0.828	12.2
5%OP	17.1a	0.834	54.5	65.9	0.828	12.3
10%OP	16.3b	0.858	55.8	66	0.847	13.1
Enzymes supplementation (Enz)						
Without	16.6	0.859	55.1	66.1	0.834	13.2
With Enz	17	0.867	54.9	65.9	0.835	11.9
Olive pulp levels X Enzymes supplementation						
Control	17.2	0.908	55.5	66.7	0.834	12.6
Control + Enz	17.1	0.884	53.9	65.6	0.822	11.8
5%OP	16.7	0.824	54.1	65.2	0.831	13.6
5%OP + Enz	17.5	0.844	54.9	66.6	0.825	11
10%OP	15.9	0.844	55.6	66.5	0.838	13.4
10%OP+Enz	16.6	0.872	55.9	65.4	0.857	12.8
SEM	0.642	0.011	5.067	8.042	5.100	0.003
Probabilities						
OP	0.034	0.422	0.564	0.965	0.654	0.506
Enz	0.146	0.836	0.881	0.77	0.98	0.062
OPX Enz.	0.382	0.837	0.618	0.393	0.801	0.43

a,b,c Means in the same row followed by different letters are significantly different at($P \leq 0.05$); Sig.= Significantly; SEM= Standard error of mean; Alk.ph.= Alkaline phosphates; RBC's =Red blood cells; WBC's= White blood cells; AST=aspartate amino transferees; ALT=alanine amino transferees.

Carcass characteristics:

The results for carcass characteristics of NZW rabbits as affected by supplementation of multienzyme to diets contain olive pulp are reported in Table 7. The 5% OP group showed a significantly higher dressing percentage ($P<0.01$) compared to the 10% OP group.

However, no significant difference was found between the control and 5% OP groups. On the other hand, no significant changes ($P>0.05$) were observed in the liver, heart, kidney, lungs, stomach, intestines, abdominal fat, spleen, pancreas, and cecum across all treatments. This indicates that olive pulp and enzyme supplementation did not negatively impact organ weights or gastrointestinal development. Although enzyme supplementation did not significantly alter dressing percentage, it could potentially enhance nutrient digestibility, improving feed efficiency and overall carcass yield.

In harmony with the obtained results of carcass characteristics, Azazi et al. (2020) who mentioned that rabbits fed 10 % olive cake meal inclusion 0.25 or 0.50% sodium bicarbonate (NaHCO3) had the highest of carcass (%) compared with the treatments.

Similarly, Salama *et al*. (2016) showed that there were significant effects on carcass traits by olive cake inclusion in rabbits diets. Moreover, inclusion EY in rabbits diets containing 20% and 25% OP increased the dressing percentage (Abd-Alfattah 2024). The same trend was found by Abdel-Moneim *et al*., (2024) found that broiler fed diets containing 10%OP plus *Aspergillus awamori* enhancing carcass percentage.

The addition ENZ could be improving nutrient digestibility by altering gut morphology and gut microbial content leading to improved nutrient digestion and absorption as a result enhanced FCR and dressing weight (Elghandour *et al*., 2020 and Abu Hafsa *et al*., 2022).

However, there was no significant effect of inclusion of olive pulp in rabbits diets at levels (15, 20 and 25%) on all carcass traits Bakr *et al*., (2019). Also, olive pulp incorporation in rabbits diets up to 28% exhibited there was no significant improvement for carcass traits (Aboul-Ela *et al*. 2011).

Table 7: Effect of fed diets supplementation with multienzyme to diets containing olive pulp on carcass traits of (NZW) rabbits

