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UTILIZATION OF OLIVE POMACE MEAL AND ORANGE BY-PRODUCT MEAL IN BROILER RATIONS

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ABSTRACT

The present work was designed to study the effect of using some untraditional energy sources produced in north Sinai on the performance and physiological characteristics of broiler chicks under north Sinai environmental condition. In this respect, yellow corn, as the main source of energy, was substituted by olive pomace meal and orange west meal at rate 3, 6 and 9%, each alone in different diet formulated on the basis of economic efficiency and iso-nutritive value. A total number of 400 one day old Hubbard broiler chickens were brooded up to 45 day of age. Chicks were given iso-nitrogenous and iso-caloric diets and assigned in two stages of growth. The started from 7 to 28 day old, while the second was durated from 28 until 45 day of age. The results indicated that the waste product from the manufacture of orange west meal at rates of 9% and 6% and olive pomace meal 6% without the occurrence of any side effects either on production performance or physiological characteristics of the bird as those ratios achieved the best results in terms of production and economic efficiency, the proportions of the rate, respectively.

Key words: Untraditional feed, olive pomace meal, orange west meal, physiological characteristics and poultry.

INTRODUCTION

Animal production sector plays an important role in the Egypt economy. However, this sector is facing some obstacles, such as shortage of roughage and dependency on imports from the abroad market for many materials used in animal rations.

At the same time, disposal of agricultural wastes is becoming an environmental and health hazard in rural communities. Agricultural wastes such as olive pomace meal and orange west meal can be utilized in many ways to become an important source of beneficial materials especially to the agricultural community. It could be utilized in an integrated farm approach where waste is not any more a waste but a natural source instead. However, the traditional agricultural activities performed by Egyptian farmers since ages are somehow a kind of integrated farming. The utilization of agro-industrial by products may be economically worthwhile, since conventional feedstuffs are often expensive.

However, animal have historically utilized large amounts of well-known and widely-available traditional by-products such as bran, middlings, brewers' grains, olive pomace meal, distillers' grains, orange west meal and molasses. But less conventional by-products have become available.

Examples of important crop residues and agricultural by-products in Egypt are: wheat straw, orange west meal, tomato pulp, poultry litter and olive pomace meal.

Olive pomace meal, a remainder of olive cake (the raw material resulting from extraction of olive oil) after removal of the seed fraction is widely available in Egypt. About 4 million tons of the raw materials are produced each year several research studies were conducted to investigate the feasibility of utilizing olive pomace meal in broiler diets.

The proportion of olive pomace meal in its diets is variable. There seems to be a limit between 50 and 100g/ kg **(Abo Omar, 2000; Rabayaa*et al.*, 2001)**. Higher portions cause lower digestibility, less weight gain and poor broiler performance.

Citrus extract due to having water-soluble vitamins, especially vitamin C has an important role in health and immune system. Feeding by-product and processed residues to feed livestock is common historically. In recent years, many factories have been built in order to citrus extract.

After extraction of citrus extract, large remnants including external shell, the internal parts and seeds will remain. Dried citrus is a mixture of various citrus fruits rich in pectin, which is as a rich source of energy and calcium. Various studies showed that citrus by-products can also be utilized for monogastric animals **(Oluremi et al., 2006; Oluremi et al., 2007)**. However, **Jong-Kyu et al. (1996)** showed more information is needed on what levels and types of citrus by-products are best to use.

The objectives of this study are to investigate the performance of broiler chicks fed different levels of olive pomace meal, orange pulp and peel as an by-product, and its effect on some physiological characteristics and economic efficiency.

MATERIAL AND METHODS

This study was carried out in the Experimental Farm of Animal Production Department, Faculty of Environmental Agricultural Sciences, El-Arish, Suez Canal University.

A total number of 210 one day old Hubberd broiler chickens were brooded up to 45 day of age. Chicks were given iso-nitrogenous and iso-caloric diets and assigned in two stages of growth.

The started from 7 to 28 day old, while the second was durated from 28 until 45 day of age. Chicks were randomly allocated and kept under similar condition of heat, light and management.

Feed and water were provided ad-libitum during the whale experimental period. Chicks were fed for the first week of age on a basal diet containing 22% crude protein (C.P) and 2900 K. Cal. metabolizable energy (energy/Kg diet).

In the first stage (7 – 28 days) a total of 210 Hubbard broiler chicks at 7 days of age were used until 28 day old, chicks were divided equally into seven treatment groups; each contained 3 replicates of 10 chicks each. Olive pomace meal (OPM) and orange west meal (OWM) were added to experimental diets at graded levels in which 3, 6 and 9% at the expense of yellow corn along with the control and fed to chicks at starting period from 7 to 28 days of age Table 1.

However in the second stage (28 – 45 days) a total of 210 Hubberd broiler chicks, 28 days of age were used up to 45 day old (growing period).

Olive pomace meal (OPM) and orange west meal (OWM) were used in similar quantities at that mentioned in starting period. 3, 6 and 9% Table 2.Starting or growing periods were reared under similar management conditions.

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Table (1): Composition and calculated analysis of the experimental diets during starting period (7-28 day old).

