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Effect of using Guava and olive waste with or without enzyme addition in the diets on growing Japanese quail performance

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ABSTRACT:

The experimental work of the current search was executed at El-Azab Poult. Res. Station, Fayoum, Anim. Prod. Res. Institute, Agric. Res. Center, Ministry of Agric., Dokki, Egypt during the period from April to May 2018. Chemical analyses were performed in the laboratories of Poult. Prod. Dep., Faculty of Agric., Fayoum University. This experiment was planned to study the effect of using two type of food processing waste (Guava or Olive) at three dietary levels (0.0, 5.0 and 10.0%) of each source with or without 0.1% Polyzyme (PZ) supplementation in 2 x 3 x 2 factorial arrangement giving twelve dietary treatments on productive performance, mortality rate and economical efficiency of growing Japanese quail diets. The total number of the experimental birds is 612 at 10 days of age were divided equally into twelve treatments (51 birds each), each treatment contained three replicates (17 birds each).

Results obtained could be summarized in the following: The main effects of type, level of substitution and enzyme addition had insignificantly affected live body weight (LBW), body weight gain (BWG) and growth rate (GR), while, significant effect on feed intake (FI), feed conversion ratio (FCR), crude protein conversion (CPC), caloric conversion ratio (CCR) and performance index (PI) during the period from 10 to 38 days. Birds fed diet containing Guava waste (GW) at level of 10% without enzyme had higher values of LBW and BWG during the period from 10 to 38 days, however, those fed control diet had the lower values of LBW and BWG during the same period. Birds fed GW at level of 10% with 0.1% PZ had higher value of FI. Birds fed Olive waste (OW) at level of 5% with 0.1% PZ had lower FI, highest PI value and the best FCR, CPC and CCR values, however, those fed control diet had the worst FCR, CPC and CCR values during the period from 10 to 38 days.

Neither type or level of substitution, enzyme addition nor interaction due to type, level of substitution and enzyme addition had insignificantly affected some slaughter parameters%, except, type of substitution with gizzard, enzyme addition with gizzard and length of small intestine, and interaction due to type, level of substitution and enzyme addition with half rear which were significantly affected. Feeding GW or OW with or without enzyme addition insignificantly affected blood parameters% except, interaction due to type, level of substitution and enzyme addition with mean corpuscular hemoglobin concentration which was significantly affected.

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Birds fed control diet had significantly higher value of mean corpuscular hemoglobin concentration; however, those fed diet containing 10% OW without enzyme addition had significantly lower value. Type of addition, level of substitution and interaction due to type, level of substitution and enzyme addition had insignificant effect on chemical composition of quail meat, except, enzyme addition with moisture and fat and interaction due to type, level of substitution and enzyme addition with fat and ash%, which was significantly affected.

Economical and relative efficiency values during the period from 10 to 38 days of age improved in birds fed all experimental diets, except, birds fed diet containing GW at level of 10% with 0.1%PZ enzyme (the lowest corresponding values, being 0.8625 and 98.12%, respectively), as compared with those fed the control diet and other diets. Birds fed diet containing OW at level of 5% with 0.1%PZ enzyme had the best economical and relative efficiency values being 1.1162 and 127.20%, respectively, followed by birds fed diet containing OW at level of 5% without enzyme being 1.0648 and 122.54%, respectively.

Key words: Guava waste, Olive waste, enzyme, productive performance, Japanese quail.

1- INTRODUCTION:

One of the biggest agriculture industries in Egypt is poultry production and its development is one of the main objects of both public and private sectors. Feeding cost represents the major part (up to 65-70%) of total poultry production cost. Reducing the feed cost could be reached using untraditional inexpensive feed ingredients such as some local by-products agricultural and industrial, the concern for using these unconventional feed has increased, particularly for reducing the nutritional deficit between poultry requirements and feed source **(Al-Shanti et al., 2013)**, or improving operation of common feeds by using some additives. Vegetable, fruit and oilseed processing result in different amounts of wastes depending on the raw material.

Guava (Psidium guajava Linn) is an essential hot tree and a known tropical fruit branded by a high vitamin C being more than 100 mg/100 g fruit. Egyptian Guava is an essential tropical and semitropical, fruits (yellow in color) are processed for human nutrition as drinks, jam, puree, syrup concentrate, canned slices and juices **(Hassan et al., 2016)**. In Egypt, a great amount (millions of tons) of Guava waste (GW) is produced as a by-product of canning industry and was not totally evaluated as a feedstuff for poultry. The Guava processing by-products such as the leaves, pulp, peel, seeds, stone and inedible fruits themselves can be substantial contribute to better and further economic feeding of poultry due to feedstuff deficiency, also, decrease of the environmental impediment.

Guava waste constitutes 4-12% of the total mass of the fruit **(Uchoa-Thomaz et al., 2014).** In another study, **Yitbarek (2019)** reported that about 1.2-2 billion tons of wastes (around 30 to 50% from the total production) is produced globally per year. These wastes materials are considered an ecological problem due to accumulation of large and useless quantities. A fruit waste is obtained from culled or damaged fruits and after juice extraction, with high potential for use in animal feeding. **Marquina et al. (2008)** noted that, pulp and peel fractions of Guava had high content of dietary fiber from 48.55 to 49.42% and extractable polyphenols methoxylated pectin from 2.62 to 7.79%, so, GW also can be a suitable basis of natural antioxidants, which are associated with the polyphenols, ascorbic acid and carotenoids **(Kumari et al., 2013).**

The seeds are 6 to 12% of the fruit weight **(Cordoba, 1994).** Dried Guava pomace consisted of about 94% seeds and 6% skins **(Denny et al., 2013).** Proximate chemical composition of Guava by product is 7.6 to 10.90, 4.52 to16.0, 40.0 to 61.4%, for crude protein (CP), ether extract (EE) and crude fiber (CF), respectively **(El-Deek et al., 2009, Lira et al., 2009 and Khalifa, 2014),** 0.93 and 4.1% for ash and moisture, respectively **(Khalifa, 2014)**, 33.14%, 5.62% and 2226 kcal/kg for nitrogen free extract (NFE), Ca and ME, respectively **(El-Deek et al., 2009)** and 47.04 to 90.81, 0.11, 0.037, 0.025 and 48.81 to 81.95% for dry matter, total P, available P, Ca and NDF, respectively **(Lira et al., 2009).** The fat contains 87.3% unsaturated fatty acids (76.5% polyunsaturated) and 11.8% saturated fatty acids. **Bikrisima et al. (2014)** reported that inclusion of Guava by-product in the diet were improved performance of broiler chickens. Furthermore, the synergic effect of EE and CF in GW increases total retention time with improving nutrient absorption and therefore decreases FI and improve growth performance **(Lira et al., 2009).**

In the Mediterranean region, the Olive (Olea europaea L.) tree is extensively cultivated for its edible fruits and oil **(Pappas et al., 2019)**. According to **Kostas et al. (2020)** Olive Oil industry displays an vital economic role in this area. Yearly, about two million tons of Olive oil is produced in this region only and about three million tons/year of Olive waste (OW) are generated worldwide **(Simonato et al., 2019).** The world yearly production of OW is 2881500 tons/year whose disposal signifies a great problem for Olive oil manufacturers. This means that near 71653 tons of Olive pulp. In Egypt, the production quantity was estimated as 932927 tons of Olive by the year 2020 **(FAOSTAT, 2022**).

Among the different wastes produced by the Olive manufacturing, Olive pomace is the chief residue of the Olive oil extraction techniques. It is the pulpy soiled residual after removing maximum of the oil from the Olive paste and more it consists of parts of pulp from 70 to 90%, stone from 9 to 27%, and Olive kernel from 2 to 3% (**Moral and Méndez 2006**).