Treatment	Dressing (%)	Heart (%)	Liver (%)	Kidny (%)	lungs (%)	Stomach (%)	Intestinal (%)	Abdominal fat (%)	Spleen (%)	Pancreas (%)	Cecum (%)
Main effects											
Olive pulp levels (OP)											
Control	71.92a	0.542	3.822	0.946	0.745	3.05	3.898	1.758	0.079	0.179	6.604
5%OP	72.29a	0.499	4.004	0.994	0.779	2.994	3.636	1.587	0.09	0.224	6.819
10%OP	69.14b	0.546	4.122	0.962	0.823	3.242	4.356	1.547	0.074	0.18	7.392
Enzymes supplementation (Enz)											
Without	70.89	0.546	4.022	0.979	0.803	3.117	4.31	1.562	0.083	0.183	7.363
With Enz	71.35	0.513	3.943	0.956	0.762	3.074	3.616	1.7	0.079	0.207	6.514
Olive pulp levels X Enzymes supplementation											
Control	71.45	0.565	3.749	0.943	0.746	3.032	4.234	1.744	0.078	0.165	6.693
Control + Enz	72.38	0.519	3.896	0.95	0.745	3.068	3.562	1.772	0.08	0.194	6.514
5%OP	71.27	0.523	3.949	1.022	0.808	2.886	4.312	1.367	0.099	0.222	7.269
5%OP + Enz	73.31	0.475	4.059	0.966	0.75	3.102	2.959	1.807	0.082	0.226	6.37
10%OP	69.94	0.549	4.369	0.973	0.856	3.432	4.385	1.575	0.073	0.161	8.128
10%OP+Enz	68.34	0.544	3.874	0.952	0.79	3.051	4.326	1.52	0.075	0.2	6.656
SEM	0.898	0.039	0.347	0.057	0.075	0.355	0.653	0.133	0.011	0.029	0.72
Probabilities											
OP	0.003	0.423	0.689	0.702	0.588	0.768	0.545	0.264	0.311	0.23	0.536
Enz	0.538	0.306	0.782	0.62	0.505	0.883	0.205	0.217	0.615	0.318	0.161
OPX Enz.	0.138	0.827	0.59	0.862	0.894	0.694	0.618	0.161	0.592	0.822	0.672

a, b Values within a row with different superscripts differ significantly at $P<0.05$.

Economic efficiency and production index

The results for economic efficiency of NZW rabbits as affected by supplementation of multienzyme to diets contain olive pulp are summarized in Table 8. Total cost decreased with increasing OP levels ($P<0.01$), with the lowest cost recorded at 10% OP.

However, total revenue also declined with higher OP levels, with the control group achieving the highest revenue. Net revenue and economic efficiency were significantly higher ($P<0.01$) in the control group compared to 5% and 10% OP groups. On the other hand, Enzyme supplementation significantly improved economic efficiency (62.63% vs. 58.73%, $P<0.01$) by enhancing nutrient utilization and growth performance.

The production index (%) significantly declined with increasing OP levels ($P<0.01$), indicating that high fiber content may limit growth performance. On the other hand, Enzyme supplementation significantly improved the production index (50.05 *vs.* 44.12, $P<0.01$), suggesting its role in enhancing feed efficiency and overall productivity.

The present results are supported with obtained by Araujo *et al.*, (2014) found that addition of enzymes to diets with fibrous oil industry byproducts may have improved economic efficiency. Moreover, enzyme supplementation in rabbits diets reduce the feed costs related with poultry production (Choct, 2006). Similarly Feeding growing rabbits on diets containing 15, 20 and 25% olive cake pulp decreased the feed cost and improved economic efficiency (Bakr,2019). Furthermore, El-Kelawy and Refaie (2024) mentioned that quail fed diets contained 5% or 10% olive pomace with EZ had reduced feed cost and improved economic efficiency.

Additionally, Fed broiler diets containing 5, 10, or 15% of olive pulp reduced feed cost and enhance economic efficiency compared to control group (Elbaz et al,.2020).Moreover, broiler fed diets inclusion OP treated with the fungi and NaOH decreased the feed cost and increased the net return beside enhance economic efficiency (Abdeldayam,2021). Another study by Abd-Alfattah (2024)feeding growing rabbits on 20% and 25% SOP diets supplemented with enzyme and yeast decreased the feed cost and increased economic efficiency.

