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UTILIZATION OF SOME UNCONVENTIONAL PROTEIN SOURCES IN THE DIET OF BLUE TILAPIA (*Oreochromis aureus*) CULTURED IN NET ENCLOSURES

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ABSTRACT

Sixteen weeks feeding experiment was conducted in net enclosures to study the effect of dietary kochia (*Kochia indica*) dried leaves and buds (KDLB) together with different unconventional protein sources on growth performance, feed utilization and carcass composition of blue tilapia (*Oreochromis aureus*). Two dietary levels of KDLB (15 and 30 %) were used with four protein sources [fish meal (FM), poultry viscera meal (PVM) yeast and the basal diet protein]. Forming eight isocaloric diets, approximately 23 % crude protein, were fed to duplicate groups of fish (initial weight 15.5 g) at a daily rate of 2.5 % of their body weight. The results revealed that growth performance and feed utilization of fish fed on 15 % KDLB diets were significantly higher than that fed 30 % KDLB diets. Feed conversion ratio of fish received the diets contained fish meal surpassed the other groups, followed by those received PVM then yeast and finally the basal diet. There were insignificant ($P > 0.05$) differences between fish fed diets contained FM or PVM in feed intake, PER, PPV and EU, While, significant differences were noticed between fish fed the diets contained yeast and those fed the basal diets. Body composition of fish was affected by dietary KDLB levels and protein sources. Moreover, the economical analysis of the tested diets indicated that inclusion of 30 % KDLB with PVM into the diet was the best, followed by that contained 15 % KDLB with PVM compared to the other tested diets. These data suggested that the inclusion of 15 % KDLB with poultry viscera meal could be used in the diet of blue tilapia without any adverse effect on either growth performance or feed and nutrient utilization compared to FM diets.
Keywords: Tilapia, Protein sources, Kochia

INTRODUCTION

The worldwide expansion of aquaculture in recent years has increased the demand for protein and energy sources for intensively cultured species. In addition, the rapid expansion of the livestock industry in many parts of the world is absorbing almost all of the feedstuffs produced (FAO, 1983). Meanwhile, the success of intensive fish production depends on a large extent of supplemental feeding (Halver, 1972). Feed represents the single largest expenditure in this operations and protein is the most expensive component in diets for aquatic species. (Higgs *et al.*, 1995). Protein requirement of fish in general is higher than that of livestock. To meet this requirement, fish meal is considered the ideal protein source and usually used at a high level in diets, from 25 to 60 % (average 35 %) (Tacon and Jackson, 1985). In turn, the price of fish meal which is the main protein source for cultured fish has increased sharply. Therefore, many efforts are continuously being made to find other alternative protein sources which are cheap, available and have a good nutritional value as substitutes for fish meal. Plant proteins are cheaper sources of feed for all types of fish.

Generally, it has been observed that a partial substitution of fish meal by plant protein sources is well supported by fish So currently more than 30% of fish meal is already replaced by plant proteins in most commercial fish feeds (Teskeredzic *et al.*, 1995). Under conditions of partial replacement of fish meal, reasonably good growth performance has been observed with minor effects on metabolism (Sanz *et al.*, 1994; Gomes *et al.*, 1995, Refstie *et al.*, 1997, and Me'dale *et al.*, 1998). Fish meal free diets have also been used with success in some studies with rainbow trout (Kaushik *et al.*, 1995, and Watanabe *et al.*, 1998). Many efforts estimate the potential of using unconventional plant protein in fish feeding as Hasan *et al.* (1990) who used leucaena and water hyacinth leaf meal as plant proteins in diets containing 20 and 40 % of total dietary protein for the fry of Indian major carp, *Labeo rohita*. Also, Srour *et al.* (2004) found that the inclusion of 15 % Kochia in the vegetarian diet for blue tilapia resulted in higher growth performance and feed utilization compared with 30, 45 and 60 % kochia levels. On the other hand, some studies have attempted to use unconventional animal protein (poultry by-products) in the diet of fish as fish meal protein replacers, since El-Sayed (1994) with seabream and Srour (2003) with catfish and tilapia. Meanwhile, yeasts have been also used as complementary protein source in fish diets together with fish meal and other animal protein sources (Liao, 1977). Few studies were conducted to evaluate the effect of complete substitution of fish meal by yeast in fish diet (Hecht, 1981 and Safner, 1987).

