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EFFECT OF ORANGE PEEL WASTE ON GROWTH PERFORMANCE AND FEED UTILIZATION OF RED TILAPIA (*Oreochromis Mossambicus* X *O. niloticus*) FINGERLINGS

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Abstract

This study investigated the effects of Digestrom supplementation with rate 200mg/kg diet in all treatments as a growth promoter beside addition three levels of orange peel waste 0.0%, 50% and 75% as food replacement of yellow corn for estimation growth performance, feed utilization and some blood constituents of Red tilapia **(*Oreochromis mossambicus* X *O. niloticus*)** fingerlings. Fish fed with the diet containing 50% orange peel gave the best results concerning the weights parameters and nutritional status. It is noticed that increasing the protein in the diet to 30% and substituting 50% of the corn with orange peel increased dry matter, ash and reduced fat content in the body. The replacement of 50% of the corn with orange peel (in fish fed on a diet containing a 25% protein) did not affect the dry matter, but increases the level of protein and fat in the body.

Increasing orange peel to 75% led to significant increases in red blood cells, urea and triglycerides and at the same time reduced the levels of all the hormones studied. It is worth to mention that the applications led to a reduce the cost /kg diet, feed cost per kg fresh fish, relative % of feed cost/ g fish, consumed feed to produce 1 kg fish gain, feed cost /1kg gain, and relative % of feed cost of kg gain.

It could be concluded that replacing 50% of yellow corn in the diet with orange peel waste in terms of growth performance, feed utilization,

body chemical composition, blood sample, hematology and economic evaluation.

Keywords: red tilapia, feed utilization, growth performance, orange peel waste, blood sample.

INTRODUCTION

The red tilapia is fast gaining popularity among local consumers due to its favorable characteristics such as easy culture management and as a protein source (Bimbo and Crowtber, 1992). Studies have recently demonstrated that red tilapia can be cultured in the portable canvas tank system, with a slight modification (Ahaotu *et al*., 2017). Due to this rapid development of tilapia farming, the production systems have been steadily shifted from extensive and semi-intensive systems to more intensive systems, which raise a demand for artificial feeds. (Helou and Harris, 2007). Thus, formulating economic tilapia diets using untraditional and cheap feed resources remains a major challenge facing tilapia farmers (Guimarães *et al.,* 2010).

The problems facing of using food waste is an environmental pollution and fish contamination; the past and present situation of fish culture; upgrade of food waste based feed pellets by adding enzymes, vitamin-mineral premix, and probiotics (yeast) into feeds (Akpoilih *et al*., 2016 and Metwally and Gallal, 2009). Orang waste is of immense economic value as it contains an abundance of various flavonoids, carotenoids, dietary fiber, sugars, polyphenols, essential oils, and ascorbic acid, as well as considerable amounts of some trace elements and high levels of sugars (El- Ghfar *et al*., 2016).

Some attempt of artificial feed insured that orange peel waste could be used as alternative source of fish dietary; addition of 0.5%, 1% and 2% dried C. lime peels powder improved growth performance antioxidant activity, immune status, and disease resistance in some common freshwater fish species Nile tilapia, mullet and African catfish (Afaf *et al*., 2019; Mohamed *et al*., 2018 and Guimarães *et al*., 2010). The highest growth performance and feed utilization of Nile tilapia were noticed with diets containing 75% orange peel instead of

yellow corn as an alternative sources of energy (Faiza *et al*., 2003). Orange peels could replace corn in fish feeds because the protein content of corn varies from 9.0-10.0 percent (Megias *et al*., 1993)

Moreover, unfermented orange peels can replace 20 percent of corn in African catfish diets, while fermented peels can enhance mineralization in the fish (Nwanna *et al*., 2011). So, orange peel composition explains why the peels of oranges are used in animal feeds. On a dry matter basis, nutritional values of the peels are comparable with concentrates such as sorghum, barley and corn (Oluremi *et al*., 2006). Citrus lime peel in fish diets could improve the enzymatic antioxidant capacity, immune response and enhanced the serum lysozymes myeloperoxidase level and phagocytic activity. Similarly, the blood parameter results showed that Nile tilapia fed 2% dietary lemon peel had the lowest triglyceride and glucose levels, in contrast, resulted with thin lip mullet fed 0.5% dietary lemon (Mohamed *et al*., 2018). Similarly Metwally and El-Gallal (2009) studied the changes in growth rate; various blood constituents of Nile tilapia (*Oreochromis niloticus*) fed on diets containing different remaining plant materials. Cholesterol, triglycerides, AST and ALT concentrations showed obvious increase in fish fed on olive mill than the other groups. Glycogen content in liver and muscles increased in groups 1and 2 than other groups. This activity requires high-quality feeds, which should contain not only necessary nutrients but also complementary feed additives to keep organism's healthy as well as favor growth and environment-friendly aquaculture (Eid and Mohamed, 2008).