Table 8: Effect of fed diets supplementation with multienzyme to diets containing olive pulp on economic efficiency and production index digestibility of (NZW) rabbits

Treatment groups	Total cost	Total revenue	Net revenue	Economic efficiency	Production index
Main effects					
Olive pulp levels (OP)					
Control	43.13a	70.44a	27.31a	63.45a	51.48a
5%OP	36.46b	58.52b	22.05b	60.23b	47.16b
10%OP	35.23c	55.84c	20.60c	58.35b	42.62c
Enzymes supplementation (Enz)					
Without	35.75b	56.83b	21.08b	58.73b	44.12b
With Enz	40.80a	66.37a	25.56a	62.63a	50.05a
Olive pulp levels X Enzymes supplementation					
Control	37.18b	61.16b	23.98b	64.34a	51.25a
Control + Enz	49.08a	79.72a	30.64a	62.57a	51.71a
5%OP	35.27c	55.38cd	20.12d	56.90b	42.40c
5%OP + Enz	37.66b	61.65b	23.99b	63.57a	51.92a
10%OP	34.80c	53.95d	19.15d	54.94b	38.71d
10%OP+Enz	35.67c	57.73c	22.06c	61.77a	46.52b
SEM	0.526	1.041	0.630	1.250	0.941
Probabilities					
OP	0.003	0.001	0.004	0.004	0.004
Enz	0.002	0.004	0.003	0.003	0.002
OPX Enz.	0.002	0.007	0.010	0.010	0.001

a,b,c Values within a row with different superscripts differ significantly at $P<0.05$.

IN CONCLUSION.

From these results could be concluded that including up to 5% olive pulp with enzyme supplementation enhances growth and feed efficiency, while higher levels (10%) impair performance. To maximize productivity, olive pulp should not exceed 5%, with enzymes mitigating fiber-related drawbacks.

REFERANCES

A.O.A.C. (2004). *Association of Official Analytical Chemists*. International: Official Methods of Analysis of AOAC International. 18th edition, AOAC International, Gaithersburg, MD, USA.

Abd El-Galil, K.; Mona, M. H.; Henda, A. M. ; Abu El-Soud, K.M. and Abd El-Dayem, A.A. (2017). Utilization of olive pulp meal as a non-traditional feedstuff in growing local hens feeding under desert conditions. *Egypt. Poult. Sci*. Vol 37 (IV): 1237-1248.

Abd El-Ghani, E.A.D. (2000). Utilization of olive pulp in broiler rations. *Master Thesis.* An Najah National University. Nablus, Palestine.

Abd-Alfattah, A. A. ; El-Kassas, N. E.M. ; Hussein, E. A. ; Farag , S. A. ; Hassan , A. A. ; Atia , E.S. ;Manal, H.A. G.; Eman S. E. and Salma H. A.(2024). Impacts of enzymes and probiotic in improving the utilization of sieved olive pulp meal in growing rabbit diets. *J. Adv. Vet. Anim. Res*., 11(1): 161–170.

Abdeldayam, A.A. (2021). Utilization of Untreated and Treated Olive Pulp Meal in Feeding Broiler Chicks. *J. of Animal and Poultry Production, Mansoura Univ.*, Vol 12 (10.

Abdel-Moneim E. A. M.; Raafat, S. K.; Aml, M. M. B.; Shimaa, A. A.; Badri, F. B. ; Ghada, G. G; Thabet, H. A. and Elbaz, A. M.(2024). Efficacy of supplementing *Aspergillus awamori* in enhancing growth performance, gut microbiota, digestibility, immunity, and antioxidant activity of heat-stressed broiler chickens fed diets containing olive pulp. *BMC Veterinary Research*. 20:205.2:11.

Abid, K; Jabri, J; Yaich, H; Malek, A; Rekhis, J and Kamoun, M. (2023).Bioconversion of alperujo into an alternative feed for ruminants by pretreatment with live yeasts and/or exogenous fibrolytic enzymes. Environ *Sci Polluter Res Int*; 30(23):64747–54; https://doi.org/10.1007/ s11356-023-27056-4

Abo Omar, J.M. (2000). The effect of different levels of olive pulp on the feed intake and digestibility of broilers. Bethlehn University Journal;19:97-100.

Aboul-Ela, S. S.; Ali, F. A. F.; Madi, A. and El-Naby, M. R. A. (2011). Olive cake meal as partial orcomplete substitute for clover hay in growing rabbit diets. *Egyptian Journal of Nutrition and Feeds*. 14; 109-119.