Ingredients (%)	control	Olive pomace meal			Orange west meal		
		3%	6%	9%	3%	6%	9%
Yellow corn	56.32	51.92	47.7	43.48	51.62	46.92	42.22
Soybean meal	37.93	38.24	38.47	38.7	38.45	38.97	39.48
Oil	1.6	2.73	3.78	4.83	2.92	4.23	5.54
Dicalcium phosphate	0.5	0.5	0.5	0.5	0.5	0.5	0.5
Limestone	0.79	0.75	0.69	0.63	0.65	0.52	0.39
Salt	0.2	0.2	0.2	0.2	0.2	0.2	0.21
Bone meal	2.35	2.35	2.35	2.35	2.35	2.35	2.35
Lysine	0.03	0.03	0.03	0.03	0.03	0.03	0.03
Dl-methionine	0.03	0.03	0.03	0.03	0.03	0.03	0.03
Vit&min.mix*	0.25	0.25	0.25	0.25	0.25	0.25	0.25
Olive pomace meal	-	3	6	9	-	-	-
Orange west meal	-	-	-	-	3	6	9
Total	100.00	100.00	100.00	100.00	100.00	100.00	100.00
Calculated analyses (%)							
Crude protein %	22	22	22	22	22	22	22
Metabolizable energy (kcal/Kg)	2900	2900	2900	2900	2900	2900	2900
Calcium %	1.291	1.252	1.267	1.254	1.281	1.271	1.261
Av. phosphorus	0.461	0.435	0.445	0.436	0.445	0.445	0.441
Lysine %	1.279	1.319	1.347	1.38	1.385	1.491	1.597
Dl-methionine %	0.409	0.435	0.463	0.49	0.445	0.481	0.518
Price/Ton	3425	3885	3796	3707	3915	3857	3796

* Each 1 kg contains Vit. A 12000 IU, Vit. D 2500 IU, Vit. E 10 mg, Vit. K 3 mg, Vit. B_1 1 mg, Vit. B_2 4 mg, Vit. B_6 3 mg, Vit. B_{12} 20 mg, Mn 62 mg, Fe 44 mg, Se 100 mg, Cu 56 mg and Niacin 40 mg.

Table (2): Composition and calculated analysis of the experimental diets during growing period (28-45 day old).

Ingredients (%)	control	Olive pomace meal			Orange west meal		
		3%	6%	9%	3%	6%	9%
Yellow corn	68.55	64.15	59.93	55.71	64.97	60.27	55.57
Soybean meal	26.4	26.7	26.93	27.16	26.69	27.21	27.73
Oil	0.98	2.11	3.16	4.21	1.9	3.21	4.52
Dicalcium phosphate	0.5	0.5	0.5	0.5	0.05	0.05	0.05
Limestone	0.71	0.68	0.62	0.56	0.53	0.4	0.27
Salt	0.2	0.2	0.2	0.2	0.2	0.2	0.2
Bone meal	2.35	2.35	2.35	2.35	2.35	2.35	2.35
Lysine	0.03	0.03	0.03	0.03	0.03	0.03	0.03
Dl-methionine	0.03	0.03	0.03	0.03	0.03	0.03	0.03
Vit&min.mix*	0.25	0.25	0.25	0.25	0.25	0.25	0.25
Olive pomace meal	-	3	6	9	-	-	-
Orange west meal	-	-	-	-	3	6	9
Total	100.00	100.00	100.00	100.00	100.00	100.00	100.00
Calculated analyses (%)							
Crude protein %	18	18	18	18	18	18	18
Metabolizable energy (kcal/Kg)	3000	3000	3000	3000	3000	3000	3000
Calcium %	1.23	1.910	1.185	1.178	1.095	1.085	1.075
Av. phosphorus	0.420	0.494	0.490	0.486	0.430	0.424	0.417
Lysine %	0.97	1.011	1.1.049	1.088	1.072	1.178	1.284
Dl-methionine %	0.353	0.379	0.405	0.431	0.39	0.426	0.462
Price/Ton	3682	3592	3503	3428	3567	3509	3449

* Each 1 kg contains Vit. A 12000 IU, Vit. D 2500 IU, Vit. E 10 mg, Vit. K 3 mg, Vit. B_1 1 mg, Vit. B_2 4 mg, Vit. B_6 3 mg, Vit. B_{12} 20 mg, Mn 62 mg, Fe 44 mg, Se 100 mg, Cu 56 mg and Niacin 40 mg.

During the experiment the ambient temperature and humidity were measured three times a day at times (10:00 AM – 5:00 PM – 10:00 PM) average was calculated for them. Live body weight and feed intake were recorded every week for each replicate.

Then, calculated feed conversion ratio for each treatments through every week and record the quantity of mortality.

Slaughtering procedure and carcass measurements:

At the end of the experimental period (45days), 3 chicks were taken randomly from each treatment to carry out slaughter characteristics. Birds were fasted for about 12 hours before slaughtering weighted individually after fasting, then slaughtered to complete bleeding, followed by plucking the feathers.

Blood samples:

Were collected At 35 and 45 days of age, from one chick chosen randomly from each replicate. Samples of about 5 ml of blood were after slaughter and placed tube containing heparin and unheparin tube from each bird. The whole blood in heparin tube was used to determine the blood physical characteristic. While the blood in the other tube was centrifuged at 3000 R.P.M for 15 minutes to obtain blood sera. Then the sera were stored at – 20^{o}C till biochemical. Serum total protein, albumin, total lipids, glucose, cholesterol, creatinine, T3, T4 and T4/T3 Hemoglobin levels were determined colorimetrically using commercial kits Bio-Merieus, Laboratory Reagent and products, France. The globulin values were obtained by subtracting albumin values from protein values.