Therefore, the present work is an attempt to study the effect of combination some unconventional protein sources in the diet on growth performance, feed utilization and carcass composition of blue tilapia (*Oreochromis aureus*) cultured in net enclosures. A simple economic evaluation was considered.

MATERIALS AND METHODS

The experimental work of the present study was carried out in a private farm called Halk El-Gamal situated in El-Behera Governorate, to find out the effect of different unconventional protein sources together with Kochia (*Kochia indica*) dried leaves and buds (KDLB) in the diet of blue tilapia (*Oreochromis aureus*) cultured in net enclosures on its growth performance, feed utilization and carcass composition.

Fish and Culture Facilities

Tilapia (*O. aureas*) fingerlings averaging 15.5 g/fish, obtained from Halk El-Gamal Farm were used in the present study. One earthen pond of 1 feddan, 1 meter in depth (80 cm depth of water allowance) contained 16 net enclosures (80 X 80 X 100 cm in diameter) were used in the present experiment. About 50 % of the earthen pond water was changing every week. The net enclosures were randomly stocked in all treatments at a rate of 10 fish/enclosure net, with two replications per treatment. Fish of each replicate were weighed at the start of the experiment and henceforth counted and weighed every 2 weeks. About 20 fish were frozen for initial body chemical analysis. The experiment lasted for sixteen weeks from 1st June to 30th September 2005.

Experimental Diets

Herbs of *Kochia indica* were collected from various places in Alexandria (during August 2004) dried then leaves and buds were removed. Kochia dried leaves and buds (KDLB) were washed, dried (70° C for 24 hrs) and stored in plastic bags until incorporated into various treatments. Similarly, poultry viscera were collected fresh from the local Egyptian markets, cooked and treated by steam under pressure with continual agitation (Binkley and Vasak, 1950). The poultry cooked viscera were minced, oven dried at 60-80° C for 48 hrs, and then ground in a house mincer. Meanwhile, the commercial yeasts (*Saccharomysis cerevisiae*) were obtained from the Egyptian Company for Starch and Yeast Products. The other diets ingredients were bought from the local markets. Two levels of KDLB (15 and 30 % of the diet) and four protein sources [FM, PVM, yeast and the basal diet protein] were used to formulate eight diets of 23 % protein having the composition given in Table 2. However, the eight diets were almost isonitogenous and isocaloric. The ingredients were finely ground, mixed well and completed with essential vitamins and trace minerals (NRC, 1993). The oil was added, a few drops at a time, during mixing, warm water (45° C) was slowly added under continuous mixing until the diets began to clump. The diets were passed through commercial meat grander 3 times, and oven dried at 80° C for 24 hrs in a drying oven. Diets were fed to the experimental fish two times a day (10,00 and 14,00 hr) at a rate of 2.5 % of live body weight (the quantities were readjusted every two weeks) on feed dry weight basis (6 days a week).

Samples Collection and Analysis

At the termination of the experiment, fish were collected, weighed, counted per each replicate and samples from each treatment were taken for whole-body composition analysis. Fish samples were pulverized, autoclaved and afterwards homogenized with ultra-tunax. The homogenized samples were oven dried at 60 – 80° C for 48 hrs. Chemical composition of fish and feeds were performed using standard AOAC (1990) methods. All data were analyzed for statistical significances by using analysis of variance (Costat/PC program). Multiple comparisons among means were made with the Duncan Multiple range test (Puri and Mullen, 1980).