Olive by-products can be combined in poultry diets as an economy dietary feedstuff to reduction the feed cost and decrease the pollution problems. **Al Afif and Linke (2019)** reported that the Olive meal, Olive cake or Olive pomace is a by-product of the Olive oil extraction methods. **Wedyan et al. (2017)** demonstrated that, every 100 kg of olives resulted in 35 kg of Olive pomace as a by-product. Olive pulp or Olive pomace is favored due to its great amount produced, low price and it's a good oil percentage nearly 12 to 25%, which used in metabolic processes chiefly for energy production **(Al-Harthi, 2017),** and by a high level of monounsaturated fatty acids, which may have a certain effect on the intramuscular fatty acids composition **(Terramoccia et al., 2013 and Serafini and Tonetto, 2019).** It is known that the intake of essential fats stimulates numerous health benefits like glucose homoeostasis, regulation of insulin sympathy and enhancements in the circulating lipid profile in the blood, which in turn reduces the risk of cardiovascular problems **(Abdullah et al., 2017).**

Olive pomace or Olive pulp is attracting more interest because to a great extent, it contains valuable substances like carbohydrates and organic acids **(Romero-García et al., 2014 and Iannaccone et al., 2019)**, and besides it has adequate CP content from 8 to 12.8% for poultry and rich in amino acids glycine and arginine **(Zarei et al., 2011)**. Olive pulp is considered also as a good source of minerals such as Ca, Cu and Co but poor in P, Mg and Na with impartial levels of Mn, Zn and phenolic compounds **(Serafini and Tonetto, 2019)**, making it an economic ingredient alternative for poultry feeding **(Al-Harthi et al., 2009)** and could be used as a partial ingredient in dietary formula **(Zarei et al., 2011).** It is also considered as a one of the most interesting wastes of Olive tree farming **(Sayehban et al., 2020)**, moreover, Olive by-products being a good source of numerous biologically active compounds with antioxidant, antibacterial and antifungal properties **(Gerasopoulos et al., 2015),** with a great nutraceutical potential. Antioxidant nutrients present in the waste can possibly capable of scavenge free radicals and afford antioxidant protection by impede the oxidative reactions in the muscle tissues and improve the immune response of birds **(Kidd, 2004).** Moreover, Olive by-products contained a high percentage of bioactive phenols **(Servili et al., 2007)** and cellulose, hemicellulose and lignin **(De Oliveira et al., 2021).** The crude fiber present in OW can vary from 20 to 48% **(Sayehban et al., 2016 and El-Moneim and Sabic, 2019)**. For these properties, this waste could be of particular interest after drying in the feedstuff industry or in broiler chicken feeding **(Papadomichelakis et al., 2019)**.

The use of dried Olive waste (OW) as replacement of energy sources in poultry chicken diets has given varying results **(Papadomichelakis et al., 2019)**. In some studies, dietary addition rates up to 10% was not harmful **(Al-Harthi, 2017)**, whereas in others dietary inclusion of 5 to 10% OW had a negative influence on growth performance, chiefly at the initial stages of growth of birds, which was attributed to the high crude fiber content of OW **(Rabayaa et al., 2001).** Observably, the fiber content of OW is a major issue, because chickens have an undeveloped digestive tract **(Thomas et al., 2008)** that cannot competently utilize fibrous diets at an initial age. Many alternative plant feed resources are constrained by low CP, high fiber and active anti-nutritional factors **(Agbede, 2019).** In particular, high fiber has been reported to limit the use of alternative plant resources in animal feeds **(Oloruntola et al., 2016).** However, the use of fiber degrading technology such as exogenous enzymes supplementation has been reported to enhance the utilization of fiber rich diets by improving LBWG, feed efficiency and health status in livestock **(Ogunsipe, 2017 and Oloruntola et al., 2018).**

When high fiber diets are used for poultry, feed manufacturers can add supplemental enzyme to the diets to increase fiber digestibility. Supplementing enzyme greatly increases the quantity of nutrients that avian digestive tracts can get from this feed waste **(O'Neill et al., 2014).** Exogenous enzymes may be supplemented to poultry diets containing these wastes to help fiber digestion or to solubilize phytic phosphorus via phytase enzyme, thus reducing their negative effects on poultry performance **(Choct,**

2006). Enzyme supplementation has been stated to enhance changes in the intestinal environment, including the viscosity of the digesta, which may promote contact among absorptive mucosae, nutrients and endogenous enzymes, thus improving the usage of the nutrients by the concerned animal **(Mateos et al., 2010).**

Thus, the objective of the present study was to evaluate the effect of using GW or OW with or without enzyme supplementation on the performance, mortality rate, carcass yield and economical efficiency of growing Japanese quails chickens.

2- MATERIALS AND METHODS:

The experimental work of the current search was executed at El-Azab Poult. Res. Station, Fayoum, Anim. Prod. Res. Institute, Agric. Res. Center, Ministry of Agric., Dokki, Egypt during the period from April to May 2018. Chemical analyses were performed in the laboratories of Poult. Prod. Dep., Faculty of Agric., Fayoum University. This research was conducted to study the effects of using GW or OW with or without adding enzyme in diets of growing Japanese quail.

The by-products (dried) of food processing wastes (Guava or Olive) used in the present study were procured from a trading Company, Fayoum Governorate, Egypt. These varieties of wastes were chosen according to many beneficial nutrition effects. The GW (peel, seeds and inedible fruits), on the other hand (damaged and unfit for consumption) which measured as a waste material from the Guava processing was obtained through the decanter method, which detached the juice from the pulp, producing a solid residue which is equal to about 10% of the volume of Guava processed. Peel, seeds and inedible Guava fruits were sun dried for ten days nearly and then fine grinded. Olive waste (include Olive meal (pulp and skin), stone and seeds) is a by-product of the Olive oil extraction process.

In Egypt, the largest amount of GW and OW is collected during the autumn months, especially September and October. The chemical analysis of GW and OW were estimated at the laboratories of Regional Center for Food and Feed-RCFF, Giza, Egypt, the determined analysis of the detached samples of GW and OW is showed in Table 1.

Table 1. Chemical composition of Olive and Guava wastes used in the present study (on air dried basis).

Chemical composition%		Olive waste	Guava waste
Moisture		7.90	5.80
Crude protein		10.00	6.60
Fat		10.98	0.55
Ash		5.70	29.30
Crude fiber		40.88	32.57
Fiber fractions%	**Neutral detergent fiber**	68.35	51.35
	Acid detergent fiber	59.80	49.47
	Acid detergent lignin	33.82	21.61
	Hemicelluloses	8.55	1.88
	Celluloses	25.98	27.86
	Lignin	30.59	12.61
Nitrogen free extract		24.54	25.18
Tannins		0.615	0.371
Gross energy Cal/Kg		**4304**	**2842**

The enzyme used in this study is Polyzyme (P), which is manufactured by Delta Vet. Center Company, Egypt. It is a multi-enzyme preparation, each 1 kg contains: Xylanase 1000000 units, Cellulose 500000 units, Beta-glucanase 50000 units, Alpha-amylase 10000 units, Protease 200000 units, Phytase 550000 units, and Beta-Mananese 80000 units.

At 10 days of age, 612 unsexed Japanese quail birds were individually weighed to the nearest gram at the start of the experiment (birds were initially fed a control diet for nine days), wing-banded and randomly dispersed to twelve dietary treatments (birds were fed the experimental diets from 10 days until 38 days of age). Chicks were raised in electrically heated batteries with raised wire mesh floors and had a free access of feed and water. Light (23 h/day), ventilation and room temperature were reached according to standard poultry rearing practices.

This experiment was planned to study the effect of using two type of food processing waste (Guava or Olive) at three dietary levels (0.0, 5.0 and 10.0%) of each source with or without 0.1% Polyzyme (PZ) supplementation in 2 x 3 x 2 factorial arrangement giving twelve dietary treatments on productive performance, mortality rate and economical efficiency of Japanese quail diets. The total number of the experimental birds is 612 at 10 days of age were divided equally into twelve treatments (51 birds each), each treatment contained three replicates (17 birds each).

According to **NRC (1994),** the experimental diets were formulated to contain 2900 kcal ME/Kg diet and 24%CP and complemented with mixture of vitamins and minerals and L-Lysine HCl and DL-methionine and were formulated to be iso-nitrogenous and iso-caloric. The composition and calculated analysis of the experimental diets are presented in Table 2. The tested raw material was analyzed for moisture, CP, EE, ash, CF, NFE% and Gross energy kcal/Kg, by the methods outlined by Association of Official Analytical Chemists, **A.O.A.C. (1990).** In addition, fiber fractions (neutral detergent fiber, acid detergent fiber, acid detergent lignin, hemicelluloses, celluloses and lignin) were determined and the percentage of tannins were estimated at the laboratories of Regional Center for Food and Feed-RCFF, Giza, Egypt, (Table 1). Birds were individually weighed to the nearest gram at weekly intervals during the experimental period. At the same time, feed consumption was recorded and feed conversion (g feed/g gain) and body weight gain were calculated. Crude protein conversion (CPC), caloric conversion ratio (CCR), growth rate (GR) and performance index (PI) were also calculated. Sex determination through plumage dimorphism (feather sexing) was done at 24 days of age.

At the end of the growing period (38 days of age), slaughter tests were performed using four birds (2 males and 2 females) around the average live body weight (LBW) of each treatment. Birds were individually weighed to the nearest gram, and slaughtered by severing the jugular vein (Islamic method).