Metabolism trials:

At the end of each period Nutritional inside each experimental period, a digestion trial was conducted to determine digestion coefficients of experimental diets. Three birds from each treatment were randomly chosen and housed in individual cages which enable a complete separation and collection of excreta.

Birds were fed on the same tested diet used during growing period which means no need for preliminary period, so collection period starter directly for three days. Daily feed intake was measured and excreta were collected from each bird through 24 hours intervals and spraying boric acid 2%.

Feather and scattered feed were separated or taken out of the excreta. The excreta of each treatment were pooled together, dried at 60C for 18 hour till constant weight, then weighed, ground, well mixed and kept in screw top glass jars for analysis. Chemical analyses were carried out for diets and excreta according to methods of **A.O.A.C. (2000)** for dry matter, ash, crude protein, ether extract, and crude fiber. The nitrogen free extract was obtained by difference, i,e., for feed, it is 100-(moisture% + ash% + CP% + CF% + EE%), while for excreta, it is 100-(moisture% + ash% + CP% + CF% + EE% + urinary OM%).

Digestion coefficient =

$$\frac{\text{Digested nutrient}}{\text{Consumed nutrient}} \times 100$$

Where, digested nutrient = consumed nutrient – excreted nutrient in faecal

The economic efficiency (y) was calculated according to the following equation.

Economic evaluation =

$$\frac{\text{The revenue}}{\text{price of feed consumption}}$$

The data were subjected to analysis of variance (ANOVA). Using the general liner model (GLM) procedure of the statistical analysis system institute **(SAS, 2010).**

RESULTS AND DISCUSSION

Chemical composition of experimental energy source:

Chemicalanalysis of olive pomace meal (OPM) is shown in Table (3). The mean values on DM basis for chemical composition of OPM were 9, 19.54, 9.11, 41.31, 13.78 and 76.90 for CP, CF, EE, NFE, Ash and OM, Respectively. These values were within the published ranges of many investigators **(kamel, 1998; Khemis *et al.,* 1989; Azouz, 1994; and Abo-El-Nasr, 1985).** It is clear that OPM contains a markedly high percentage of all nutrients including fiber.

Comparing the chemical composition of OPM with that of yellow corn Table (7), it was found that, although the CP 9% and NFE 41.31% of OPM were less than of yellow corn. The EE of OPM 9.11% was slightly higher than that of yellow 5.11%. The CF content in OPM 19.54% was higher than that of YC 3.71%. The high content of crude fiber may be the limiting factor for using it as a feed ingredient for poultry. The ash content in OPM 13.87% was higher than of yellow corn 1.94%.

Chemical analysis of orange west meal (OWM) is shown in Table (3). The means values on DM basis for chemical composition of OWM were 71, 5.8, 6.2, 1.6, 87.3, 3.7 and 91.64 for DM, CP, CF, EE, NFE, Ash and OM, Respectively. These values were within the published range of many investigators and **FAO, (2001)**. It is clear that OWM contains a markedly high percentage of NFE and low levels of other nutrients including protein. The high NFE fraction is an indicative of their potential value mainly as an energy sources for livestock.

Digestion coefficients of experimental diets

In stage A:

The CP digestion coefficient of experimental diets were 77.08, 74.85, 76.96, 71.91, 74.09, 77.13 and 77.39 for the control group and groups containing 3,6 and 9% of olive pomace meal and orange west meal, respectively. However, The EE digestion coefficient of experimental diets were 72.51, 72.12, 72.50, 69.70, 72.72, 72.62 and 72.65 for the control group and groups containing 3, 6 and 9% of olive pomace meal and orange west meal, respectively.

Also, The CF digestion coefficient of experimental diets were 18.93, 18.62, 18.84, 10.99, 18.75, 18.93 and 18.96 for the control group and groups containing 3,6 and 9% of olive pomace meal and orange west meal, respectively. The NFE digestion coefficients ranged from 82.17 to 84.80. The highest value was recorded for 9% of orange west meal (84.80) and the lowest value was recorded for 9% of olive pomace meal (82.17) and the other value

Table (3): Chemical composition of yellow corn, olive pomace meal and orange west meal in formatting the experimental diets. (as feed%).

Item	Yellow corn YC	Olive pomace meal OPM	Orange west meal OWM
Dry matter	89.21	90.90	71
Crude protein	8.77	9.00	5.8
Crude fiber	3.71	19.54	6.2
Ether Extract	5.11	9.11	1.6
Nitrogen free extract	80.14	41.31	87.3
Ash	1.94	13.78	3.7
Organic matter	95.36	76.90	91.64

ranged between (84.42) to (84.77). The digestion coefficients of OM ranged from 74.11 up to 80.81%. 9% of OWM had recorded the highest value (80.81).

Followed by OWM 6% (80.72), the control (80.69), OPM 6% (80.61), OWM 3% (80.56) and OPM 3% (80.51), while the lower value was recorded with 9% OPM (74.11) Table (4).

In stage B:

The CP digestion coefficient of experimental diets were 77.63, 75.44, 77.81, 72.85, 74.52, 77.95 and 77.67 for the control group and groups containing 3, 6 and 9% of olive pomace meal and orange west meal, respectively. The digestion coefficient of EE ranged from 74.18% to 69.55%. The highest value of EE digestion coefficient was recorded by the control group (74.18%), while the lowest value was recorded by olive pomace meal 9% (69.55%).