RESULTS AND DISCUSSION

A comparison among chemical analysis of fish meal (FM), poultry viscera meal (PVM), yeast and Kochia dried leaves and buds (KDLB) is shown in Table 1. The obtained results cleared that FM and PVM were almost similar in crude protein contents. The lower ash content was found in yeast compared with other protein sources but the content of nitrogen free extract was the highest. Lipids and gross energy were higher in PVM followed by FM. Kochia dried leaves and buds were lowest in protein and fat while higher in ash and crude fiber contents. Results of protein and ash of FM and PVM are in harmony with the findings of Fowler (1982), El-Sayed (1994) and Srour (2003). Also, the results of yeast analysis are nearly in agreement with the findings of Abd El-Rahman (1991). Moreover, the chemical composition of KDLB is almost in agreement with the results obtained by Srour *et al.* (2004). On the other hand, neither FM nor PVM contained crude fiber or nitrogen free extract.

Table (1): Proximate analysis (%) of different protein sources used in the experimental diets

Protein sources	DM	On dry matter basis					GE*
		CP	EE	Ash	CF	NFE	
FM	88.5	60.00	16.00	24.00	-	-	489.44
PVM	24.7	59.27	25.65	15.08	-	-	576.42
Yeast	89.0	42.00	5.7	6.8	1.8	43.7	470.30
KDLB	23.75	23.0	5.0	15.0	17.5	39.5	339.27

FM = Fish meal; PVM = Poultry viscera meal; KDLB = Kochia dried leaves and buds; DM = Dry matter; CP = Crude protein; EE = Ether extract; CF = Crude fiber and NFE = Nitrogen free extract.

***Gross energy (Kcal/100g DM), calculated on the basis of 5.64, 4.11 and 9.44 Kcal GE/g protein, NFE and lipid, respectively (NRC, 1993).**

The composition and proximate analysis (%) of the experimental diets are shown in Table 2. The experimental diets were almost isonitrogenous and isoenergetic, about 23 % and 382.6 – 398.1 Kcal GE/100 g protein and gross energy, respectively. The mean value of protein to energy ratio was 59.32 mg protein/ Kcal gross energy. The basal diets contained vegetarian protein source only had the higher values of crude fiber accordingly, diets contained 30 % KDLB were higher in crude fiber than those contained 15 % KDLB.

Data for growth performance of blue tilapia fed two levels of KDLB and different protein sources are shown in Table 3. Blue tilapia fed 15 % of KDLB in the diet had the higher values of final weight, gain, average daily gain and specific growth rate compared to the fish received 30 % KDLB in their diets. These data support the previous findings which also showed that blue tilapia received 15 % of Kochia in the diet had the higher values of growth performance parameter (Srour *et al.*, 2004). In regard to protein sources, growth performance was significantly ($P < 0.05$) higher in fish received diets contained fish meal (FM) followed by those received poultry viscera meal (PVM) and then those received yeast and finally fish received the basal diet (BD). Results obtained by Steffens (1994) on rainbow trout, revealed that poultry by-product is suitable as partial or complete replacement, but the complete substitution required amino acid supplementation. Whilst, El-Sayed (1994) found that growth performance of sea bream (*Rhabdosargus sarba*) fed chicken offal meal at 25 % substitution level were not significantly different ($P > 0.05$) from those fed the control diet. Meanwhile, Srour (2003) demonstrated that PVM as untraditional protein source could replace 25 : 50 % of FM protein for Nile tilapia and African catfish, respectively without any adverse effects on their growth performance. On the other hand, the decrease in growth performance in fish fed diets contained yeast versus those fed FM is in agreement with the results reported also on the blue tilapia by Wu and Jan (1977).

Table(2):Composition and proximate analysis of the experimental diets containing two levels of KDLB and different protein sources.