Given economic considerations, significant efforts should be devoted to reducing waste outputs from aquaculture operations. Since most aquaculture wastes are ultimately from dietary origin, reduction of waste outputs should first be through improvements of diet formulation and feeding strategies. The first step less solid waste is to eliminate poorly digestible ingredients and to use highly digestible one. (Cho, 2002). In addition, use of low cost live feed supplements as feed additives is highly accepted and encouraged due to its eco-

friendly nature, savings with the environmental improvement of the decline ammonia in the water medium (Lim *et al.*, 2013)

The use of organic waste provides not only cheap alternative source of fish feed but also eliminates the problems associated with indiscriminate dumping of organic waste in the environment because of the associated air, water and soil pollution (Akamkaili and Nabila, 2015). Natural feeding is a money saver, since most commonly used fish feed contains fish meal as protein source, which ranges between 10-50% of the operational costs. Moreover, the common edible fish's food habits have been well established, but we can easily use food waste to reduce cost and increase income (Gupta and Banerjee, 2016)

The present study aimed to study using orange peel waste as an replacement of yellow corn on growth performance, feed utilization and economical evaluation.

MATERIALS AND METHODS

The present study was carried out in the privet fish farm in El Kantra-Ismailia Governorate. This experiment was designed in order to using orang fruit peel waste as an replacement of yellow corn on growth performance , feed utilization ,economical evaluation, carcass composition and some blood constituents in Red tilapia fingerlings.

Management of experimental fish:

Red tilapia fingerling with an average initial body weight of (27±0.50 g) was used in this experiment. It is being homogenous in body weights and apparently healthy. The experimental fish were adapted for two weeks in floating cages in a water pond. At the start of the experiment, 360 fish were chosen, healthy fish weighed and then distributed randomly into experimental units.

Experimental units:

Fish were stocked in concrete basins (distances 3× 2× 1.25m) under a plastic greenhouse condition. There are 9 basins distributed for first protein level (25%) as following design (3 treatments ×3 replicates), similarly, another 9 basins for second level of protein (30%). Each basin provided with 20 fish and supplied with air blowers. Increase health and immunity by using Pond Toss™ compound to consume organic waste and uneaten food before they begin to decay, preventing accumulation of harmful ammonia, nitrite, and nitrate that are difficult to remove, can be toxic, and can cause health problems. When Pond Toss™ is consumed by fish stock they stimulate the immune response. Improved water quality reduces the need for water exchanges and increasing biosecurity.

Water used properties:

Water quality parameters were measured daily. Water temperature was maintained at (25 ±1^{o}C) by using a 250-watt immersion heater with thermostat, dissolved oxygen concentration (4.7 mg/L) were measured using an apparatus model Lutron 206 (Lutron Taiwan). The water pH value (7.7) was determined using a Lutron 5510 pH meter (Lutron Taiwan). However, ammonia concentration was about 0.07mg/L. Photoperiod was 12h light/ 12h dark. The basin water was exchanged with fresh water 2-3 time per week, washed and changed with fresh water every 4 weeks.

Material used in study:

Preparation of orange peel waste:

Draying orange peel waste is the first step of utilization of orange peel, samples draying by microwave methods according to (Abd El- Ghfar1 *et al.*, 2016). The orange dried peels were grounded to a fine powder using a mechanical laboratory grinder and passed through a 24-mesh sieve, then packaged in polyethylene bags and stored at 4±1°C until use. Other components are presented in Table 1.

Table 1. Chemical composition for orange peel incomparable with some grain crops based on the base of solids ratio.

Item	Orang peel[1]	Sorghum	Barley	Corn
Dray matter %	14.25	87.00	87.00	86.00
Crude protein	7.00	10.50	12.10	9.90
Crude fibre	12.50	3.40	6.30	2.90
Fat	3.50	3.20	2.10	4.70
Ash	5.50	2.00	2.90	1.40
T.D.N. %	87.00	80.00	83.00	87.00
ME	3.42	3.11	3.24	3.46

Dry matter elemental analysis contents (mg/kg) was as follow: Calcium (3.30)-phosphorus (2.30) and Iron (0.40). Vitamins analysis (unit) was as follows: Ascorbic acid (49.00) – Thiamine (0.08) –Riboflavin (0.03) –Niacin (0.02)

The experiment:

The experimental work used orange peel waste (OP) powder as an energy source alternative of yellow corn by levels of 50% and 75%. At the end of the experimental period, a total number of 360 fingerlings were randomly assigned to 18 basins with 20 fish per one. Three replicates were made for each treatment. The ponds were subdivided into 9 basins for each level of protein (25 and 30%). The promoter Digestrom was used with rate of 200 mg /kg diet in all experimental basins. Red tilapia fingerlings are fed to saturation.

The design of treatment:

In each level of protein (25% and 30%) the diet mixed with three levels of orange peel waste as an alternative to corn by rates (0.0, 0.50 and 75%) as shown in Table 2.