Abu Hafsa, S.H.; Mahmoud, A.E.M.; Fayed, A.M.A. and Abdel-Azeem, A. S.(2022). The effect of exogenous lysozyme supplementation on growth performance, caecal fermentation and microbiota, and blood constituents in growing rabbits. *Animals*; 12(7):899; https:// doi.org/10.3390/ani12070899

Afsari, M.; Mohebbifar, A.; Torki, M. (2013). Effects of phytase supplementation of low phosphorous diets included olive pulp and date pits on productive performance of laying hens, egg quality traits and some blood. *Parameters Annual Review & Research in Biology*;3(4):777-793.

Alderey, A. A.; Hussein, E. A., and El-Kassas, N. E. (2023). Impacts of enzymes and probiotic in improving the utilization of sieved olive pulp meal on reproductive performance and some blood traits of rabbit bucks. *Egyptian J. Nutrition and Feeds (2023), 26(3):329-342.*

Al-Harthi, M. (2017). The effect of olive cake, with or without enzymes supplementation, on growth performance, carcass characteristics, lymphoid organs and lipid metabolism of broiler chickens. *Brazilian Journal of Poultry Science*,19:83–90.

Al-Harthi, M. A.; Y. A. Attia; A. S. El-Shafeyb and M. F. Elgandy (2020). Impact of phytase on improving the utilization of pelleted broiler dietscontaining olive by products. *Italian J. of Anim. Sci.,* Vol. 19, No. 1, 310–318 https://doi.org/10.1080/1828051X.2020.17408.

Allain, C. C., Poon, L. S., Chan, C. S. G., Richmond, W., & Fu, P. C. (1974). Enzymatic determination of total serum cholesterol. *Clinical Chemistry*, *20*(4), 470-475.

Amaravadhi, S. C.; Mallam, M.; Manthani, G. P. and Komireddy, K. R. (2012). Effect of dietary supplementation of probiotics and enzymes on the haematology of rabbits reared under two housing systems. *Vet. World*, Vol. 5(12): 748-753.

Araujo, W.A.G; Albino, L.F.T;Rostagno, H.S; Hannas, M.I; Pessoa, G.B.S and Messias R.K.G.(2014). Sunflower meal and enzyme supplementation of the diet of 21- to 42-d-old broilers. *Brazilian Journal of Poultry Science;*16:17-24.

Attia, Y.A.; El-Tahawy, W.S.; Abd El-Hamid, A. E.; Nizza, A.; Bovera, F.; Al-Harthi, M. A. and El-Kelawy, M.I. (2014). Effect of feed form, pellet diameter and enzymes supplementation on growth performance and nutrient digestibility of broiler during days 21-37 of age. *Archiv Tierzucht*, 57(34): 1-11.

Attia, Y.A.; El-Tahawy, W.S.; Abd El-Hamid, A.E.; Hassan, S.S.; Nizza A. and El-Kelaway, M. I. (2012). Effect of phytase with or without multienzyme supplementation on performance and nutrient digestibility of young broiler chicks fed mash or crumble diets. *Italian Journal of Animal Science*, 11: 303-308.

Azazi, I. A.; Abd EL-Haliem, H. S.; Gadelrab, S.; EL-Komy, H. M. ; Ahmed, A. S. and Ouda, M. M. M. (2020). Influence of using olive cake meal with or without sodium bicarbonate on productive performance of growing New Zealand white rabbits. *Egypt J. Anim. Prod*., 57(1):43-51.

Azazi, I. A.; S. Gadelrab; H. A. EL-Komy and A. S. Ahmed (2018). Growth performance and feed utilization of growing rabbits fed diets containing olive cake meal supplemented with or without citric. *Egypt J. of Rabbit Sci.*, 28 (2): 241 -262.

Bakr, E. O. A.; Shetaewi, M. M. and El- Desoky, A. E. M. I. (2019). Effect of olive cake pulp as a partial or a complete substitute of wheat bran in growing rabbits' diet on growth performance, carcass traits and blood constituents under north Sinai conditions. *J. Anim. and Poult. Prod*., Mansoura Univ., Vol.10, (3): 83 - 88.

Belfield, A., & Goldberg, D. M. (1971). Revised assay for serum phenyl phosphatase activity using 4-amino-antipyrine. *Enzyme, 12*(5), 561-573.

Bogen, L., & Kaller, H. (1987). Kinetic enzymatic method for automated determination of triglycerides in serum. *Clinical Chemistry, 33*(9), 1433-1436.