Ingredients	Diets							
	15 % KDLB				30 % KDLB			
	1	2	3	4	5	6	7	8
FM*	19.16	-	-	-	19.16	-	-	-
PVM*	-	19.40	-	-	-	19.40	-	-
Yeast	-	-	27.38	-	-	-	27.38	-
KDLB*	15.0	15.0	15.0	15.0	30.0	30.0	30.0	30.0
Soybean meal	6.00	5.60	8.00	36.65	3.10	2.28	4.50	29.80
Yellow corn	36.84	38.95	22.48	21.89	39.13	41.52	24.52	15.00
Wheat bran	19.12	19.00	20.20	21.00	4.80	4.80	6.70	19.55
Corn oil	1.88	0.05	4.94	3.46	1.81	-	4.90	3.65
Vit. & Min[1]	2	2	2	2	2	2	2	2
Total	**100**	**100**	**100**	**100**	**100**	**100**	**100**	**100**
	Nutrient (%) on dry matter basis:							
CP*	23.05	23.02	23.03	23.08	23.03	23.04	23.10	23.08
EE*	8.31	8.30	8.30	8.30	8.30	8.31	8.30	8.30
CF*	6.93	6.94	7.64	8.74	7.34	7.50	7.70	8.68
NFE*	42.59	42.94	46.20	44.00	42.41	42.98	46.00	43.83
Ash	19.12	18.80	14.83	15.88	18.92	18.17	14.90	15.91
Total	**100**	**100**	**100**	**100**	**100**	**100**	**100**	**100**
GE*	383.5	384.7	398.1	389.4	382.6	385.0	397.7	388.7
P/E ratio[2]	60.10	59.84	57.85	59.27	60.19	59.84	58.08	59.38

*** Abbreviations as footnoted in Table 1.**
[1]Meveco premix, Vit. & Min., every 1.5 kg contains Vit. A 125 million IU, D_3 3 million IU, E 15 g, K_3 2.5 g, B_1 1.5g, B_2 5 g, B_6 2 g, Pantothanic acid 10g, B_{12} 0.01g, Nicotinic acid 30g, , Folic acid 1.2 g, Fe 30g, Mn 60g, Cu 10g, I 1g, Cobalt 0.25 g, Se 10 g and Zn 55g.
[2]Protein to energy ratio (mg/Kcal)

The reduction in growth performance of fish fed the BD or that contained yeast, may attributed to one or more of several factors affecting the utilization of plant protein, including poor palatability, low digestibility, poor utilization of protein and amino acids, anti-nutritional factors and other unknown factors (Xie and Cui, 1998 and Becker and Makkar, 1999). Concerning the interaction between KDLB and protein sources, the higher values of growth performance was noticed in fish received the diets contained 15 and 30 % KDLB with fish meal followed by those received 15 and 30 % KDLB with PVM, respectively. Meanwhile, the lowest values recorded by fish received the BD diets with 15 and 30 % KDLB. Apparently, the inclusion of animal protein, especially FM, into vegetarian diet enhanced tilapia growth performance because of its high nutritional quality and biological value to tilapia (ADCP, 1983 and FDS, 1994). Also, Omar (1994) found that growth performance of Nile tilapia was higher with diets containing a mixture of FM and soybean (1:1) than diets with FM or soybean as a dietary sole protein source.

Data presented in Table 4 showed the effect of two levels of KDLB with different protein sources in the diet, on feed and nutrient utilization of blue tilapia (*Oreochromis aureus*) cultured in net enclosures. Regardless feed conversion ratio (FCR), insignificant differences were found between fish fed 15 and 30 % KDLB for feed and energy utilization. On the other hand, FCR of fish received diet contained 15 % KDLB surpassed those receiving 30 % KDLB. Except for the result of FCR the other results of feed and nutrient utilization are in accordance with the findings of Srour *et al.* (2004), this difference in the results of FCR may be due to the difference in the initial body weight of fish in the previous and the present study. In the meantime, FCR of fish received the diets contained FM surpassed other groups followed by those received PVM then yeast and finally the BD.

Table(3): Growth performance of blue tilapia (*Oreochromis aureus*) fed diets containing two levels of KDLB with different protein sources.