Table 2. Ingredients and chemical composition of experimental diets.

	protein level %					
	25					30
Treatments / **Ingredients**	**T1 (0.0%) orange peel waste**	**T2 (50%) orange peel waste**	**T3 (75%) orange peel waste**	**T4 (0.0%) orange peel waste**	**T5 (50%) orange peel waste**	**T6 (75%) orange peel waste**
fish meal (60%) protein	5.00	5.00	5.00	5.00	5.00	5.00
Soybean meal (45%) protein	25.00	25.00	25.00	30.00	30.00	30.00
Corn Gluten(60%) protein	9.00	9.00	9.00	15.00	15.00	15.00
Rice bran	14.00	14.00	14.00	14.00	14.00	14.00
Yellow corn	43.00	21.50	10.75	32.00	16.00	8.00
Orange peel waste	00.00	21.50	32.25	00.00	16.00	24.00
Sun flour oil	3.00	3.00	3.00	3.00	3.00	3.00
Mineral mixture[1]	0.50	0.50	0.50	0.50	0.50	0.50
Vitamin mixture[2]	0.50	0.50	0.50	0.50	0.50	0.50
Total	100	100	100	100	100	100
Proximate analysis						
Protein	24.86	24.73	24.68	29.67	29.61	29.57
Lipids	7.60	9.42	10.34	7.11	6.82	6.68
Ash	5.63	6.25	6.56	5.35	6.37	6.66
Fibers	6.12	7.94	8.64	7.48	8.61	9.13
NFE[3]	60.00	53.39	50.06	53.33	50.55	48.75
Gross energy (Kcal /100g)[4]	457.64	446.92	442.83	454.17	439.49	430.58
Cost /Kg (L.E)	7.68	6.97	6.62	8.48	7.95	7.69

1. Each Kg mineral mixture premix contained Mn, 22 g; Zn, 22 g; Fe, 12 g; Cu, 4 g; I, 0.4 g, Selenium, 0.4 g and Co, 4.8 mg.Each Kg
2. Vitamin contained Vitamin A, 4.8 million IU, D3, 0.8 million IU; E, 4 g; K, 0.8 g; B1, 0.4 g; Riboflavin, 1.6 g; B6, 0.6 g, B12, 4 mg; Pantothenic acid, 4 g; Nicotinic acid, 8 g; Folic acid, 0.4 g Biotin,20 mg,. Ascorbic acid (49.00) – Thiamine (0.08) –Riboflavin (0.03) –Niacin (0.02)
3. Nitrogen Free Extract = 100 – (%Protein + %Fat + %Fiber + %Ash).
4. Gross Energy based on protein (5.65 Kcal/g), fat (9.45 Kcal/g) and carbohydrate (4.11Kcal/g). According to (NRC, 2011).

Growth performance parameters:

The growth performance parameters are calculated according to the following equations:

Weight gain (WG) = final weight(g)- initial weight (g).

Weight gain percent (WG%) = (Final weight–initial weight) / initial weight×100.

Average daily gain (ADG) = [Average final weight (g) – Average initial weight (g)] / time (days).

Specific Growth Rate (SGR %/day) = 100 [(Ln final weight – Ln initial weight) / time].

Feed utilization parameters:

Feed Intake (FI) = Amount of consumed feed per period (g).

Feed Conversion Ratio (FCR)= Total feed consumption (g)/ weight gain (g).

Feed Efficiency (FE) = weight gain (g) / Total feed consumption (g).

Protein Efficiency Ratio (PER) = body weight gain (g)/ protein intake (g).

Survival Rate (SR %)= 100× (final number of fish in basin/initial number of fish survived).

Body chemical composition:

At the beginning and end of the experiment, 5 fish sample was taken randomly from each experimental group to determine chemical analysis of body components. The whole body composition of fish samples was analyzed for crude protein (CP %), ether extract (EE %), dray matter (DM %) and ash (%). All chemical analyses were carried out in three replicate according to **(AOAC, 2009**).The gross energy contents of the fish samples were calculated using factors of 5.65, 9.45 and 4.11 k.cal/g of protein, carbohydrate and lipid respectively **(NRC, 2003)**.

Blood sample and hematology:

At the end of the experimental period 10 fish were randomly taken from each replicate. The blood samples were collected from caudal vain by syringe. The red and blood cells were counted and hemoglobin (g/dl) concentrations were determined by using commercial Kits (Elnasr Pharmaceutical Chemicals Co. Egypt).

Serum constituents:

Serum of blood samples were then separated by centrifugation at 3000 (rpm) for 5 minutes. Serum was stored at -20C^{o} until analysis for urea, total protein (g/dl), albumin (g/dl), cholesterol (mg %), aspartate aminotransferase, AST (u/ml) Glutamic oxalo-acetic transaminase and serum alanine aminotransferase ALT (u/ml) which were determined using Kits supplied by Elnasr Pharmaceutical Chemicals Co. (Egypt). Serum globulin (g/dl) levels were obtained by differences between total protein (g/dl) and albumin (g/dl). Serum triglycerides (mg/dl) were determined calorimetrically using commercial Kits of Bio Diagnostic Co. (Egypt).