After two minutes bleeding time, each bird was dipped in a water bath for approximately one minute, and feathers were removed by hand. After the removal of head, neck and legs, carcasses were manually eviscerated to determine some carcass traits, dressing and total giblets% (gizzard, liver and heart). The eviscerated weight included the front part with wing and hind part. The bone of front and rear were separated and weighed to calculate meat%, the meat from each part was weighed and blended using a kitchen blender. Chemical analyses of representative samples of the carcass meat (including the skin) were carried out to determine dry matter (DM), CP (N x 6.25), EE and ash contents according to the methods of **A.O.A.C. (1990)** and NFE was calculated by difference. The abdominal fat was removed from the parts around the viscera and gizzard, and was weighed to the nearest gram. The length of the small and large intestine, and the percentage of sexual organs (ovarian and/or testis) weight in relation to body weight were also estimated.

At the end of the growing period (38 days), individual blood samples were collected during exsanguinations, immediately centrifuged at 3500 rpm for 15 min. Serum was harvested after centrifugation of the clotted blood, stored at–20Ċ in the deep freezer until the time of chemical determinations. Accumulative mortality rate was obtained by adding the number of dead birds during the experiment divided by the total number of chicks at the beginning of the experimental period. To determine the economic efficiency for the different dietary treatments, the amount of feed consumed during the entire experimental period was obtained and multiplied by the price of one Kg of each experimental diet, which was estimated based upon local current prices at the experimental time. The price of 38 days old quail was taken as 900 PT.

Statistical analysis of results was performed using the General Linear Models procedure of the SPSS software **(SPSS, 2007),** according to the follow general model:

$$Y_{ijkl}= \mu+T_i+L_j+E_k+TL_{ij}+TE_{ik}+LE_{jk}+TLE_{ijk}+e_{ijkl}$$

Where:

Y_{ijkl}: observed value. **μ:** overall mean.

T_i: type of substitution effect (**i**: Guava waste or Olive waste)

L_j: level of substitution (**j:** 0, 5 and 10%)

E_k: enzyme supplementation effect (**k**: 0.00 and 0.10%).

TL_{ij}: interaction effect of type of substitution by level of substitution.

TE_{ik}: interaction effect of type of substitution by enzyme supplementation.

LE_{jk}: interaction effect of level of substitution by enzyme supplementation.

TLE_{ijk}: interaction effect of type of substitution by level of substitution by enzyme supplementation (treatments). e_{ijkl}: random error.

Treatment means indicating significant differences ($P \leq 0.01$ and $P \leq 0.05$) were tested using Duncan's multiple range test **(Duncan, 1955)**.

Table 2. Composition and analysis of the experimental diets.

	Items %	Guava waste			Olive waste	
		Level of substitution%				
		0	5	10	5	10
Feed Ingredients	Yellow corn, ground	53.82	46.22	38.59	48.13	42.44
	Olive waste, ground	0.00	0.00	0.00	5.00	10.00
	Guava waste, ground	0.00	5.00	10.00	0.00	0.00
	Soybean meal (44%CP[1])	33.68	34.48	35.30	33.70	33.69
	Broiler concentrate (45%CP[2])	10.00	10.00	10.00	10.00	10.00
	Calcium carbonate	1.10	1.07	1.05	1.00	0.92
	Sodium chloride	0.08	0.08	0.08	0.08	0.08
	Vit. and Min. premix[3]	0.30	0.30	0.30	0.30	0.30
	Vegetable oil[4]	0.90	2.77	4.65	1.70	2.49
	DL–Methionine	0.01	0.01	0.01	0.01	0.02
	L-Lysine HCl	0.11	0.07	0.02	0.08	0.06
	Total	100.0	100.0	100.0	100.0	100.0
Calculated analysis[5]:						
Protein and amino acids	Crude protein	24.00	24.00	24.00	24.00	24.00
	Lysine	1.30	1.30	1.30	1.30	1.30
	Methionine	0.51	0.51	0.51	0.51	0.51
	Methionine+Cystine	0.90	0.91	0.92	0.89	0.90
Crude fiber and fiber fractions	Crude fiber	3.74	5.26	6.77	5.66	7.58
	Neutral detergent fiber	9.65	11.59	13.53	12.52	15.39
	Acid detergent fiber	4.67	7.01	9.35	7.51	10.34
	Acid detergent lignin	0.00	1.08	2.16	1.69	3.38
	Hemicelluloses	3.70	3.44	3.18	3.85	3.99
	Celluloses	3.77	5.08	6.38	4.96	6.14
	Lignin	0.67	1.23	1.79	2.15	3.62
	Ether extract	3.34	4.95	6.58	4.02	4.70
Minerals	Calcium	0.81	0.81	0.81	0.81	0.81
	Available phosphorus	0.34	0.35	0.36	0.34	0.34
	Sodium	0.15	0.15	0.15	0.15	0.15
	Chloride	0.18	0.18	0.18	0.18	0.18
ME, kcal./Kg		**2900.46**	**2900.31**	**2900.04**	**2900.81**	**2900.42**
Cost (£.E./ton)[6]		**6077.8**	**6100.1**	**6121.0**	**5988.5**	**5904.7**
Relative cost[7]		**100.00**	**100.37**	**100.71**	**98.53**	**97.15**

[1]Crude protein [2]Broiler concentrate manufactured by Alpha Feed For Premix Production Company and contains: 45% Crude protein; 1.98% crude fiber; 1.25% ether extract; 2.85% calcium; 2.1% available phosphorus; 1.92% methionine; 2.65% methionine + cystine; 1.71% lysine; 1.05% Sodium; 2600 K cal ME/kg.

[3]Each 3.0 Kg of the Vit. and Min. premix manufactured by Egypt Pharma Company and contains: Vit. A 10000000 IU; Vit. D_3 2500000 IU; Vit. E 10000 mg; Vit. K_3 1000 mg; Vit. B1 1000 mg; Vit. B2 5000 mg; Vit. B6 1500 mg; Vit. B12 10 mg; biotin 50 mg; folic acid 1000 mg; niacin 30000 mg; pantothenic acid 10000 mg; Zn 50000 mg; Cu 4000 mg; Fe 30000 mg; Co 100 mg; Se 100 mg; I 300 mg; Mn 60000 mg, choline chloride 300000 mg and complete to 3.0 Kg by calcium carbonate.

[4] Mixture from 75% soybean oil and 25% sunflower oil.

[5]According to NRC, 1994 and chemical analysis at the laboratories of Regional Center for Food and Feed-RCFF, Dokki, Giza, Egypt, the determined analysis of the representative sample of Guava waste or Olive waste

[6] According to the local market price at the experimental time.

[7] Assuming the price of the control group equal 100.

3- RESULTS AND DISCUSSION:

Productive performance: Effect of using GW or OW with or without enzymes addition in growing Japanese quail diets on productive performance are shown in Tables 3 and 3 continue. The main effects of type, level of substitution and enzyme addition had insignificantly affected LBW, BWG and GR during the overall experimental period (Table 3). Numerically, all the level of substitution and enzyme addition increase LBW at 38 days and BWG during the period from 10 to 38 days compared with those fed the control diet (0.0:%), will, these did not reach a level of statistical significance.

Effect of using GW or OW with or without enzyme addition in growing Japanese quail diets on FI, FCR, CPC, CCR and PI are shown in Tables 3 and 3 continue. Type, level of substitution and enzyme addition had significant ($P \leq 0.01$) effect on FI, FCR, CPC, CCR and PI during the period from 10 to 38 days (Table 3). It is clear that, birds fed diet-containing GW had significantly higher values of FI, while, chicks fed diet OW had significantly lower FI during the total period (10 to 38 days), this result may be due to the high LBW and BWG values recorded for these groups during this period. The results cleared that, birds fed diet containing OW had the best FCR, CPC and CCR values, while, chicks fed diet containing GW had the worst FCR, CPC and CCR values during the total period.

Concerning of level of substitution (Table 3), birds fed diet containing 10% waste had significantly higher value of FI during the total period. Birds fed diet containing 5% waste had significantly lower value of FI and the best FCR, CPC and CCR values (highest PI) during the total period. While, chicks fed diet containing 0.0% waste had the worst FCR, CPC and CCR values during the same period (the differences between values of FCR, CPC, CCR and PI for chicks fed diets containing 0.0 and 10% waste were not significant). Also, the results cleared that, birds fed diet containing 0.1%PZ had lower FI (highest PI) and the best FCR, CPC and CCR values during the period from 10 to 38 days, while, chicks fed diet without enzyme addition had the higher FI (lowest PI) and the worst FCR, CPC and CCR values during the same period (Table 3).

Table 3. Effects of different levels of Guava or Olive wastes substitution in Japanese quail diets with or without enzyme supplementation on productive performance (main effects).