The CF digestibility of the control diet (16.84%) was lower than the OWM levels and OPM levels except 9% (11.09%).

The highest value was recorded by 9% of OWM (19.52%) followed by 19.24%, 19.15%, 18.97%, 18.88% and 16.84 for the 6% of OWM, 6% OPM, 3% OWM and the control group, respectively.

The highest of CF digestion coefficients might be due to the higher the gizzared size. The digestion coefficient of NFE ranged from 85.67% to 82.88%. The highest value of NFE digestion coefficient was recorded for 9% of OWM followed by 3% and 6% of OWM (85.34%), 6% of OPM (85.21%), 3% of OPM (84.98%) and the control group (84.55%). The digestion coefficient of OM ranged from 81.87% to 75.53%.

The highest value of NFE digestion coefficient was recorded for 9% of OWM (81.87%) followed by 6% of OWM (81.34%), 3% of OPM (81.21%), 6% of OPM (81.20%), 3% of OWM (81.12%) and the control group (80.95%). The high percent of the NFE indicated that orange west contained high percent of digestible carbohydrates. Similar higher fiber digestibility levels were observed by **(Onifade and Babatunde, 1997).**

These results were agreement with those recorded by **Ahmed (1997)** when studied the effect of replacing yellow corn with date stone meal (DSM) in broiler diets, and **(Onifade and Babatunde, 1997)** when high level of fiber was fed to broiler chicks from 7 to 35 days of age.

Growth Performance:

The Experimental (1):

In the stage A (starting period)

Body weight and weight gain of chicks groups were increased as a orange west meal level increased in tested diets till 9%. The chicks fed on diet containing 6% and 9% OWM had significantly ($P<0.01$) higher in live body weight than the other tested level of OWM (Table 6).

The present results are in agreement with those obtained by **Al-Khawajah (2003), Rizal *et al.* (2010) and Osman (2009)**Feed consumption in group fed 3% OWM had significantly lowest feed intake as compared with group 6%, 9% and control group.

However, feed conversion ratio resulted that 3% of orange west meal had significantly higher ($P<0.05$) as compared with groups 6%, 9% OWM and control group (Table 6). These results were agreement with those recorded by **Abo Omar (2000)**, **Khawajah (2003)**, **Osman (2009)** and **Moura˜o*et al.* (2008).**

In stage B (growing period)

The statistical analysis showed significant differences ($P<0.05$) in live body weight among treatments. The highest value was recorded by groups fed

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Table (5): Digestibility coefficients of the experimental treatments.

Period		Starter (7 – 28) days						Grower (28 – 45) days					
Parameters	control	OPM			OWM			OPM			OWM		
Ration		3%	6%	9%	3%	6%	9%	3%	6%	9%	3%	6%	9%
CP	77.08	74.85	76.96	71.91	74.09	77.13	77.39	77.63	75.44	77.81	72.85	74.52	77.95
EE	72.51	72.12	72.50	69.70	72.72	72.62	72.65	74.18	70.97	71.59	69.55	73.08	73.84
CF	18.93	18.62	18.84	10.99	18.75	18.93	18.96	16.84	18.88	19.15	11.09	18.97	19.24
NFE	84.74	84.42	84.76	82.17	84.55	84.77	84.80	84.55	84.98	85.21	82.88	85.34	85.34
OM	80.69	80.51	80.61	74.11	80.56	80.72	80.81	80.95	81.21	81.20	75.53	81.12	81.34

Table (6): Effect of OWM and OPM levels on growth performance during the experimental 1 (from 7 to 45 days).

Traits Treatment		Initial body weight (g)	Final body weight (g)	Total body weight gain (g)	Average feed intake (g)	Average feed conversion
			Stage A (starting period)			
Control		148±1.16	1118^{a}±3.33	970^{a}±2.87	1413^{ab}± 1.87	1.42^{d}±0.4
	3%	146±1.30	962^{c}±6.01	815^{c}±2.95	1355^{b}± 2.91	1.62^{a}±0.03
OWM	**6%**	149±0.58	1113^{a}±3.61	964^{ab}±2.21	1412^{ab}± 3.24	1.43^{d}±0.01
	9%	148±0.60	1119^{a}±2.08	971^{a}± 3.14	1437^{a}± 3.51	1.46^{c}±0.04
	3%	144±1.30	974^{b}±1.92	830^{c}± 2.44	1344^{b}±1.27	1.59^{ab}±0.03
OPM	**6%**	149±0.76	1111^{a}±2.03	962^{b}±2.78	1412^{ab}± 2.84	1.44^{d}±0.03
	9%	147±1.01	919^{d}±4.58	772^{d}±3.71	1277^{c}±2.88	1.63^{a}±0.05
			Stage B (growing period)			
Control		1118^{a}±3.33	1680^{a}±7.15	561^{a}±3.13	1467^{a}±2.54	2.64^{c}±0.05
	3%	962^{c}±6.01	1426^{b}±17.41	465^{d}±5.56	1395^{c}±4.12	3.11^{a}±0.14
OWM	**6%**	1113^{a}±3.61	1660^{a}±11.20	547^{b}±3.76	1458^{ab}±4.33	2.74^{b}±0.07
	9%	1119^{a}±2.08	1677^{a}±5.40	558^{ab}±3.45	1449^{b}±3.67	2.63^{c}±0.07
	3%	974^{b}±1.92	1423^{b}±3.99	449^{e}±3.66	1371^{d}±2.03	3.21^{a}±0.08
OPM	**6%**	1111^{a}±2.03	1667^{a}±6.97	556^{ab}±2.98	1459^{ab}±2.95	2.68^{c}±0.10
	9%	919^{d}±4.58	1438^{b}±1.44	519^{c}±3.17	1395^{c}±2.08	2.76^{b}±0.08

a, b, c … = means on the same row with different letters are differ significantly (P<0.05).