Brenes, A., Marquardt, R. R., Guenter, W., and Viveros, A. (2016). Enzyme supplementation to improve the nutritional value of poultry diets containing barley. *World's Poultry Science Journal*, 72(1), 77- 88.

Chabrol, E. and Charonnat, R. (1973). Determination of plasma total lipids. *Press Medical*, 45: 17131720.

Choct, M. and Annison, G. (1992).The inhibition of nutrient digestion by wheat pentosans. *Br. J. Anim. Nutr*., 67: 123-132.

Choct, M.(2006). Enzymes for the feed industry:past, present and future. *World's Poultry Science Journal;*62 (1):5-16.

Cowieson, A. (2010). Strategic selection of exogenous enzymes for corn/soy-based diets by laying hens. *Italian Journal of Animal Science*;14(3):394- 402.

Doumas, B. (1971). Colorimetric determination of serum albumin. *Clinical Chimica Acta*, 31: 400-403

Doumas, B. T., Watson, W. A., & Biggs, H. G. (1981). Albumin standards and the measurement of serum albumin with bromcresol green. *Clinica Chimica Acta, 31*(1), 87-96.

Duncan's, D.B. (1955). Multiple range and multiple F tests. Biometrics, 11: 1-42. Jain, N.C 1986. Schalm's Veterinary Hematology, 4th ed . Lea and Febiger, Philadelphia, USA, pp. 140-175.

El Hachemi, A.; EL Mecherfi, K.E.; Benzineb, K.; Saidi, D.; Kheroua, O. (2007). Supplementation of olive mill wastes in broiler chicken feeding. *Afr. J. Biotechnol*., 6, 1848–1853.

ELbaz, A. M.; Thabet, H. A. and Ghada, G. G.(2020). Productive and Physiological Performance of Broilers Fed Diets Containing Different Levels of Olive Pulp. *J. of Animal and Poultry Production*, Mansoura Univ., Vol, 11 (11): 435 – 439.

Elghandour, M.M.Y.(2024). Prospect of yeast probiotic inclusion enhances livestock feeds utilization and performance: an overview. *Biomass Convers Bioref;* 14(3): 2923–2935: https://doi.org/10.1007/ s13399-022-02562-6

Elghandour, M.M.Y.; Khusro, A.; Adegbeye, M.J.; Tan, Z; Abu Hafsa, S.H. and Greiner, R.(2020). *Saccharomyces cerevisiae* as a probiotic feed additive to non and pseudo-ruminant feeding: a review. J. Appl. Microb.; 128(3):658–74; https://doi.org/10.1111/jam.14416

El-katcha, M., Soltan, M.A. & El-badry, M., 2017. Effect of Dietary Replacement of Inorganic Zinc or Organic Nano-particles Sources on Growth Performance, Immune Response and Intestinal Histopathology on Broiler Chicken. *Alexandria Journal of Veterinary Sciences*. 55 (2), 129 – 145.

El-Kelawy, M. I. and El-Shafey, A. S. (2017). Effect of adding of enzyme complex (kemzyme) to diet containing date stone meal on blood parameters, immune response, microbial activity and carcass characteristics of growing rabbits. *Egypt J. of Rabbit Sci., 27* (2): 485- 506.

El-kelawy. M. and Refaie, M. S. (2024). Effect of olive pomace and enzymes on productive performance, nutrients digestibility and some blood parameters in japanese quail. *Egyptian J. Nutrition and Feeds*, 27(1): 107- 118.

El-Kelawy; H. M. and El-Kelawy, M. I. (2016). Impact of dietary supplementation with multi enzyme and/or probiotic on growth performance, nutrients digestibility and blood constituents of growing rabbits. *Egypt J. Nutr. and Feeds,* 19 (2): 313-323.

El-Kerdawy, D.M.A. (1997). Olive pulp as a new energy source for growing rabbits. *Egyptian Journal of Rabbits Science*, 7 (1): 1-12.

Fabiny, D.L. and Ertingshausen, G. (1971) Automated reaction-rate method of serum creatinine with the centrifichem. *Clinical Chemistry*, 17(8):696–700.

Farahat, M. A. A.; Mohamed, F. A. ; Shoukry, H. M. S. and Hammad, A. M. S..(2022). Effect of using olive pulp supplemented with or without sodium bentonite supplementation on productive performance of broilers. *Al-Azhar Journal of Agricultural Research*, 47(2): 159-170.