Items	Live body weight, g	Body weight gain, g	Feed intake, g	Feed conversion ratio	Crude protein conversion	Caloric conversion ratio	Growth rate	Performance index
Type of substitution:								
Guava waste	202.62	151.95	527.17[a]	3.87[a]	0.93[a]	11.28[a]	0.34	4.04[b]
Olive waste	200.27	149.05	491.42[b]	3.61[b]	0.87[b]	10.46[b]	0.34	4.25[a]
SEM[1]	1.32	1.21	1.23	0.06	0.02	0.18	0.01	0.06
P-value	0.215	0.095	0.000	0.004	0.001	0.001	0.207	0.014
Level of substitution%:								
0	197.67	146.52	498.35[b]	4.00[a]	0.96[a]	11.63[a]	0.33	4.09[b]
5	200.94	150.12	491.44[c]	3.59[b]	0.87[b]	10.47[b]	0.34	4.26[a]
10	201.95	150.89	527.15[a]	3.89[a]	0.93[a]	11.27[a]	0.34	4.03[b]
SEM	1.34	1.23	1.25	0.06	0.02	0.18	0.01	0.06
P-value	0.598	0.657	0.000	0.001	0.002	0.002	0.959	0.007

Polyzyme enzyme%:								
0.0	200.04	149.28	511.43^{a}	3.87^{a}	0.93^{a}	11.26^{a}	0.34	4.06^{b}
0.1	201.33	150.13	502.77^{b}	3.71^{b}	0.89^{b}	10.79^{b}	0.34	4.20^{a}
SEM	1.20	1.09	1.12	0.06	0.01	0.16	0.01	0.05
P-value	0.355	0.410	0.000	0.002	0.002	0.002	0.843	0.049
Sex effect:								
Female	207.24^{a}	155.02^{a}	507.16	3.64^{b}	0.88^{b}	10.58^{b}	0.34	4.40^{a}
Male	194.14^{b}	144.39^{b}	507.05	3.94^{a}	0.95^{a}	11.47^{a}	0.34	3.87^{b}
SEM	0.96	0.88	0.90	0.04	0.01	0.13	0.01	0.04
P-value	0.000	0.000	0.856	0.000	0.000	0.000	0.367	0.000

$^{a–c}$ Means in a column with different superscripts differ significantly (P≤0.05). [1] Pooled SEM

Table 3 (continue). Effects of different levels of Guava or Olive wastes substitution in Japanese quail diets with or without enzyme supplementation productive performance (treatments).

Type of substitution	Level of substitution%	Polyzyme enzyme %	Live body weight, g	Body weight gain, g	Feed intake, g	Feed conversion ratio	Crude protein conversion	Caloric conversion ratio	Growth rate	Performance index
Guava waste	0	0.0	196.02^{c}	144.39^{d}	515.00^{d}	4.42^{a}	1.06^{a}	12.83^{a}	0.33	3.98^{cd}
		0.1	204.63^{ab}	153.23^{abc}	482.46^{e}	3.45^{e}	0.84^{de}	10.09^{de}	0.34	4.43^{b}
	5	0.0	206.74^{a}	155.42^{ab}	525.15^{bc}	3.62^{cde}	0.88^{cde}	10.66^{cde}	0.34	4.16^{bcd}
		0.1	201.58^{abc}	150.62^{abcd}	519.36^{cd}	3.65^{cde}	0.88^{cde}	10.67^{cde}	0.33	4.06^{cd}
	10	0.0	208.46^{a}	157.19^{a}	531.20^{ab}	3.92^{bc}	0.94^{bc}	11.36^{bc}	0.34	4.25^{bc}
		0.1	202.08^{abc}	150.46^{abcd}	534.13^{a}	4.13^{ab}	0.99^{ab}	11.97^{ab}	0.34	4.02^{cd}
Olive waste	**0**	0.0	196.02^{c}	144.39^{d}	515.00^{d}	4.42^{a}	1.06^{a}	12.83^{a}	0.33	3.98^{cd}
		0.1	204.63^{ab}	153.23^{abc}	482.46^{e}	3.45^{e}	0.84^{de}	10.09^{de}	0.34	4.43^{b}
	5	0.0	200.33^{abc}	149.08^{bcd}	462.42^{f}	3.48^{de}	0.84^{de}	10.10^{de}	0.34	4.43^{b}
		0.1	204.90^{ab}	153.54^{abc}	457.10^{f}	3.33^{e}	0.80^{e}	9.650^{e}	0.34	4.83^{a}
	10	0.0	198.19^{bc}	146.69^{cd}	525.00^{bc}	3.83^{bcd}	0.92^{bcd}	11.09^{bcd}	0.33	3.87^{d}
		0.1	206.11^{ab}	154.42^{ab}	519.22^{cd}	3.60^{cde}	0.86^{cde}	10.34^{cde}	0.34	4.24^{bc}
SEM[1]			2.56	2.34	2.30	0.12	0.03	0.32	0.01	0.11
P-value			0.016	0.003	0.000	0.000	0.000	0.000	0.361	0.000

$^{a–e}$ Means in a column with different superscripts differ significantly (P≤0.05). [1] Pooled SEM

Concerning sex effect (Table 3), females had significantly higher LBW, BWG and PI (P ≤ 0.01) than males. Females had the best FCR, CPC and CCR values (P ≤ 0.01) than males during the period from 10 to 38 days. Sex had insignificant effect on FI during the same period (Table 3). As shown in Table 3 (continue), interaction due to type, level of substitution and enzyme addition (experimental treatments) had significantly (P≤0.01) affected LBW, BWG, FI, CPC, CCR and PI during the total period studied. Birds fed GW at level of 10% without enzyme had higher values of LBW and BWG during the period from 10 to 38 days, however, those fed control diet had the lower values of LBW and BWG during the same period (Table 3 continue). Numerically, as shown in Table 3 (continue), all the dietary treatments increase LBW and BWG during the experimental period as compared with those fed control diet. Birds fed GW at level of 10% with 0.1% PZ had significantly higher value of FI during the period from 10 to 38 days. Birds fed OW at level of 5% with 0.1% PZ had significantly lower FI, highest PI value and the best FCR, CPC and CCR values during the total period (10 to 38 days), however, those fed control diet had the worst FCR, CPC and CCR values during the same period. Data presented in

Table 3 (continue), indicate experimental treatments had insignificantly affected GR during the period from 10 to 38 days. Similar to the present findings, **Lira et al. (2009)** found that inclusion up to 12% GW in the diet was similar to performance (levels of GW did not influence the FI and FCR during the period from 1 to 42 days) of broilers fed control diet. In addition, **Aditya et al. (2013),** inclusion GW at level of 5 to 10% maintained growth performance when used in properly balanced broilers diets. On the other hand, **El-Deek et al. (2009)** found that a level of 2 or 4% GW enhanced feed utilization. The same authors also reported that feeding with the higher levels 6 to 8% Guava byproduct showed slightly reduction of broiler LBW and BWG, but not significantly. They also added that this observation could be due to the presence of higher amount of fiber compared to the other treatments. However, **Oliveira et al. (2018)** demonstrated that, BWG was improved at 21 days old although FI was not affected by the addition of the byproduct in the diet. In another study, high fiber diets increased FI, leading to worst feed efficiency **(Abiola and Adekunle, 2002 and El-Deek et al., 2009)**. The increase in FI at levels 10 and 15% GW compared to 5% may indicate that GW improved diet palatability and/or lower ME value than the calculated one **(El-Deek et al., 2009)**. However, **Chaturvedi and Singh (2000) and Abdel-Azeem (2005)** found that FI decreased as the dietary CF levels increased.