on 9% OWM. While, the lowest value was recorded by groups fed on 3% of OPM and OWM. Also the data showed no differences in mean values between control group and groups fed on 6%, 9% of orange west meal, 6% of olive pomace meal(Table 6). In the present study results obtained are in good agreement with those reported by **Al-Khawajah (2003), Rizal et al. (2010) and Osman (2009).**

The data in Table (6) showed significant differences (P<0.05) in body weight gain among treatments. The chicks fed on 3% OPM diet gaved the lower body weight gain while chicks fed on the control group diet recorded the highest body weight gain value. While, there were no differences between groups fed on 3%, 6% of orange west meal and 6% of olive pomace meal as compared with the control group. This results agreement with **Al-Khawajah (2003) and Osman (2009).**

Feed consumption showed highly significant with the group 6% had significantly higher ($P<0.05$) feed intake as a compared with all levels of OWM, the group fed on 3% OWM and 9% OPM was recorded lowest value for feed intake. While no differences between groups fed on 6%, of orange west meal and 6% of olive pomace meal as compared with the control group (Table, 6).

These results were agreement with those recorded by **Abo Omar (2000) and Moura˜o *et al.* (2008). F**eed conversion ratio showed highly significant with t 3% orange west meal had significantly higher ($P<0.05$) as compared with control group and all levels of OWM. The lowest value of feed conversion ratio was recorded by 9% of orange west meal (Table, 6).

Growth Performance:

The Experimental (2):

In the stage A (starting period)

Body weight of chicks groups were increased as a orange west meal level increased in tested diets till 9%. The chicks fed on diet containing 6% and 9% OWM had significantly ($P<0.01$) higher in live body weight than the other tested level of OWM.

Statistical analysis showed that no significantly ($P<0.05$) difference between chicks fed on control diet and diet containing 6% and 9% of orange west meal. Birds fed on diets containing 3% of OWM gave lower live body weight Table 7.These results were similar with thos recorded by **Al-Khawajah (2003), Osman (2009)** and **Rizal *et al.* (2010)**. The weight gain of chicks fed on control, 6% and 9% of orange west meal and 6% of olive pomace meal were significantly higher ($P<0.05$) than those of other treatment Table 7. Similar results were obtained with **Rizal *et al.* (2010)**.

Feed consumption showed that the group fed 3% OWM had significantly lowest feed intakes as compared with group 6%, 9% and control group. At this period 6% and 9% of orange west meal had no significant ($p\leq0.05$) feed consumption as compared with the control group and no significant ($P<0.05$) between 3% OPM and OWM table7. These results were agreement with those recorded by **Abo Omar (2000).**

Feed conversion ratio resulted that 9% of olive pomace meal had significantly higher ($P<0.05$) as compared with groups 3%, 6% OPM and control group. Groups containing 6% and 9% of OWM had no significant ($P<0.05$) differences in feed conversion as compared with the control group. Table (7).

There were no significant differences ($P<0.05$) between 6%, 9% OWM and 6% OPM. The highest value of feed conversion ratio was recorded by OPM 9% followed by olive pomace meal and orange west meal at 3%. **In stage B (growing period)**, Live body weight showed statistical significantly ($P<0.05$) differences between treatments.

The highest value was recorded by groups fed on 6% OPM. While, the lowest value was recorded by groups fed on 9% of OPM (table7). The results obtained are in good agreement with those reported by **Al-Khawajah (2003) and Osman (2009)**.

Table (7): Effect of OWM and OPM levels on growth performance during the experimental 1 (from 7 to 45 days).

Traits / Treatment		Initial body weight (g)	Final body weight (g)	Total body weight gain (g)	Average feed intake (g)	Average feed conversion
Stage A (starting period)						
Control		149 ± 1.30	1202^{a} ± 2.29	1052^{ab}±1.87	1.46^{b}±0.02	1572^{a}± 1.33
	3%	150 ± 0.44	1024^{b} ± 2.21	874^{c}±1.79	1.74^{a}±0.03	1561^{b}± 1.85
OWM	**6%**	150 ± 0.44	1203^{a} ± 1.80	1053^{ab}±2.67	1.45^{b}±0.02	1564^{c}±2.37
	9%	150± 0.33	1208^{a} ± 4.41	1059a±2.34	1.46^{b}±0.02	1585^{a}±2.29
	3%	148± 0.88	1032^{b} ± 4.29	884^{c}±2.64	1.74^{a}±0.03	1577^{a}±1.37
OPM	**6%**	150 ±0.93	1201^{a} ± 5.01	1051^{b}±2.52	1.45^{b}±0.04	1562^{ab}±2.57
	9%	149± 0.50	1003^{c} ± 2.24	855^{d}±1.97	1.75^{a}±0.01	1534^{d}±1.27
Stage B (growing period)						
Control		1202± 2.29	2046^{a} ± 8.09	844^{ab}± 4.13	1808^{a}± 2.03	2.15^{c}± 0.03
	3%	1024± 2.21	1595^{c} ± 3.50	570^{c}±3.76	1762^{c}± 2.55	3.09^{a}± 0.02
OWM	**6%**	1203± 1.80	2035^{a} ± 3.03	832^{b}±3.03	1803^{ab}± 3.03	2.17^{c}± 0.03
	9%	1208±4.41	2044^{a} ± 10.70	836^{b}±4.11	1798^{b}± 3.14	2.16^{c}± 0.04
	3%	1032± 4.29	1681^{b} ± 1.86	650^{c}±3.67	1751^{c}± 3.35	2.72^{b}± 0.04
OPM	**6%**	1201± 5.01	2051^{a} ± 3.79	851^{a}±3.58	1810^{a}± 2.87	2.14^{c}± 0.03
	9%	1003± 2.24	1502^{d} ± 3.22	499^{d}±2.98	1674^{d}± 3.22	3.43^{a}±0.05