Economical Evaluation:

The cost of feed to raise unit biomass of fish was estimated by a simple economic analysis. The estimation was based on local retail sale market price of all the dietary ingredients at the time of the study (2019).

Cost /kg diet (LE) = Cost per Kg diet L.E.

Consumed feed to produce 1kg fish (kg) = Feed intake per fish per period/ final weight.

Feed cost per kg fresh fish (LE) = Step 1X step 2

Relative % of feed cost/ kg fish = Respective figures for step 3/ highest figure in this step

Feed cost /1Kg gain (LE) = Feed intake per Kg gain X step 1.

Relative % of feed cost of Kg gain = Respective figures for step 5/ highest figure in this step.

Cost of 1 kg ingredients used were calculated byL.E, Egypt pound at end of 2018 and started 2019.

Statistical analysis:

The data obtained in this study were analyzed by one-way ANOVA procedure of Statistical Analysis System (SAS, 1998). Means were compared by Duncan's new multiple ranges test Duncan (1955).

RESULTS AND DISCUSSION

The effect of replacement of yellow corn with orange peel on growth and survival rates of Red tilapia is summarized in Table 3. The results revealed that fish fed on dietary orange peel 2 g kg-1 diet (T2) significantly ($P \leq 0.05$) produced the highest final body weight (FW), body weight gain (WG), average daily gain (ADG) and specific growth rate (SGR), followed by fish fed on orange peel 50g kg-1 diet (T5). Increasing dietary replacement of OP to 75%resulted in a significant reduction ($P \leq 0.05$) in growth rates. These results in a general agreement with that mentioned by Guimaries *et al*. (2010); Siyal *et al.* (2016); Mohamed *et al*. (2018) and Afaf *et al*. (2019). Similarly, growth performance parameters and feed utilization indices were improved in Nile tilapia fed diet supplemented with *Aspragalus* polysaccharides (Zahran *et al*., 2014 and Mo.Lun *et al*., 2016) and blackberry syrup (Yilmaz *et al.*, 2019) . On the other hand, treatment No. (3) replacing 75% of the corn by orange peel waste, resulted in a growth inhibitory effect and recorded the lowest results incomparable to control for the previous weights measurements, in spite of its consumed more food than control. Similar trend was detected when using 25 or 30% protein levels in the diet components. It is worth to mentioned that these data in contrast with that obtained by Doan *et al*. (2018). Similar results were obtained by Abdel-Tawwab *et al.*(2010) and Acar *et al*. (2015), who studied the effect of essential oil extracted (EO) from sweet orange peel (*Citrus sinensis*) on growth performance of Mozambique tilapia (*Oreochromis mossambicus).*

Table 3. The effect of replacement of corn with orange peel on growth performance, feed utilization and survival rates of Red tilapia.

Items \ Treatments	Protein levels					
	25 %			30		
	Control T1	T2 50%	T3 75%	Control T4	T5 50%	T6 75%
Initial weight (g)	30.40	29.96	30.40	30.03	30.32	30.29
Final weight (g)	64.50^{c} ±0.13	78.46^{a} ±0.10	59.56^{d} ±0.12	62.40^{b} ±0.13	68.43^{b} ±0.10	56.45^{d} ±0.10
Weight gain (g)	34.12^{c} ±0.10	48.50^{a} ±0.10	29.16^{d} ±0.10	32.37^{b} ±0.10	38.11^{b} ±0.10	26.16^{d} ±0.10
Weight gain (%)	112.24^{c} ±0.11	161.88^{a} ±0.11	95.92^{d} ±0.11	107.79^{b} ±0.11	125.69^{b} ±0.11	86.36^{d} ±0.11
Average daily gain	0.61^{c} ±0.13	0.87^{a} ±0.12	0.52^{d} ±0.14	0.58^{b} ±0.11	0.68^{b} ±0.10	0.47^{d} ±0.13
Specific growth rate	1.34^{c} ±0.15	1.72^{a} ±0.12	1.20^{d} ±0.11	1.31^{b} ±0.15	1.45^{b} ±0.12	1.11^{d} ±0.11
Feed intake (g) feed /fish	66.37^{c} ±0.14	82.26^{a} ±0.12	78.27^{b} ±0.10	65.07^{c} ±0.14	80.25^{a} ±0.12	72.79^{b} ±0.10
Food conversion ratio	1.95^{c} ±0.13	1.70^{d} ±0.11	2.69^{a} ±0.10	2.01^{b} ±0.13	2.11^{b} ±0.11	2.78^{a} ±0.10
Feed efficiency	0.51^{b} ±0.11	0.59^{a} ±0.13	0.37^{d} ±0.10	0.50^{b} ±0.13	0.47^{c} ±0.11	0.36^{d} ±0.10
Protein efficiency ratio	2.06^{b} ±0.13	2.36^{a} ±0.11	1.49^{e} ±0.10	1.66^{c} ±0.13	1.58^{d} ±0.11	1.20^{f} ±0.10
Survival rate (%)	98.33^{a} ±0.14	98.33^{a} ±0.14	86.67^{c} ±0.11	96.67^{b} ±0.12	85.00^{c} ±0.11	85.00^{c} ±0.11

Means within the same row with different superscripts are significantly different ($p<0.05$).