There are inadequate studies on the inclusion OW in Japanese quails diets. **El-Moneim and Sabic (2019)** found no negative effects of the inclusion of 5 and 10% of processed OW (without seeds) in the diet on LBW, feed consumption and FCR of Japanese quails. In broilers, **Rabayaa et al. (2001),** reported that inclusion levels up to 7.5% of OW showed no negative impact of OW on performance traits. However, fed inclusion levels above 10% of OW showed lower feed consumption and LBWG. The result was attributed to the high CF content, since high levels of CF in the diet of birds have a negative effect on FI **(Leung et al., 2018).** In addition, **Hetland et al. (2005)** noted that, this observation might be due to presence of CF in the poultry gizzard that causes a delay in the feed passage through the gastrointestinal tract, increasing satiety. The inclusion of OW up to 10% in the diet of broilers and quails does not adversely affect the performance but only a decrease in voluntary consumption, perhaps caused by the great fiber content in this ingredient **(De Oliveira et al., 2021).**

A number of studies have observed positive impact of the dietary use of OW on FI. **Al-Shanti (2003)**, found that birds fed OW up to 10% in broiler diets showed the highest significant LBWG values and improved FCR. On the contrary, other authors have found that dried Olive by-products do not impair the performance in broiler when added at levels 5% **(Al-Harthi, 2017 and Pappas et al., 2019**) or 10% **(Sayehban et al., 2016).** Olive waste can be included by the level of up to 10% (**Terramoccia et al., 2013),** 16% **(El Hachemi et al., 2007), 16% (Abo Omar et al., 2003)** in the feed with no adverse effects on growth performance of broiler. In addition to this, **Zangeneh and Torki (2011)** reported that feeding diets inclosing up to 9% OW in broiler diets had no adverse effect on growth performance and significantly increased the daily FI in birds. **Abo Omar (2000)** reported an increase in broiler FI (decreased feed efficiency) with the inclusion of about 6% of OW in the diet. This author related this high FI to the CF content and the consequent increase in passage rate in the gastrointestinal tract. In particular, there were no significant differences among dietary groups on growth performance in terms of final LBW, BWG, FI and feed efficiency. As it happens with other agro-industrial by-products, dried Olive residues are characterized by a high variability in the chemical composition, due to different oil extraction methods and Olive varieties, or the posterior processing out such as drying or destining **(Joven et al., 2014).**

Enzymes are added to poultry diets to make up some compounds in feed that cannot be broken down by the digestive enzymes. The addition of the supplemental enzyme to broiler diet had minimal impact on the evaluated parameters **(Sateri et al., 2017)**. The enzyme supplementation (0.5 g/kg) improved the growth performance in terms of final LBW and BWG of the growing rabbits **(Adeyeye et al., 2018).** Furthermore, **Hossain et al. (2016)** and **Oloruntola et al. (2018)**, reported that multienzyme supplementation enhanced the performance of broilers, this may be due to the fact that exogenous enzymes could have helped to breakdown non-starch polysaccharides, antinutritional factors epitomized via phytates and oxalates with attendant enhancement in the biological value of the diet **(Choct, 2006 and Oloruntola et al., 2018).** The reasons of these variances may be atreputed to methods of feed preparation, breeds, differences in the composition of the multi-enzyme, management practices and dosage used in the different experiments **(Pereira et al., 2017)**. In addition to this, **Oloruntola et al. (2018)** noted that, while, the multienzyme addition was able to increase the BWG, it could only numerically improve the FI and improve FCR. This may be due to improves the availability of some trace minerals (for e.g. Cu, Zn, Mn) known to motivate a greater FI **(Larbier and Leclercq, 1994)** in broiler chickens**.** The increased FI may be the consequence of the faster growth of poultry caused by enzyme, which results in higher nutritional requirements **(Hossain et al., 2016).** Numerical improvement by enzyme addition in BWG broiler chickens at the finisher period **(Akinyele et al., 2021)**. The reason may be is that exogenous enzyme has the capability to viscosity reduction of the digesta in the lumen with a concomitant release of nutrients for use by the poultry; the effect of enzyme supplementation was not significant **(Akinyele et al., 2021)**.

Slaughter parameters%: As shown in Tables 4, 5 and 4 and 5 (continue), neither type or level of substitution, enzyme addition nor interaction due to type, level of substitution and enzyme addition had any significant effect on some and other slaughter parameters%, except, type of substitution with head, gizzard and half breast, enzyme addition with neck, gizzard and length of small intestine, and interaction due to type, level of substitution and enzyme addition with neck and half rear which were significantly affected.

Table 4. Effects of different levels of Guava or Olive wastes substitution in Japanese quail diets with or without enzyme supplementation on some slaughter parameters% (main effects).

Items	Live body weight (g)	Blood and feather	Leg	Head	Neck	Heart	Liver	Gizzard	Total giblets	Abdominal fat
Type of substitution:										
Guava waste	194.46	13.50	2.21	4.15^{a}	4.05	0.87	2.35	2.07^{a}	5.29	0.13
Olive waste	195.15	12.82	2.12	3.93^{b}	4.38	0.92	2.22	1.82^{b}	4.96	0.11
SEM[1]	3.20	0.49	0.06	0.07	0.12	0.05	0.17	0.06	0.19	0.09
P-value	0.882	0.324	0.259	0.025	0.060	0.460	0.562	0.011	0.242	0.898
Level of substitution%:										
0	196.46	12.09	2.10	3.82	4.32^{ab}	0.81	2.34	1.62	4.77	0.21
5	194.05	12.63	2.12	4.04	4.02^{b}	0.90	2.35	1.88	5.12	0.13
10	195.56	13.69	2.21	4.04	4.41^{a}	0.90	2.23	2.01	5.13	0.10
SEM	3.08	0.45	0.05	0.06	0.11	0.05	0.15	0.06	0.18	0.09
P-value	0.746	0.132	0.247	0.993	0.031	0.997	0.602	0.158	0.981	0.846
Polyzyme enzyme %:										
0.0	196.40	13.29	2.11	4.02	4.02^{b}	0.84	2.40	2.00^{a}	5.24	0.14
0.1	193.88	12.61	2.19	3.97	4.45^{a}	0.92	2.19	1.76^{b}	4.87	0.14
SEM	2.93	0.43	0.05	0.06	0.11	0.04	0.15	0.05	0.18	0.08
P-value	0.288	0.369	0.197	0.326	0.014	0.252	0.310	0.011	0.156	0.812
Sex effect:										
Female	201.04^{a}	12.81	2.13	3.87^{b}	4.14	0.84	2.54^{a}	1.77^{b}	5.15	0.17
Male	189.24^{b}	13.09	2.18	4.12^{a}	4.34	0.92	2.06^{b}	1.99^{a}	4.96	0.10
SEM	2.93	0.43	0.05	0.06	0.11	0.04	0.15	0.05	0.18	0.08
P-value	0.007	0.724	0.520	0.015	0.171	0.248	0.022	0.021	0.338	0.483

$^{a-b}$ Means in a column with different superscripts differ significantly (P≤0.05). [1] Pooled SEM

Table 4 (continue). Effects of different levels of Guava or Olive wastes substitution in Japanese quail diets with or without enzyme supplementation on some slaughter parameters% (treatments).

Type of substitution	Level of substitution	Polyzyme enzyme %	Live body weight (g)	Blood & feather	Leg	Head	Neck	Heart	Liver	Gizzard	Total giblets	Abdominal fat
Guava waste	0	**0.0**	206.80	11.97	2.00	3.96	4.16^{abcd}	0.78	2.51	1.68	4.97	0.05
		0.1	192.73	12.59	2.18	3.75	4.37^{abc}	0.79	2.29	1.58	4.67	0.57
	5	**0.0**	196.75	13.88	2.03	3.97	3.62^{d}	0.77	2.47	1.70	4.94	0.13
		0.1	197.25	12.47	2.30	4.05	4.33^{abc}	1.00	2.53	2.17	5.69	0.11
	10	**0.0**	193.25	14.69	2.21	4.07	4.04^{bcd}	0.73	2.20	2.08	5.02	0.16
		0.1	194.75	12.57	2.38	4.41	4.37^{abc}	0.87	1.95	1.76	4.58	0.09
Olive waste	0	**0.0**	206.80	11.97	2.00	3.96	4.16^{abcd}	0.78	2.51	1.68	4.97	0.05
		0.1	192.73	12.59	2.18	3.75	4.37^{abc}	0.79	2.29	1.58	4.67	0.57
	5	**0.0**	194.08	11.55	2.11	4.17	3.80^{cd}	0.92	2.30	1.99	5.21	0.29
		0.1	188.13	12.64	2.04	3.97	4.35^{abc}	0.90	2.09	1.65	4.65	0.00
	10	**0.0**	196.35	14.61	2.17	3.86	4.65^{ab}	0.90	2.30	1.81	5.01	0.00
		0.1	203.05	12.84	2.10	3.76	4.86^{a}	0.94	2.06	1.64	4.63	0.13
SEM[1]			0.64	0.78	0.10	0.14	0.22	0.09	0.32	0.23	0.42	0.10
P-value			0.715	0.097	0.145	0.092	0.015	0.512	0.932	0.620	0.733	0.720

$^{a-c}$ Means in a column with different superscripts differ significantly (P≤0.05). [1] Pooled SEM

Table 5. Effects of different levels of Guava or Olive wastes substitution in Japanese quail diets with or without enzyme supplementation on other slaughter parameters (main effects).