a, b, c … = means on the same row with different letters are differ significantly (P<0.05).

Body weight gain showed significant differences (P<0.05) among treatments. The chicks fed on 9% OPM diet gaved the lower body weight gain while chicks fed on the OPM 6% diet recorded the highest body weight gain value (Table 7). The results were not similar with those recorded by **Osman (2009).**

Feed consumption showed that the group 6%, 9% of orange west meal and 6% of olive pomace meal OPM had significantly higher (P<0.05) feed intake as a compared with all levels of OWM and OPM, the group fed on 3% OWM and 9% OPM was recorded lowest value for feed intake. These results were agreement with those recorded by **Abo Omar (2000).**

Feed conversion ratio results that 9% olive pomace meal had significantly higher (P<0.05) as compared with control group and all levels of OPM. The lowest value of feed conversion ratio was recorded by 6% of olive pomace meal followed by the control group, 9% and 6% of orange west meal.

Carcass Characteristics:

Experimental (1):

The olive pomace meal and orange west meal added to broiler diets caused a slight decreased in the percentage of different organs such as liver, heart, gizzard, digestive tract, real stomach and head (Table 8).

These results cleared that OPM and OWM caused a slight decrease in the weight of heart, liver, gizzard, digestive tract, real stomach and head compared to the control group. Accordingly, the weight of total edible organs as a percent of live body weight for all treatments followed the same trend as the dressed weight percentage (Table 8). These results were not agreement with those recorded by **Osman (2009).**

Carcass Characteristics:

Experimental (2):

Data in Table (9). Showed a variation between the different experimental groups. However, the control group had recorded a greater dressing weight and percentage as compared with other diets.

Also, the OPM and OWM in broiler diets didn't cause any increase either in heart, liver, gizzard, digestive tract, real stomach and head percentage compared to the control group.

However, groups fed diets containing the OPM and OWM didn't cause an increase in the level of total edible organs Table 9. Similar results obtained with **Abd El-Ghani (2000**) and **Abo Omar (2005)**.

The addition of untraditional energy source to the experimental diets showed clear variation in the total edible parts as compared to the groups fed 3, 6 and 9% of orange west meal and olive pomace meal.

Blood analysis

Experimental (1):

The Total protein showed significant differences (P<0.05) among treatments.

The control group and groups fed 3, 6 and 9% of orange west meal and olive pomace meal, respectively.

Among groups fed diets containing the untraditional energy sources, the group fed on 9% olive pomace meal recorded the lowest values at and 45 days of age compared with the control group and other treatments Table 10. The same result those agreement with **El-Kerdawy (1997) and Kamel (1998).**

The white blood cells and red blood cells showed significant differences (P<0.05) among treatments.

The chicks fed on 3% OPM diet gave the lower number of RBC'S while chicks fed on the 6% OWM diet gave the highest number of RBC'S. While, there were no differences between groups fed on 9% of orange west meal and 6% of olive pomace meal diets.

The same result those agreement with **El-Kerdawy (1997) and Kamel (1998).** The T_3 and T_4 showed significant differences (P<0.05) among treatments.

Table (8): Effect of treatments on dressing percentage, carcass yield and total edible parts.

Treat. / Parts	Control	OWM 3%	OWM 6%	OWM 9%	OPM 3%	OPM 6%	OPM 9%
Live body weight	1679.5a	1426.43b	1660.07a	1676.83a	1422.6b	1666.83a	1437.5b
Dressed	1097.22a	851.67 b	1082.78 a	1071.67 a	725.56 c	1058.33 a	539.44 d
Bone	399.44	312.78	401.67	394.45	285.56	385	225
Bone less meat	697.78	538.89	681.11	677.22	440	673.33	314.44
Liver	42.3 [a]	33.12 b	41.99 a	41.66 a	29.84 c	41.17 a	22.16 d
Heart	19.53[a]	15.29 b	19.38 a	19.23 a	13.77 c	19.00 a	10.23 d
Gizzard	40.68[a]	31.85 b	40.38 a	40.06 a	28.69 c	39.58 a	21.31 d
Total edible parts*	800.29	619.15	782.86	778.17	512.3	773.08	368.14
Total edible organs**	102.51	80.26	101.75	100.95	72.3	99.75	53.7
Head	28.54[a]	22.33 b	28.33 a	28.12 a	20.13 c	27.76 a	14.92 d
Digestive tract	93.57[a]	73.25 b	92.86 a	92.13 a	66.00 c	91.04 a	49.00 d
Real stomach	10.39[a]	8.08 b	10.31 a	10.23 a	7.33 c	10.11 a	5.44 d
Dressing percentage	71.44[a]	70.90 a	71.02 a	70.90 a	67.36 b	70.90 a	67.59 b
Drawn percentage	63.57[a]	63.23 ab	62.91 b	63.18 ab	60.63 c	63.62 a	58.25 d

a, b, c … = means on the same row with different letters are differ significantly (P<0.05).
*Total Edible Organs = Liver + Heart + Gizzard
**Total Edible Parts = Boneless meat + Total Edible Organs.