Hassan, A. M.; A. S. Morsy; K. R. S. Emam and K. Abd El-Galil (2016). Physiological responses and semen characteristics of male chickens fed olive cake under south Sinai conditions. *J. Basic Sci. Appl. Res*., 1(4)1-10.

Helal F; El-Badawi, A and El-Naggar, S.(2021). Probiotics role of *Saccharomyces cerevisiae* and Bacillus subtilis in improving the health status of rabbits' gastrointestinal tract. *Bull Natl Res Cent*; 45:66; https://doi. org/ 10.1186/ s42269-021-00522-0

Hyvarinen, L., & Nikkila, E. A. (1962). Specific colorimetric method for determination of blood glucose. *Clinical Chemistry, 8*(5), 431-441.

Jain, N.C 1986. Schalm's Veterinary Hematology, 4th edn. Lea and Febiger, Philadelphia, USA, pp. 140-175.

Kurtong, D. A. (2014). Performance of weaner rabbits fed maize husk based diets with and without enzyme supplementation. MSc. Thesis, Faculty of Agric., Ahmadu Bello Univ., Zaria.

Martin, A.L.; Moumen, A.; Ruiz , D. Y and Alkaid, E. M. (2003). Chemical composition and nutrients availability for goats and sheep of two stage olive cake and olive leaves. *Anim., Sci. and Tech*., 107:61-74.

Mehrez, A. Z. and Mousa, M. R. M. (2011). Growth performance of rabbits fed olive pulp in North Sinai. *Asian Journal of Animal Sciences*, 5(5): 317-329.

Mohammed, A. (2023). Effect of multi-enzyme supplementation on growth performance of rabbits. *Asia Pacific J. of Sustainable Agric. Food and Energy* (APJSAFE). Vol. 11 (1) 11-15

Mousa, M. R. M. and A. M. Abd El-Samee (2002). Effect of olive pulp feeding on the growth performance and some related blood biochemical changes of growing rabbits under semi- arid conditions. *Egypt J. of Rabbit Sci*., 12 (1): 59-68.

NRC (1977). *National Research Council*. Nutrient requirements of domestic animals. *Nutrient Requirement of Rabbits*, 2nd revised edition. *USA National Academy of Sci*., Washington, D.C.

Oloruntola, A and David, O. (2018). Influence of enzyme supplementation on rabbits fed rumen liquor with poultry waste fermented cassava peels based diets. *Anim. Res. Int*. , 15(1): 2950 – 2964.

Petersen, S.T; Wiseman, J; Bedford, M.R. (1999).Effects of age and diet on the viscosity of intestinal contents in broiler chicks. *British Poultry Science* ;40(3):364-370.

Rabayaa, E.; Abo Omar, J. M. and Othman, R.A (2001)Utilization of olive pulp in broiler rations. *An Najah Univ. J. Res.* 15. 134-143.

Reitman, S. and Frankel, S. (1957). A Method for determination of enzymatic activities. *American Journal of Clinical Pathology*, 287: 56-58.

Sadeghi, H.; Yansari, A.T. and Ansari-Pirsarai, Z. (2009). Effects of different olive cake by products on dry matter intake, nutrient digestibility and performance of Zel sheep. *Int J Agric Biol*, 11: 39:43.

Salama, W.; Basyony, M. M.; Marwa A. Suliman; Matari, R. I. M. and Hanan A. M. Hassanein (2016). Effect of feeding olive cake supplemented with or without bentonite on performance of growing rabbis. *Egypt. J. Rabbit Sci*., 26 (2): 211-230.

Sampson, E.J.; Baird, M.A.; Burtis, C.A.; Smith, E.M.; Witte, D.L. and Bayse, D.D. (1980). A coupled-enzyme equilibrium method for the measuring urea in serum: optimization and evaluation of the AACC study group on Urea Candidate reference method. *Clinical Chemistry*, 26: 816-826.

Savory, C.J and Hodgkiss, J.P. (1984).Influence of vagotomy in domestic fowls on feeding activity, food passage, digestibility and satiety effects of two peptides. *Physiology and Behavior* ;33(6):937-944.