Items	Sexual Organs%	Half breast%	Half rear%	Breast meat%	Rear meat%	Carcass weight after evisceration%	Dressing %	length of small intestine, cm	length of large intestine, cm
Type of substitution:									
Guava waste	1.58	38.36^{b}	23.13	70.96	75.62	61.55	66.84	60.21	5.50
Olive waste	1.68	39.80^{a}	23.67	71.11	76.32	63.41	68.37	60.54	5.75
SEM[1]	0.32	0.48	0.25	0.59	0.63	0.63	0.54	1.11	0.36
P-value	0.818	0.050	0.152	0.866	0.447	0.055	0.066	0.837	0.817
Level of substitution%:									
0	2.26	39.91	23.44	71.93	76.27	63.08	67.84	56.21	5.13
5	1.75	39.31	23.28	70.75	76.01	62.66	67.78	59.69	5.72
10	1.51	38.85	23.52	71.32	75.94	62.30	67.43	61.06	5.54
SEM	0.31	0.46	0.24	0.57	0.61	0.61	0.52	1.06	0.34
P-value	0.612	0.516	0.519	0.516	0.936	0.698	0.659	0.399	0.710
Polyzyme enzyme %:									
0.0	2.08	39.10	23.01	70.79	76.14	62.08	67.32	61.25^{a}	5.69
0.1	1.43	39.38	23.81	71.64	75.92	63.11	67.98	57.83^{b}	5.38
SEM	0.29	0.44	0.23	0.54	0.58	0.58	0.50	1.01	0.33
P-value	0.060	0.567	0.063	0.225	0.556	0.273	0.438	0.012	0.704
Sex effect:									
Female	1.65	39.14	23.62	71.54	76.52	62.62	67.77	63.10^{a}	5.39
Male	1.86	39.35	23.20	70.89	75.54	62.57	67.53	55.98^{b}	5.68
SEM	0.29	0.44	0.23	0.54	0.58	0.58	0.50	1.01	0.33
P-value	0.736	0.642	0.379	0.618	0.373	0.829	0.928	0.000	0.820

$^{a\text{–}b}$ Means in a column with different superscripts differ significantly (P≤0.05). [1] Pooled SEM

Table 5 (continue). Effects of different levels of Guava or Olive wastes substitution in Japanese quail diets with or without enzyme supplementation on other slaughter parameters% (treatments).

Type of substitution	Level of substitution%	Polyzyme enzyme %	Sexual Organs %	Half breast%	Half rear%	Breast meat%	Rear Meat %	Carcass weight after evisceration %	Dressing %	length of small intestine, cm	length of large intestine, cm
Guava waste	0	0.0	3.42	39.38	23.63^{ab}	70.91	77.60	62.91	67.88	60.75	4.75
		0.1	0.93	40.14	23.00^{abc}	72.47	75.39	62.52	67.18	58.50	5.75
	5	0.0	2.00	39.14	21.78^{c}	71.86	75.82	61.02	65.96	64.00	6.25
		0.1	1.70	38.40	24.53^{a}	70.04	75.97	62.95	68.64	58.00	5.00
	10	0.0	1.03	38.48	22.64^{bc}	71.34	74.42	61.20	66.21	61.50	4.67
		0.1	1.82	37.89	23.78^{ab}	71.45	76.13	61.78	66.36	57.75	5.50
Olive waste	0	0.0	3.42	39.38	23.63^{ab}	70.91	77.60	62.91	67.88	60.75	4.75
		0.1	0.93	40.14	23.00^{abc}	72.47	75.39	62.52	67.18	58.50	5.75
	5	0.0	1.53	39.32	23.52^{ab}	70.40	76.05	62.97	68.18	60.50	5.75
		0.1	1.77	40.37	23.30^{ab}	70.72	76.19	63.69	68.34	56.25	5.88
	10	0.0	1.63	39.06	23.77^{ab}	71.24	75.98	62.60	67.61	59.00	6.67
		0.1	1.36	40.13	23.94^{ab}	72.75	76.44	64.03	68.67	64.75	4.88
SEM[1]			0.59	0.79	0.47	1.14	1.20	1.08	0.95	3.21	0.67
P-value			0.242	0.412	0.020	0.806	0.901	0.595	0.349	0.675	0.557

$^{a\text{–}c}$ Means in a column with different superscripts differ significantly (P≤0.05). [1] Pooled SEM

Birds fed diets containing GW had higher values of head and gizzard. Birds fed diets containing 0.1%PZ had lower values of gizzard and length of small intestine at the end of experimental period (38 days of age). Concerning sex effect, (Tables 4 and 5) female had higher values of LBW, liver and length of small intestine (lower value of gizzard).

In this respect, **Lira et al. (2009)** found that inclusion of GW in broiler diets has been shown to increase the carcass yields**.** However, our results are in partial agreement with **Hassan et al. (2016)** who indicated that use of about 20% of GW in diets has insignificant effect on the carcass quality. Incorporation of GW in rabbit diets has been slight meddling in their carcass quality **(Kamel et al., 2016)**. The use of GW at level 12% resulted in the linear significant effect for the thigh yield, absolute weight of gizzard and abdominal fat, which increased for each 1% of addition in the diet **(Lira et al., 2009)**. The increase in the gizzard weight can be defensible by higher particle sizes of the feed, resulting from rise in the GW levels, which consists mostly of seeds, which can cause higher contractions of the gizzard muscles and promote greater muscular mass. There were no significant differences between the GW inclusion levels for absolute weight of the eviscerated carcass **(Lira et al., 2009).**

This result is different with **El-Deek et al. (2009)** who initiate that weight of the abdominal fat revealed no significant differences in the relative weight for the broiler received 2, 4 or 6% raw Guava by-products. Nonetheless, broiler receiving 8% raw Guava by-product have significantly fewer abdominal fats than other dietary level or the control. No significant differences were observed on carcass and breast yield between treatments **(Pappas et al., 2019)**.

The weight of breast and drumsticks were not different when broilers were fed different levels of OM and enzyme or their mixture (**Ibrahim et al., 2018**). These findings are in congruent with **Abo Omar (2005)** who presented no significant effects on visceral organ mass, gastrointestinal tract weight and dressing percent in broilers fed diet continuing OW at levels up to 10%. **Sateri et al. (2014), Al-Harthi (2017) and Sateri et al. (2017)** reported that broilers fed various levels of OM with or without enzyme addition, had no significant effect on gizzard and abdominal fat. **Ibrahim et al. (2018)** found that, feeding OW, which is a high fiber ingredient (24%) to laying quail, had certain influence on gastrointestinal tract length. **Adeyeye et al. (2018)** found that slaughter weight and dressed% were significantly increased by enzyme addition, while, enzyme addition had no significant effect on the relative organs weight of the rabbits except, the lung relative weight that increased with 0.5 g/kg enzyme addition**.** The effect of enzyme addition did not influence organ weights and the carcass of the birds **(Akinyele et al., 2021)**.

Blood parameters: The data of Tables 6 and 6 continue indicated that feeding of GW or OW with or without enzyme addition insignificantly ($P>0.05$) affected some blood parameters% except, interaction due to type, level of substitution and enzyme addition with mean corpuscular hemoglobin concentration which was significantly ($P \leq 0.05$) affected. Birds fed control diet had significantly higher value of mean corpuscular hemoglobin concentration; however, those fed diet containing 10% OW without enzyme addition had significantly lower value. In this respect, **De Oliveira et al. (2021)** reported that, no significant differences were observed between Olive pulp levels and enzyme supplementation, on the studied immunity traits**.**

Our findings are similar with that of **Pappas et al. (2019)** who demonstrated that in broilers and **El-Moneim and Sabic (2019)** in quails and found that the inclusion of up to 10% of OW in the birds' diet did not cause significant changes of hematocrit. In addition, **De Oliveira et al. (2021)** found that hematocrit not modified in broilers with up to 20% OW in the diet. While, there was an increase in most erythrocytic indices in enzyme diets. This suggests possible support of this main factor of enzyme for sufficient or normal hematopoiesis. **Hossain et al. (2016)** reported enhancing the bioavailability of minerals (some of which play a significant role in blood formation) via phytase additions.

Chemical composition of Japanese quail meat: Type of addition, level of substitution and interaction due to type, level of substitution and enzyme addition had insignificant effect on chemical composition of quail meat, except, enzyme addition with moisture ($P \leq 0.05$) and fat ($P \leq 0.01$) and interaction due to type, level of substitution and enzyme addition with fat ($P \leq 0.01$) and ash% ($P \leq 0.05$), which was significantly affected (Tables 7 and 7 continue).

Table 6. Effects of different levels of Guava or Olive wastes substitution in Japanese quail diets with or without enzyme supplementation on some blood parameters% (main effects).