Table (9): Effect of treatments on dressing percentage, carcass yield and total edible parts.

Treat.	Control	OWM			OPM		
Parts		3%	6%	9%	3%	6%	9%
Live body weight	2045.67a	1594.50d	2034.83a	2043.83a	1681.33b	2051.00a	1502.17c
Dressed	1406.11 a	983.86 c	1410.56 a	1393.89 a	1044.45 b	1378.33 a	821.15 d
Bone	512.22	378.86	515.56	512.2	404.45	502.75	316.71
Bone less meat	893.89	605	895	881.69	640	875.58	504.44
Liver	52.61 a	38.28 c	52.30 a	51.97 a	40.31 b	51.42 a	32.05 d
Heart	24.28 a	17.67 c	24.14 a	23.99 a	18.61 b	23.73 a	14.79 d
Gizzard	50.58 a	36.81 c	50.29 a	49.97 a	38.76 b	49.44 a	30.82 d
Total edible parts*	1021.36	697.76	1021.73	1007.62	737.68	1000.17	582.1
Total edible organs**	127.47	92.76	126.73	125.93	97.68	124.59	77.66
Head	35.34 a	25.90 c	35.13 a	34.92 a	27.29 b	34.56 a	21.72 d
Digestive tract	116.34 a	84.65 c	115.67 a	114.94 a	89.16 b	113.72 a	70.89 d
Real stomach	12.91 a	9.40 c	12.84 a	12.76 a	9.90 b	12.62 a	7.87 d
Dressing percentage	73.74 a	70.67 bc	74.30 a	73.99 a	71.13 b	73.93 a	70.21 c
Drawn percentage	63.58 a	61.49 b	63.45 a	63.26 a	61.28 b	63.53 a	61.43 b

a, b, c … = means on the same row with different letters are differ significantly ($P<0.05$).
*Total Edible Organs = Liver + Heart + Gizzard
**Total Edible Parts = Boneless meat + Total Edible Organs

Table (10): Means ± (SE) of blood parameters as affected by treatments in Experimental 1.

Trt		Total Protein	RBCS	WBCS	T3	T4
Control		3.80^{a}±0.12	1.890.000^{d}±0.01	150.670.000^{d}±1.33	105.00^{cd}±3.06	4.63^{ab}±0.22
OW	**3%**	3.60^{a}±0.06	1.630.000^{e}±0.01	128.670.000^{e}±2.19	193.00^{b}±2.00	5.60^{c}±0.23
M	**6%**	3.73^{a}±0.09	2.640.000^{a}±0.02	185.000.000^{a}±2.31	111.33^{c}±1.86	7.17^{a}±0.18
	9%	3.87^{a}±0.15	2.110.000^{c}±0.03	167.000.000^{c}±1.16	231.67^{a}±1.76	7.23^{a}±0.17
OP	**3%**	3.73^{a}±0.09	1.440..000^{g}±0.02	122.670.000^{f}±1.20	98.00^{e}±3.00	6.23^{b}±0.20
M	**6%**	3.83^{a}±0.12	2.170.000^{b}±0.01	174.670.000^{b}±1.45	102.33_{ed}±1.2	5.37^{c}±0.13
	9%	3.17^{b}±0.18	1.560.000^{f}±0.02	151.000.000^{d}±0.58	86.33^{f}±1.33	6.73^{ab}±0.07

a, b, c … = means on the same row with different letters are differ significantly ($P<0.05$).

The lowest value of T_3 and T_4 was recorded by the diets containing 9% olive pomace meal. While, the highest value was recorded by 9% orange west meal followed by 3% then 6% of orange west meal then the control group. On other both, the results showed that the highest value of T_4 hormone was recorded by 6% orange west meal diets followed by 9% olive pomace meal, 6% of olive pomace meal then 9% of orange west meal then each of the diets containing 3% of olive pomace with the control group and the lowest value was recorded by 3% of orange west meal table 10.The same result those agreement with **El-Kerdawy (1997)**. Treatment with untraditional energy source resulted in increased the urine diets compared to the control group.

The highest value was recorded by 6 and 9% orange west meal diets. That result logical because of the high proportion of salt in the orange west meal and the lower value were recorded by the control group table 10.The same result those agreement with **El-Kerdawy (1997) and Kamel (1998).**

Blood analysis:

Experimental (2):

The Total protein showed significant differences ($P<0.05$) among treatments. The control group and groups fed 3, 6 and 9% of orange west meal and olive pomace meal, respectively.