Kochia level (%)	Source of protein				Average*
	Fish meal	PVM	Yeast	Basal diet	
		Final weight (g/fish)			
15	69.50	65.40	57.80	54.10	**61.70[A]**
30	66.20	62.90	62.30	45.60	**59.25[B]**
Mean	**67.85[a]**	**64.15[b]**	**60.05[c]**	**49.85[d]**	60.475
		Gain (g/fish)[1]			
15	54.0	49.9	42.3	38.6	**46.20[A]**
30	50.7	47.4	46.8	30.1	**43.75[B]**
Mean	**52.35[a]**	**48.65[b]**	**44.55[c]**	**34.35[d]**	44.975
		ADG (mg/fish/day)[2]			
15	482.140	445.535	377.680	344.645	**412.500[A]**
30	452.680	423.230	417.860	268.750	**390.630[B]**
Mean	**467.410[a]**	**434.383[b]**	**397.770[c]**	**306.698[d]**	401.565
		SGR (%/day)[3]			
15	1.3395	1.2855	1.1750	1.1160	**1.229[A]**
30	1.2960	1.2505	1.2415	0.9635	**1.188[B]**
Mean	**1.31775[a]**	**1.26800[b]**	**1.20825[c]**	**1.03975[d]**	1.2085

Means in the same row with different superscripts are significantly different ($p < 0.05$).
***Means in this column having the same superscript are not significantly different ($p > 0.05$).**
[1]Gain (g/fish) = Final wt., g. – Initial wt., g.
[2]Average daily gain (mg/fish/day) = (Final wt. – Initial wt.) / period (days).
[3]Specific growth rate (%/day) = *100 (ln wt-ln wi) /T*, where *wt* is weight of fish at time *t*, *wi* is weight of fish at time 0, and *T* is the experimental period in days.

However, there were insignificant ($P > 0.05$) differences between fish fed on diet contained FM and those fed on diet contained PVM for feed intake, protein efficiency ratio (PER), protein productive value (PPV) and energy utilization (EU). The results are in partial agreement with the findings of Srour (2003) who mentioned that PVM could replace 25 to 50 % of fish meal in Nile tilapia and African catfish, respectively. He observed that Nile tilapia and African catfish received diets fully replaced FM with PVM had lower feed utilization compared to the other groups. These differences could be due to the rearing conditions (aquaria vs. net enclosures). On the other hand, a significant ($P < 0.05$) difference was noticed between the fish fed on the BD and that contained yeast. This is in agreement with the results of Peng *et al.* (2003) on striped bass. In contrast, fish fed the diets contained FM or PVM had significantly ($P < 0.05$) higher values of feed intake, PER, PPV and EU compared to the diets contained yeast or the BD. Based on the studies of

Rumsey *et al.* (1991) and Oliva-Teles and Goncalyes (2001) on rainbow trout and sea bass, respectively, yeast could replace up to 25 – 50% of FM protein without adverse effect on growth or feed efficiency of these species. This mean that as the replacement level increase more than 50 %, growth and feed efficiency could be lowered. Low palatability (Kim, 1974), low digestibility, deficiency in some essential amino acids, especially lysine (Viola *et al.*, 1982) and methionine (Jackson *et al.*, 1982), and poor utilization (Xie and Cui, 1998) of plant protein may explain the retardation in feed utilization of fish fed on diets contained yeast or the BD. Concerning interaction, fish received diet contained 15 % KDLB with FM revealed highly feed intake, PER, PPV, EU and better FCR compared to the other fish groups in all treatments. Conversely, fish received the BD with 30 % KDLB revealed the poorest feed intake, PER, PPV, EU and worst FCR compared to the other fish groups in all treatments. Similar results were obtained with Nile tilapia (*Oreochromis niloticus*) by Omar (1994) who gained greatly improve in the values of protein and energy utilization by using a mixture (1 : 1) of FM (animal protein) and soybean meal (plant protein) compared with the diets containing soybean meal as a sole protein source.