The authors revealed that dietary orange EO can act as a growth promoter for Mozambique tilapia (*Oreochromis mossambicus*), where the weight gain of fish fed orange EO supplemented diet was significantly higher than those fed on other diets. Orange peels have been found to contain alkaloids, saponins, terpenes, resins, flavonoids, phenols, and tannins (Al-Saadi *et al.,* 2009). It has been reported that herbs that contain such potent bioactive components may

influence digestive processes in a positive way by enhancing enzyme activity, improving digestibility of nutrients and feed absorption, consequently resulting in an improvement in fish growth (Immanuel *et al*., 2009; Citarasu, 2010; Kaleeswaran, *et al.,* 2010 and Hashemi and Davoodi, 2011). Therefore, all these effects of phytochemicals have been found to promote growth in fish (Immanuel *et al*., 2009). For instance, Sweet orange peel was found to contain considerable amount of saponin (Oluremi *et al.,* 2007). When, Nile tilapia (*Oreochromis niloticus)* fingerlings fed diets supplemented with the dietary ginseng herb containing saponin as an active chemical component, It greatly enhanced the growth and diet utilization efficiency (Goda, 2008). Feed intake was significantly ($P<0.05$) higher in group of fish on T2 which orange peel replace corn at level 25% and the lower feed intake was recorded in control of 30% crude protein. The lower food conversion ratio recorded in group of fish in T2 which orange peel replace corn at level 25% while the highest food conversion ratio recorded in T5 in 30% crude protein levels. Similar results was obtained by El-Boushy and Van der Poel (2013) revealed that orange fruits by-products enhanced the FCR of animals in poultry sector when compared with traditional feed. In agreement with Salem and Abdel-Ghany (2018). The group of fish on T2 had a significantly ($P<0.05$) higher FE and PER than the rest of experimental groups. The lowest FE and PER was recorded in group of fish on T6 (30% replace corn). The group of fish on control and T1 (25% replace corn) had a significantly higher ($P<0.05$) survival rate than the rest of experimental groups. In agreement with Salem and Abdel-Ghany (2018).

The lowest survival rate was recorded in group of on T3 in both %25 and 30% replace corn. These data in a harmony with that reported by Bimbo and Crowther. (1992). Similar results was obtained by Salem and Abdel-Ghany (2018). Therefore, we recommend using a diet containing 25% protein and substituting 50% of corn by orange peel waste, These results in agreement with (Megias *et al.,* 1993).

Chemical composition of fish:

Table (4) shown dry matter in the fish body, the addition of 50% orange peel with 25% protein in the diet gave insignificant results, while 30% protein

in the diet increased the dry matter with addition of orange peel. As respect of protein content in fish, the results indicated that addition orange peel increased protein in fish fed on a diet containing 25% protein, while more addition of orange peel up to (75%) reduced the protein content in fish that feed on 30% protein in the diet in agreement with Salem and Abd El-Gany (2018).

This supports the results of the present study, as the body protein content slightly increased with the increasing of OP levels. Determination of fat content in fish confirmed that the addition of orange peel by 50% for fish fed on a diet containing 25% protein significantly increased the fat content. On the contrary, the same percentage of orange peel replacement reduced fat in the body of fish fed on a diet containing 30% protein. As for the percent of ash in the body of fish, the results showed that the replacement of orange peel reduced ash in the body of fish fed 25% protein in the diet. On the contrary, the percent of ash in fish fed on a diet containing 30% protein was increased. In catfish fed oregano essential oil and carvacrol and thymol in combination, muscle protein content was increased (Zheng *et al*., 2009). Our proximate analysis results as well as the other two studies suggest that phytogenic supplementation may have a beneficial effect of reducing fillet fat, enhancing protein deposition, and increasing antioxidant activity. In agreement with (Giannenas *et al*., 2012).