Among groups fed diets containing the untraditional energy sources, the group fed on 9% olive pomace meal recorded the lowest values at 35 and 45 days of age compared with the control group and other treatments Table 11. The same result those agreement with **El-Kerdawy (1997) and Kamel (1998).**

The number of red blood cells was lower than control group in diets containing 3% of OPM and OWM and 9% OPM while, increased the number of red blood cells in diets containing 6% OPM and OWM and 9% OWM as compared with the control group table 11.

The same result those agreement with **El-Kerdawy (1997) and Kamel (1998).**

The same trend were observed with white blood cells as shown in Table (11), The chicks fed on 3% OPM diet gave the lower number of WBC'S, while chicks fed on the 6% OWM diet gave the highest number of WBC'S. While, there were no differences between groups fed on 9% of orange west meal and 6% of olive pomace meal diets table 11. The same result those agreement with **El-Kerdawy (1997) and Kamel (1998).**

The effect of untraditional energy sources supplementation on triiodothyronine (T_3) and thyroxin (T_4) was significant when compared between the different levels of orange west meal and olive pomace meal.

Results showed that the lowest value of T_3 was recorded by the diets containing 9% olive pomace meal.

While, the highest value was recorded by 9% orange west meal followed by 3% then 6% of orange west meal then the control group.

On other both, the results showed that the highest value of T_4 hormone was recorded by 6% orange west meal diets followed by 9% olive pomace meal, 6% of olive pomace meal then 9% of orange west meal then each of the diets containing 3% olive pomace meal with the control group and the lowest value was recorded by 3% of orange west meal table 11.

The same result those agreement with **El-Kerdawy (1997) and Kamel (1998).**

Fed chick with untraditional energy source resulted in increased the urine compared to the control group. The highest value was recorded by 6 and 9% orange west meal and the lower value was recorded by the control group.**Economic efficiency:**

The economic efficiency of different experimental treatments during various experimental periods for broiler chicks presented in table 12.

The Overall experimental periods, 9% OWM showed highly netrevenue, economic efficiency and relative economic efficiency with an exception in 9% OWM diet comparing with the all among treatments followed by 6% OWM diet then 6% OPM diet.

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Table (11): means ± (SE) of blood parameters as affected by treatments in Experimental 2.

Trt		Total Protein	RBCS	WBCS	T3	T4
Control		3.53^{b}±0.04	$1.917.000^{c}$±0.02	$153.000.000^{e}$±4.51	107.33^{cd}±2.05	4.58^{c}±0.18
OWM	3%	3.75^{a}±0.03	$1.470.000^{d}$±0.15	$136.667.000^{f}$±4.98	194.83^{b}±0.44	4.68^{abc}±0.09
	6%	3.55^{b}±0.08	$2.647.000^{a}$±0.01	$192.667.000^{a}$±1.86	110.67^{c}±0.73	4.97^{a}±0.02
	9%	3.70^{ab}±0.08	$2.163.000^{b}$±0.01	$173.000.000^{c}$±2.08	235.33^{a}±1.88	4.75^{abc}±0.03
OPM	3%	3.57^{ab}±0.09	$1.430.000^{d}$±0.01	$130.667.000^{f}$±1.76	96.83^{e}±0.44	4.65^{bc}±0.03
	6%	3.68^{ab}±0.02	$2.160.000^{b}$±0.01	$183.000.000^{b}$±2.08	104.00^{d}±2.36	4.88^{abc}±0.11
	9%	3.28^{c}±0.07	$1.550.000^{d}$±0.02	$163.000.000^{d}$±1.82	90.00^{f}±1.97	4.9^{ab}±0.07

a, b, c … = means on the same row with different letters are differ significantly (P<0.05).

Table (12): Economic efficiency of different experimental periods for broiler chick.

Item	Treatments						
	Cont.	OWM			OPM		
		3	6	9	3	6	9
Experimental (1)							
Feed intake/ bird (Kg)	2.88	2.75	2.87	2.89	2.72	2.87	2.67
Price/Kg feed (L.E)	3.6	3.5	3.4	3.2	3.5	3.3	3.1
Cost of feed (L.E)	10.4	9.6	9.8	9.2	9.5	9.5	8.3
Fixed cost (L.E)	6	6	6	6	6	6	6
Total cost (L.E)	16.4	15.6	15.8	15.2	15.5	15.5	14.3
Price of bird (L.E)	25	21	25	25	21	24	21
Net revenue	8.6	5.4	9.2	9.8	5.5	8.5	6.7
Economic efficiency*	52.7	34.4	58.6	64.0	35.3	55.1	47.1
Relative economic efficiency**	100	65	111	121	67	105	89
Experimental (2)							
Feed intake/ bird (Kg)	3.38	3.32	3.37	3.38	3.33	3.37	3.21
Price/Kg feed (L.E)	3.6	3.5	3.4	3.2	3.5	3.3	3.1
Cost of feed (L.E)	12.2	11.6	11.5	10.8	11.7	11.1	10.0
Fixed cost (L.E)	6	6	6	6	6	6	6
Total cost (L.E)	18.2	17.6	17.5	16.8	17.7	17.1	16.0
Price of bird (L.E)	31	24	31	31	25	30	23
Net revenue	12.8	6.4	13.5	14.2	7.3	12.9	7.0
Economic efficiency*	70.6	36.2	77.6	84.3	41.6	75.2	44.2
Relative economic efficiency**	100	51	110	119	59	107	63

* Net revenue per unit cost
** Assuming that the treatment number 1 represent the control group.

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