Items	Hemoglobin (g/dL)	Red blood cells count (10^6/mm^3)	Hematocrit %	Mean corpuscular Volume (μ^2)	Mean corpuscular hemoglobin (μμg)	Mean corpuscular hemoglobin concentration%	White blood cells count (10^3/mm^3)
Type of substitution:							
None	13.20	2.50	32.54	130.32	53.27	40.77	103.56
Guava waste	14.72	3.18	39.78	126.52	46.99	37.13	118.93
Olive waste	15.59	3.86	46.65	128.73	43.58	33.72	123.42
SEM[1]	0.48	0.27	3.45	3.35	2.45	1.46	8.15
P-value	0.206	0.095	0.182	0.653	0.346	0.121	0.706
Level of substitution%:							
0	13.20	2.50	32.54	130.32	53.27	40.77	103.56
5	15.38	3.22	40.86	127.18	48.04	37.90	118.46
10	14.94	3.82	45.58	128.07	42.53	32.95	123.89
SEM	0.45	0.26	3.71	3.60	2.63	1.57	8.75
P-value	0.520	0.144	0.354	0.856	0.134	0.029	0.649
Polyzyme enzyme %:							
0.0	14.95	3.26	41.90	130.13	48.50	37.21	118.17
0.1	14.59	3.37	40.27	126.20	45.26	35.78	117.13
SEM	0.42	0.25	3.16	3.06	2.24	1.34	7.45
P-value	0.275	0.835	0.664	0.252	0.212	0.381	0.939
Sex effect:							
Female	15.02	3.05	37.67	131.03	49.84	38.09	110.93
Male	14.51	3.58	44.50	125.30	43.93	34.90	124.37
SEM	0.42	0.25	3.16	3.06	2.24	1.34	7.45
P-value	0.376	0.228	0.221	0.221	0.095	0.138	0.280

[1] Pooled SEM

Table 6 (continue). Effects of different levels of Guava or Olive wastes substitution in Japanese quail diets with or without enzyme supplementation on some blood parameters% (treatments).

Type of substitution	Level of substitution%	Polyzyme enzyme %	Hemoglobin (g/dL)	Red blood cells count (10^6/mm^3)	Hematocrit %	Mean corpuscular volume (μ^2)	Mean corpuscular hemoglobin (μμg)	Mean corpuscular hemoglobin concentration%	White blood cells count (10^3/mm^3)
Guava waste	0	0.0	14.78	2.55	35.08	137.95	59.05	42.80^{a}	103.20
		0.1	12.85	2.67	33.05	123.66	48.01	38.86^{ab}	111.08
	5	0.0	14.03	2.80	35.85	128.61	50.29	39.12^{ab}	114.28
		0.1	14.70	3.36	39.18	116.79	43.91	37.61^{ab}	105.23
	10	0.0	13.90	3.20	41.65	135.31	45.20	33.16^{abc}	116.78
		0.1	15.60	3.39	42.98	127.51	46.59	36.49^{abc}	103.73
Olive waste	0	0.0	14.78	2.55	35.08	137.95	59.05	42.80^{a}	103.20
		0.1	12.85	2.67	33.05	123.66	48.01	38.86^{ab}	111.08
	5	0.0	16.68	3.29	41.35	126.01	49.94	40.03^{a}	116.78
		0.1	16.10	3.45	47.05	137.31	48.03	34.86^{abc}	137.55
	10	0.0	14.95	4.94	61.60	126.54	35.46	27.71^{c}	111.08
		0.1	15.03	4.36	43.59	124.83	38.35	30.22^{bc}	124.63
SEM[1]			1.02	0.51	6.96	5.69	4.67	2.91	17.59
P-value			0.335	0.064	0.256	0.246	0.081	0.026	0.946

$^{a–c}$ Means in a column with different superscripts differ significantly (P≤0.05). [1] Pooled SEM

Table 7. Effect of using Guava or Olive wastes with or without enzyme addition in growing Japanese quail diets on chemical composition meat% (main effects).

Items	Moisture	Protein	Fat	Ash	NFE*
Type of substitution:					
Guava waste	69.16	20.84	6.26	2.67	1.13
Olive waste	68.48	20.77	6.69	3.06	1.18
SEM[1]	0.34	0.28	0.34	0.24	0.06
P-value	0.165	0.870	0.382	0.259	0.551
Level of substitution%:					
0	68.80	21.12	5.34	3.81	1.20
5	68.54	20.79	6.35	3.06	1.16
10	69.10	20.83	6.61	2.67	1.16
SEM	0.36	0.27	0.36	0.26	0.06
P-value	0.243	0.919	0.586	0.263	0.975
Polyzyme enzyme%:					
0.0	69.33^{a}	20.82	5.63^{b}	3.14	1.12
0.1	68.30^{b}	20.92	6.87^{a}	2.97	1.21
SEM	0.31	0.25	0.31	0.22	0.05
P-value	0.030	0.731	0.008	0.531	0.134
Sex effect:					
Female	69.08	20.80	6.17	3.21	1.13
Male	68.56	20.94	6.33	2.90	1.20
SEM	0.31	0.25	0.31	0.22	0.05
P-value	0.122	0.572	0.617	0.371	0.254

$^{a–b}$ Means in a column with different superscripts differ significantly (P≤0.05). [1] Pooled SEM *Nitrogen free extract

Table 7 (continue). Effect of using Guava or Olive wastes with or without enzyme addition in growing Japanese quail diets on chemical composition of meat% and mortality rate% (treatments).

Type of substitution	Level of substitution%	Polyzyme enzyme%	Moisture	Protein	Fat	Ash	Nitrogen free extract	Total number of chicks at the beginning of experiment	Number of dead birds	Mortality %
Guava waste	0	0.0	69.13	20.98	4.77^{c}	4.02^{a}	1.10	51	2	3.92
		0.1	68.80	20.96	5.87^{bc}	4.04^{a}	1.22	51	1	1.96
	5	0.0	69.01	20.54	5.57^{c}	3.32^{ab}	1.10	51	1	1.96
		0.1	67.83	20.81	7.90^{ab}	2.19^{b}	1.26	51	3	5.88
	10	0.0	69.92	21.02	5.47^{c}	3.46^{ab}	1.10	51	2	3.92
		0.1	69.29	20.65	6.78^{abc}	2.18^{b}	1.10	51	1	1.96
Olive waste	0	0.0	69.13	20.98	4.77^{c}	4.02^{a}	1.10	51	2	3.92
		0.1	68.80	20.96	5.87^{bc}	4.04^{a}	1.22	51	1	1.96
	5	0.0	69.13	20.69	6.14^{bc}	2.95^{ab}	1.07	51	1	1.96
		0.1	68.17	21.04	5.78^{c}	3.78^{a}	1.24	51	0	0.00
	10	0.0	69.15	20.77	6.18^{bc}	2.61^{ab}	1.30	51	2	3.92
		0.1	67.67	20.56	8.19^{a}	3.21^{ab}	1.19	51	2	3.92
SEM[1]			0.66	0.04	0.65	0.47	0.11			
P-value			0.346	0.999	0.008	0.037	0.784			

$^{a\text{–}c}$ Means in a column with different superscripts differ significantly (P≤0.05). [1] Pooled SEM

Mortality rate%: The cumulative mortality rate% during the period from 10 to 38 days of age are presented in Table 7 continue. Obtained results indicated that the percentage of mortality was 5.88% in quails fed GW at level of 5% with addition of 0.1%PZ had the highest value of mortality rate percentage during the period 10 to 38 days, however, those fed diet containing 5% OW with addition of 0.1%PZ had significantly lower value (zero%) of mortality rate percentage during the same period. While, the percentage of mortality in quails fed the other diets was within normal range and not linked to experimental treatments studied. Similarly, **Pappas et al. (2019)** noted that no significant difference between treatments were found on mortality rate. Conversely, **Rahman et al. (2013)** reported that in comparison to control, the experimental diets produced a decrease mortality rate. Moreover, **El-Deek et al. (2009)** found inclusion 6 and 8% Guava by-products in the diets significantly increased mortality rate.

Economical efficiency (EEf): Results in Table 8 showed that, economical and relative efficiency values during the period from 10 to 38 days of age improved in birds fed all experimental diets, except, birds fed diet containing GW at level of 10% with 0.1%PZ enzyme (the lowest corresponding values, being 0.8625 and 98.12%, respectively), as compared with those fed the control and other diets. Birds fed diet containing OW at level of 5% with 0.1%PZ enzyme had the best economical and relative efficiency values being 1.1162 and 127.20%, respectively, followed by birds fed diet containing OW at level of 5% without enzyme being, (1.0648 and 122.54%, respectively). **Al-Shanti (2003)**, found that birds fed OW up to 10% in broiler diets showed the highest significant economic efficiency. The use of GW as rabbit feed or inclusion in their diets has been found to economize on the costs of feed **(Kamel et al., 2016). El-Deek et al. (2009) and Lira et al. (2009),** indicated that the use of unconventional feed ingredients decrease the overall cost of production with improving profitability.