Table 4. Carcass chemical composition of red tilapia fed diet replacement by different levels of orange peel waste on dry matter basis**.**

Items	**Protein levels (%)**					
	25%			**30%**		
Orange peel level	**T1(0.0%)**	**T2(50%)**	**T3(75%)**	**T4(0.0%)**	**T5(50%)**	**T6(75%)**
Dry matter (%)	27.38^{a} ±0.10	27.21^{a} ±0.11	27.63^{a} ±0.12	27.38^{a} ±0.13	26.63^{b} ±0.14	26.48^{b} ±0.15
Protein (%)	56.38^{b} ±0.15	58.88^{a} ±0.14	57.08^{a} ±0.13	57.54^{a} ±0.12	56.08^{b} ±0.11	55.04^{c} ±0.10
Lipid (%)	20.85^{b} ±0.15	21.08^{a} ±0.10	20.45^{b} ±0.14	22.07^{a} ±0.13	20.85^{b} ±0.12	22.03^{a} ±0.11
Ash (%)	15.41^{a} ±0.10	$14,80^{b}$ ±0.12	14.71^{b} ±0.13	15.27^{b} ±0.14	15.41^{b} ±0.15	16.34^{a} ±0.11

Means within the same row with different superscripts are significantly different ($p<0.05$).

Blood biochemical component:

Results in Table (5) showed that fish fed with diets containing different addition of orange peel waste (50% or 75%) with or without Digestrom promoter exhibited a variable trend according to protein levels used (25% or 30%) in diet. Blood characteristics are very important tools that can be used as effective indices of water balance, nutritional status and overall health condition in fish (Nwani *et al*., 2015 and Zaahkook *et al.*, 2016).

Numerous dietary supplements have measurable effects on blood constituents (Animashahun *et al*. 2006 and Bhatti *et al*., 2009). Therefore, hematological and blood biochemical variables have been used as indicators of health status in fish of many species fed different kinds of food. Diet composition and metabolic adaptation are the main factors responsible for changes in hematological and blood biochemical variables in fish (Ighwela *et al*., 2012). Such parameters are reliable indicators of fish physiological status and are often used to evaluate fish health and immune potential (Kondera *et al*., 2017). pomegranate peel (PP) extract has extensively been studied for its strong antimicrobial and anti-inflammatory effects (Jurenka, 2008). Concerning the effect of orange peel waste addition (replacement by 50%), increased the following components (hemoglobin, red blood cells, albumin/ globulin ratio, total protein, creatinine, urea, albumin, triglycerides, HDL, blood cells, LDH, ALT3 and AST values) at 25 and 30% replacement. In agreement with a (Araujo *et al.*, 2017). Similar results was obtained by Yılmaz *et al.* (2012). These results proved the improvement of fish health when Digestrom supplemented diets. Moreover, the measurement of albumin, globulin, and total protein in serum or plasma is of considerable diagnostic value in fish, as it affects the general nutritional status as well as the integrity of the vascular system and liver function (Metwalli, 2009).

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Economical Evaluation:

The estimation wasbased on the local retail sale market price of all the dietary ingredients at the time of the study (2018/2019). Cost of 1 kg ingredients used were (7.68, 6.93, 6.58, 8.48, 7.91 and 7.65) for T1, T2, T3, T4, T5, and T6 respectively. Feed cost of kg: calculated from the price of feed ingredient and the cost per kg gain (FCR× price of kg feed) 1.03, 1.05, 1.31, 1.04, 1.17, and 1.29 T1, T2, T3, T4, T5, and T6 respectively. Reduction % of feed cost of Kg gain was calculated as a percentage from the highest value. The cost-effective production of high quality products from less-expensive agro-industrial by-products is a target within the feed industry in Egypt (El-Sayed *et al*., 2014). A large quantity of pomegranate peel (PP) residues is produced in juice manufacturing, representing a valuable waste of the food industry as they contain bioactive compounds (Toutou *et al*., 2019).

Table 5. Effect of replacement of yellow corn with orange peel on some blood components of Red tilapia fingerlings.