Shaw, A. L.; Blake, J. P. and Gordon, R. W. (2010). Evaluation of commercial phytase enzymes on performance and tibia-breaking strength of male broiler chicks. *Journal of Applied Poultry Research*, 19:415–421.

Snedecor, G.W. and W.G. Cochran (1982). *Statistical Methods*. 8th ed. Iowa State Univ., Press Ames, Iowa, USA

Yousef, K.M. (2009). Performance and carcass traits of goats fed agroindustrial by – products supplements as feed block. *Egyptian J. Nutrition and Feeds*, 12 (1): 99-111.

Youssef, K.M.; Fayed, A.M. and Khamis, H.S. (2001). Productive and reproductive performance of ewes and does fed non- conventional diets based on olive pulp in Sinai. *Egyptian J. Nutr. and Feeds*, 4 (Special Issue): 591.

Zarei, M.; Ehsani, M. and Torki, M. (2011). Productive performance of laying hens fed wheat-based diets included olive pulp with or without a commercial enzyme product. *African Journal of Biotechnology* Vol. 10(20), pp. 4303-4312.

Zeweil, H.S. (1996). Enzyme supplements to diets of growing Japanese quails. *Egyptian Poultry Science Journal*, 16 (III): 535-557.

تأثير استخدام مسحوق تفل الزيتون على أداء النمو وهضم العناصر الغذائية وقياسات الدم في الأرانب النامية

ابتسام عادل محمد حسن سرور[١]، مروة محمد بهنس[٢] ومحمد سيد رفاعي[١]
[١] قسم انتاج الدواجن - كلية الزراعة – جامعة الوادي الجديد – مصر
[٢] قسم انتاج الدواجن - كلية الزراعة – جامعة الفيوم -مصر

اجريت هذه التجربة بهدف دراسة تأثير الاستبدال الجزئي للشعير بتفل الزيتون (OP) بمستوى ٥ و١٠ % مع او بدون إضافة انزيمات على الأداء الإنتاجي، وهضم العناصر الغذائية، والكفاءة الاقتصادية للأرانب النامية. تم تقسيم ١٢٠ ارنب نيوزلندي ابيض عمر ٤ أسابيع عشوائيا إلى ثلاث مجموعات: المجموعة الأولى مجموعة الكنترول غذيت على عليقة مقارنة بدون اضافة تفل الزيتون، المجموعة الثانية والثالثة غذيت على عليقة تحتوي على ٥% و١٠% من تفل الزيتون على التوالي، وقسمت كل مجموعة الى مجموعتين بدون او مع إضافة الإنزيمات.

أوضحت النتائج المتحصل عليها أن زيادة نسبة تفل الزيتون ١٠% بدون إضافة انزيمات كان لها تأثير سلبي على وزن الجسم والعلف المستهلك، ومعامل التحويل الغذائي ومع ذلك، أدت اضافة الإنزيمات إلى تحسين الأداء الإنتاجي وهضم العناصر الغذائية ومعامل التحويل الغذائي، مما أدى الى تقليل الاثار السلبية لإضافة تفل الزيتون في العليقة. أدت تغذية الارانب على علائق تحتوي على نسبة مرتفعة من تفل الزيتون بدون إضافة انزيمات إلى انخفاض معنوي في مستويات البروتين الكلي، والألبومين، والجلوكوز، بينما أدت إضافة الإنزيمات الى تحسين هذه المؤشرات دون التأثير على مستويات الكوليسترول. بينما لا توجد اختلافات معنوية بين المعاملات على وظائف الكلى وانزيمات الكبد. كما أن إضافة ٥% من تفل الزيتون أظهرت اعلى نسبة تصافي مقارنة بمجموعة ١٠%، دون وجود فروق معنوية مع مجموعة الكنترول. كما أدت إضافة تفل الزيتون بنسبة ١٠% الى انخفاض الكفاءة الاقتصادية ومؤشر الإنتاج، بينما حسَّنت إضافة الإنزيمات من كفاءة استخدام العناصر الغذائية، مما أدى إلى عوائد اقتصادية أفضل.

التوصية: توصلت النتائج الى استخدام تفل الزيتون بنسبة ٥% مع إضافة الانزيمات أدى الى تحسين الأداء الإنتاجي والعائد الاقتصادي في الارانب النامية.