Table 8. Effects of different levels of Guava or Olive wastes substitution in Japanese quail diets with or without enzyme supplementation on economical efficiency (EEf).

Items	Type of substitution											
	Guava waste						Olive waste					
	Level of substitution%											
	0		5		10		0		5		10	
Polyzyme enzyme %	0.00	0.10	0.00	0.10	0.00	0.10	0.00	0.10	0.00	0.10	0.00	0.10
Diet (D)	D1	D2	D3	D4	D5	D6	D7	D8	D9	D10	D11	D12
a	0.5150	0.4825	0.5252	0.5194	0.5312	0.5341	0.5150	0.4825	0.4624	0.4571	0.5250	0.5192
b	607.78	617.78	610.01	620.01	612.10	622.10	607.78	617.78	598.85	608.85	590.47	600.47
a x b=c	313.01	295.64	320.35	319.41	325.15	329.61	313.01	295.64	276.92	276.02	310.00	309.18
d	168.54	168.54	168.54	168.54	168.54	168.54	168.54	168.54	168.54	168.54	168.54	168.54
e = c + d	481.55	464.19	488.89	487.96	493.69	498.16	481.55	464.19	445.46	444.56	478.54	477.72
f	0.1960	0.2046	0.2067	0.2016	0.2085	0.2021	0.1960	0.2046	0.2003	0.2049	0.1982	0.2061
g	4591.4	4591.4	4591.4	4591.4	4591.4	4591.4	4591.4	4591.4	4591.4	4591.4	4591.4	4591.4
f x g=h	900.00	939.53	949.22	925.53	957.12	927.82	900.00	939.53	919.79	940.77	909.96	946.33
h - e =i	418.45	475.35	460.33	437.57	463.43	429.67	418.45	475.35	474.32	496.21	431.42	468.60
EEf = i / e	0.8690	1.0240	0.9416	0.8967	0.9387	0.8625	0.8690	1.0240	1.0648	1.1162	0.9015	0.9809
r	100.00	116.64	108.36	102.04	108.02	98.12	100.00	116.64	122.54	127.20	103.75	111.65

Average feed intake (Kg/bird) a
Price / Kg feed (P.T.) b (based on average local market price of diets during the experimental time).
Total feed cost (P.T.) = a x b = c
Other costs d (including chick pries and other management costs (based on feed cost = 65% of total cost)
Total cost = c + d = e
Average LBW (Kg/ bird) f
Price / Kg live weight (P.T.) g (according to the local market price at the experimental time).
Total revenue (P.T.) = f x g = h
Net revenue (P.T.) = h - e = i
Economical efficiency = (i /e) (net revenue per unit of total cost).
Relative efficiency r (assuming that economical efficiency of the control group (1) equals 100).

CONCLUSION:

It can be recommended that, GW or OW can be used as an alternative feed ingredient in diets for Japanese quail in the period from 10 to 38 days at levels of up to 5 or 10%, without negative effect on the productive performance of the birds and/or the economic efficiency. More further researches are necessary to investigate the effect of containing more quantities of GW or OW (more than those used in the current study) in the diets of growing Japanese quail and the possibility to use useful feed additives and carrying out digestibility trials are required to decrease poultry production cost and environmental pollution. On the other hand, such an investigation would allow confirming the level and the phase at which GW or OW should introduced to the diets to maximize its use without compromising growth performance of poultry.

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الملخــص العــــربي

تأثير استخدام مخلفات الجوافة والزيتون مع أو بدون إضافة الإنزيم في العلائق على أداء السمان الياباني النامي.

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اجريت التجربة في محطة بحوث الدواجن -العزب-الفيوم وذلك خلال الفترة من شهر ابريل إلى مايو لسنة 2018. تمت التحليلات الكيمائية بمعمل قسم إنتاج الدواجن- كلية الزراعة -جامعة الفيوم. وأجريت التجربة لدراسة تأثير استخدام نوعين من مخلفات مصانع الأغذية (الجوافة اوالزيتون) وكل منها على ثلاث مستويات من العليقة (صفر،5 و10%) وكل مصدر مع او بدون إضافة البوليزيم انزيم (0.10%) إلى العليقة في نظام عاملي 2 x3x2 للحصول على 12 معاملة غذائية على الأداء الإنتاجي، نسبة النفوق والكفاءة الاقتصادية للسمان الياباني النامي. تم استخدام عدد 612 كتكوت سمان ياباني عمر 10 أيام قسمت بالتساوي على 12 معاملة (51 طائر/معاملة)، كل معاملة تحتوي ثلاثة مكررات (17 طائر/مكرر)

وتم تلخيص النتائج المتحصل عليها كما يلي:

الأداء الإنتاجي: لم يكن هناك تأثير معنوي بالنسبة للتأثيرات الرئيسية للنوع، مستوى الاستبدال واضافة الانزيم على وزن الجسم الحي ووزن الجسم المكتسب ومعدل النمو. بينما كان هناك تأثير معنوي على كمية الغذاء المستهلكة، كفاءة تحويل الغذاء، كفاءة تحويل البروتين، كفاءة تحويل الطاقة والأداء الإنتاجي خلال الفترة من 10–38 يوم من العمر. كان للكتاكيت المغذاة على مخلفات الجوافة بمستوى 10% بدون انزيم اعلي قيم وزن الجسم الحي ووزن الجسم المكتسب خلال الفترة من 10–38 يوم من العمر، بينما كان للكتاكيت المغذاة على عليقة المقارنة اقل قيم وزن الجسم الحي ووزن الجسم المكتسب خلال نفس الفترة. كان للكتاكيت المغذاة على مخلفات الجوافة بمستوى 10% مع 0.1% انزيم اعلي قيم لاستهلاك الغذاء. كان للكتاكيت المغذاة على مخلفات الزيتون بمستوى 5% مع 0.1% انزيم اقل قيم لاستهلاك الغذاء، اعلى أداء انتاجي، وأحسن كفاءة تحويل لكلا من الغذاء، البروتين، الطاقة، بينما كان للمغذاة على عليقة المقارنة اسوء كفاءة لكلا من الغذاء، البروتين، الطاقة خلال الفترة من 10–38 يوم من العمر.

لم يؤثر أي من نوع أو مستوى الاستبدال أو إضافة الإنزيم أو التداخل بين النوع ومستوى الاستبدال وإضافة الإنزيم معنوياً على بعض قياسات الذبيحة، باستثناء نوع الاستبدال مع القانصة% والتي تأثرت معنوياً، إضافة الإنزيم مع القانصة% وطول الأمعاء الدقيقة والتداخل بين النوع ومستوى الاستبدال وإضافة الإنزيم مع النصف الخلفي والتي تأثرت معنوياً. إن تغذية مخلفات الجوافة والزيتون مع أو بدون إضافة الإنزيم لم تؤثر بشكل معنوياً على قياسات الدم٪ ما عدا التداخل بين النوع ومستوى الاستبدال وإضافة الإنزيم مع متوسط تركيز الهيموجلوبين الذي تأثر معنوياً. كان للطيور التي تتغذى على عليقة المقارنة أعلى قيمة معنوية لمتوسط تركيز الهيموجلوبين في الجسم. ومع ذلك فإن تلك التي تم تغذيتها على عليقة تحتوي على 10٪ مخلفات زيتون بدون إضافة إنزيم كانت لها أقل قيمة.

نوع الإضافة ومستوى الاستبدال والتداخل بين النوع ومستوى الاستبدال وإضافة الإنزيم لم يؤثر معنويا على التركيب الكيميائي للحم السمان، باستثناء إضافة الإنزيم مع نسبة الرطوبة والدهون التداخل بين النوع ومستوى الاستبدال وإضافة الإنزيم مع نسبة الدهن والرماد والتي تأثرت معنوياً. تحسنت قيم الكفاءة الاقتصادية والنسبية خلال الفترة من 10 إلى 38 يومًا من العمر في الطيور التي تتغذى على جميع العلائق التجريبية، باستثناء الطيور التي تتغذى على عليقة يحتوي على 10٪مخلفات الجوافة مع إضافة 0.1% بوليزيم إنزيم (كان لها اقل القيم 0.8625 و98.12 ٪، على التوالي)، مقارنة مع تلك التي تغذت على عليقة المقارنة والعلائق الأخرى. حظيت الطيور التي تتغذى على عليقة تحتوي على 5٪ مخلفات الزيتون مع إضافة 0.1% بوليزيم انزيم بأفضل قيم كفاءة اقتصادية ونسبية بلغت 1.1162 و127.20٪ على التوالي، يليها التي تغذت على 5٪مخلفات الزيتون بدون إنزيم (1.0648 و122.54٪ على التوالي).