Items	Protein levels (%)							
	25%				30%			
Orange peel % Digestarom mg/kg	Control 0.0	0.0% 200	50% 200	75% 200	Control 0.0	0.0% 200	50% 200	75% 200
Hemoglobin (g /dL-1)	5.01^{f} ±0.11	6.50^{c} ±0.12	7.69^{a} ±0.10	5.05^{f} ±0.13	5.90^{e} ±0.14	7.02^{b} ±0.10	7.40^{a} ±0.15	6.30^{d} ±0.10
Red blood cells (RBCs)[1]	1.95^{e} ±0.12	2.40^{e} ±0.11	3.74^{a} ±0.13	1.47^{f} ±0.15	2.30^{d} ±0.14	2.90^{b} ±0.10	3.80^{a} ±0.12	2.01^{c} ±0.11
White blood cells (WBCs)[2]	21.30^{e} ±0.10	22.96^{c} ±0.11	23.96^{a} ±0.15	22.05^{c} ±0.14	22.24^{b} ±0.13	22.00^{b} ±0.10	23.10^{a} ±0.12	22.02^{d} ±0.11
Total Protein (g/dl)	2.00^{d} ±0.10	2.43^{a} ±0.11	2.46^{a} ±0.12	2.28^{b} ±0.13	2.00^{d} ±0.14	2.20^{c} ±0.15	2.42^{a} ±0.10	2.28^{b} ±0.11
Serum Creatinine (mg/dl)	0.32^{d} ±0.12	0.32^{c} ±0.10	0.40^{a} ±0.11	0.39^{b} ±0.13	0.32^{d} ±0.15	0.30^{a} ±0.14	0.45^{a} ±0.11	0.31$^{b.}$ ±0.12
Urea(mg/dl)	2.90^{c} ±0.11	3.00^{c} ±0.10	3.50^{a} ±0.12	3.20^{b} ±0.13	2.90^{c} ±0.15	3.00^{c} ±0.14	3.50^{a} ±0.10	3.20^{b} ±0.11
Albumin(g/dl)	0.80^{d} ±0.10	0.90^{b} ±0.12	0.95^{a} ±0.11	0.83^{c} ±0.13	0.86^{d} ±0.15	0.90^{b} ±0.14	0.95^{a} ±0.11	0.85^{c} ±0.10
Globulin(g/dl)	1.30^{d} ±0.10	1.43^{c} ±0.11	1.55^{a} ±0.13	1.43^{b} ±0.14	1.32^{d} ±0.13	1.40^{c} ±0.14	1.57^{a} ±0.10	1.43^{b} ±0.11
Albumin/ Globulin Ratio	59.77^{d} ±0.11	67.82^{c} ±0.13	75.44^{a} ±0.14	61.00^{b} ±0.15	59.66^{d} ±0.12	67.12^{c} ±0.13	74.14^{a} ±0.12	60.47^{b} ±0.15
Triglycerides (mg/dl)	95.50^{d} ±0.12	96.30^{c} ±0.11	96.50^{a} ±0.13	90.00^{b} ±0.15	95.15^{d} ±0.11	96.62^{c} ±0.13	97.10^{a} ±0.11	89.80^{b} ±0.13
HDL-C(mg/dl)[3]	35.60^{d} ±0.12	42.01^{a} ±0.11	39.50^{c} ±0.15	41.00^{b} ±0.14	38.20^{c} ±0.13	46.14^{a} ±0.11	41.20^{b} ±0.14	31.00^{d} ±0.15
LDL-C(mg/dl)[4]	82.12^{b} ±0.12	76.10^{d} ±0.11	79.40^{c} ±0.13	91.00^{a} ±0.14	72.50^{c} ±0.15	77.30^{b} ±0.13	81.20^{a} ±0.10	81.00^{a} ±0.11
ALT3 (U/dl)[5]	41.00^{b} ±0.11	38.00^{c} ±0.12	42.00^{b} ±0.13	56.00^{a} ±0.15	38.00^{c} ±0.14	39.00^{c} ±0.12	41.00^{b} ±0.10	46.00^{a} ±0.11
AST(U/dl)[6]	123.5^{b} ±0.15	121.7^{c} ±0.14	124.8^{a} ±0.13	125.0^{a} ±0.12	126.10^{b} ±0.11	120.30^{c} ±0.10	124.2^{b} ±0.14	135.0^{a} ±0.10

Note: Values are means ± SE of three replications. Means in the same row having different superscripts are significantly different (P <0.05). 1. RBC- Red Blood Cells 2. WBC – White Blood Cells.
3. (HDL-C) High – density lipoprotein cholesterol. 4. (LDL-C) Low – density lipoprotein cholestero.l
5. ALT (SGPT) Alanine aminotransferase. 6. (AST) aspartate aminotransferase.

Table 6. Economical analysis of replacement yellow corn with orange peel of Red tilapia fingerlings.

Items	Treatments					
	Diet 25% protein			Diet 30% protein		
	T1 (0.0%) Control	T2 (50%) Orange	T3 (75%) Orange	T1 (0.0%) Control	T2 (50%) Orange	T3 (75%) Orange
Cost /kg diet (LE)[1&7]	7.68	6.93	6.58	8.48	7.91	7.65
Consumed feed to produce 1kg fish (kg)[2]	1.03	1.05	1.31	1.04	1.17	1.29
Feed cost per kg fresh fish (LE)[3]	7.91	7.28	8.62	8.82	9.25	9.87
Relative % of feed cost/ g fish[4]	91.76	84.45	100	89.36	93.72	100
Consumed feed to produce 1 Kg gain(Kg	1.95	1.70	2.69	2.01	2.11	2.78
Feed cost /1Kg gain(LE)[5]	14.98	11.78	17.70	17.04	16.69	21.27
Relative % of feed cost of Kg gain[6]	84.63	66.55	100	80.11	78.67	100

1-Cost /kg diet (LE) = Cost per Kg diet L.E.
2-Consumed feed to produce 1kg fish (kg) = Feed intake per fish per period/ final weight per fish Kg/Kg.
3-Feed cost per kg fresh fish (LE) = Step 1X step 2.
4-Relative % of feed cost/ kg fish = Respective figures for step 3/ highest figure in this step.
5-Feed cost /1Kg gain (LE) = Feed intake per Kg gain X step 1.
6-Relative % of feed cost of Kg gain = Respective figures for step 5/ highest figure in this step.
7-Component cost / kg: commercial fish meal (4.5l/k g); commercial Spirulina(105l/kg); corn meal (1.8l/kg); Rice bran (1.5l/kg); sunflower oil (8.00l/kg); mineral mix (1.5l/kg) and vitamin (3.5l/kg).

Calculations of economic efficiency of the tested diets based on the cost of feed, costs of one Kg gain in weight and its ratio with the control group are shown in Table (6). For addition of 50% orange peel waste, the applications led to a reduction in cost /kg diet, feed cost per kg fresh fish, relative % of feed cost/ g fish, consumed feed to produce 1 kg fish gain, feed cost /1kg gain, and relative % of feed cost of kg gain. Increasing peel waste addition to 75% tended to raise all measurements in comparison with control. Simultaneously, using diets contained 30% protein with 50% or 75% orange peel waste addition showed increases in consumed feed to produce 1kg fish (kg), feed cost per kg fresh fish (LE), relative % of feed cost/ g fish, consumed feed to produce 1 Kg gain(Kg), feed cost /1Kg gain(LE)and relative % of feed cost of Kg gain. In

contrast reduced cost /kg diet (LE). The obtained results there are in a general agreement with that mentioned by Dada (2015) and Kristina *et al*. (2015).

In conclusion, dried orange peels can efficiently be replaced yellow corn for Red tilapia fingerlings diets but to a certain limit. The optimal response was found to occur at 50% replacement of corn diet.

CONCLUSION

It could be concluded that the best level of replacement corn with 25% corn in term of growth performance , feed utilization and economic efficiency under the present experimental conditions.

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تأثير استخدام قشر البرتقال على أداء النمو والاستفادة الغذائية في إصبعيات البلطي الأحمر

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الملخـــــص العربـــــى

أجريت هذه الدراسة بمزرعة خاصة (قنطرة غرب) بمحافظة الاسماعلية جمهورية مصر العربية بهدف دراسة تأثير استبدال مكون الذره الصفراء فى العليقه بمخلفات قشور البرتقال بنسب صفر، ٥٠%، ٧٥% على نمو أصبعيات البلطى الاحمر. الاصبعيات التى تغذت على عليقه أستبدل فيها٥٠% من الذرة اعطت افضل النتائج المتعلقة بقياسات النمو والغذاء وهذه كانت نتيجة منطقية بالقياس لكمية الغذاء التى استهلكتها الاسماك. على العكس من ذلك اضافة زيادة قشور البرتقال الى ٧٥% ادى الى زيادة اليوريا و لدهون الثلاثية فى الدم كما اظهرت النتائج تحسن في صحة الأسماك نتيجة عملية الاحلال الغذائي، حيث ارتفعت قيم كل من البروتين الكلى للسيرم والكرياتين واليوريا والألبيومين والجلوبيولين والجليسريدات الثلاثية والكولسترول المرتفع الكثافة بينما انخفضت قيم الألبيومين / الجلوبيولين والكولسترول منخفض الكثافة وانزيمات الكبد (ALT, AST) .

بالنسبة للمادة الجافة فى جسم الاسماك فإن إضافة قشور برتقال بنسبة ٥٠% مع مستوى ٢٥% بروتين فى العليقة أعطت نتائج غير معنوية بينما بزيادة نسبة البروتين فى العليقة الى٣٠% زادت المادة الجافة فى الاسماك عند إضافة قشور البرتقال بنسبتيه. وبتقدير النسبة المئوية للبروتين فى الاسماك اشارت النتائج الى ان اضافة قشور البرتقال يزيد من البروتين فى الاسماك التى تتغذى على عليقة تحتوى ٢٥% بروتين، بينما يخفض نسبة البروتين فى الاسماك التى تتغذى على ٣٠% بروتين فى العليقة.

تقدير نسبة الدهون فى الاسماك اكد ان اضافة قشور البرتقال بنسبة ٥٠% للاسماك التى تغذت على عليقة تحتوى ٢٥% بروتين زادت بها نسبة الدهون معنويا. وعلى العكس من ذلك نفس نسبة الاضافة لقشور البرتقال خفضت الدهون فى جسم الاسماك التى تغذت على عليقة تحتوى ٣٠% بروتين.

فيما يخص نسبة الرماد فى جسم الاسماك اوضحت النتائج ان اضافة قشور البرتقال خفض الرماد فى جسم الاسماك التى تغذت على ٢٥% بروتين فى العليقة.و العكس صحيح فقد زادت نسبة الرماد فى اجسام الاسماك التى تغذت على عليقة تحتوى ٣٠% بروتين بالقياس بالكونترول والمعاملات الاخرى.

ويستنتج من هذه الدراسة ان استبدال الذرة الصفراء بنسبة ٥٠% بمخلف قشر البرتقال كان الافضل تأثيرا على نمو اصبعيات أسماك البلطي الاحمر وكذلك من الناحية الاقتصادية تحت ظروف هذه التجربة.