Table(4):Feed and nutrient utilization of blue tilapia (*Oreochromis aureus*) fed diets containing two levels of KDLB with different protein sources.

Kochia level (%)	Source of protein				Average*
	Fish meal	PVM	Yeast	Basal diet	
		Feed intake (g/fish)			
15	71.76	70.44	64.14	60.60	66.735^{A}
30	70.38	67.80	67.14	53.76	64.770^{A}
Mean	71.07^{a}	69.12^{a}	65.64^{b}	57.18^{c}	65.753
		FCR[1]			
15	1.33	1.42	1.54	1.57	1.460^{A}
30	1.39	1.43	1.44	1.79	1.510^{B}
Mean	1.36^{a}	1.43^{b}	1.49^{c}	1.68^{d}	1.490
		PER[2]			
15	3.265	3.080	2.665	2.675	2.921^{A}
30	3.130	3.035	3.005	2.425	2.898^{A}
Mean	3.198^{a}	3.058^{a}	2.835^{b}	2.550^{c}	2.910
		PPV (%)[3]			
15	48.355	42.990	36.830	38.775	41.738^{A}
30	43.020	45.140	39.925	35.905	40.998^{A}
Mean	45.688^{a}	44.065^{a}	38.378^{b}	37.340^{b}	41.368
		EU (%)[4]			
15	30.80	27.42	21.26	24.52	26.00^{A}
30	27.19	28.41	22.75	22.36	25.18^{A}
Mean	29.00^{a}	27.92^{a}	22.00^{b}	23.44^{b}	25.59

Means in the same row with different superscripts are significantly different ($p < 0.05$).
***Means in this column having the same superscript are not significantly different ($p > 0.05$).**
[1]Feed conversion ratio: total dry diet fed (g)/total wet weight gain (g).
[2]Protein efficiency ratio: wet weight gain (g)/amount of protein fed (g).
[3]Protein productive value (%): $(P-P_0)\ 100/P_i$ where P is protein content in fish carcass at the end of the experiment, P_0 is the protein content in fish carcass at the start of the experiment and P_i is the protein in feed intake.
[4]Energy utilization (%): $(E-E_0)\ 100/E_i$ where E is the energy in fish carcass (Kcal) at the end of the experiment, E_0 is the energy in fish carcass (Kcal) at the start of the experiment, and E_i is the energy in feed intake (Kcal).

However, FM is a good source for essential amino acids, fatty acids, digestible energy, macro and trace minerals, vitamins and generally act as a feeding stimulant for most finfish species (ADCP, 1983 and FDS, 1994). This may explain why fish fed the diets contained FM surpassing other fish fed on the diet free of FM in growth performance and feed efficiency ratios.

Data of body composition of blue tilapia (*Oreochromis aureus*) fed diets contained two levels of KDLB with different protein sources are presented in Table 5. Fish fed the diets contained 15 and 30 % KDLB had similar ($P > 0.05$) body dry matter and crude protein contents. However, fish fed the diets contained 15 % KDLB had significantly ($P < 0.05$) higher body ether extract and energy contents than those fed the 30 % KDLB, conversely, ash contents was significantly higher in fish received the diets contained 30 % KDLB. These are in agreement with the previous study on Kochia with blue tilapia (Srour *et al.*, 2004). Dry matter and ether extract values of fish received the BD or those contained FM and PVM were similar. Significantly higher crude protein and energy contents were observed in the fish fed the diets contained FM and PVM; however, the group of fish fed the diet contained yeast had significantly ($P < 0.05$) higher body ash content compared to the other groups.

Table (5): Carcass composition of blue tilapia (*Oreochromis aureus*) fed diets containing two levels of KDLB with different protein sources.

Kochia level (%)	Source of protein				Average*
	Fish meal	PVM	Yeast	Basal diet	
		Dry matter			
15	26.00	25.45	23.90	25.85	**25.30^A**
30	24.95	2C.75	24.8	27.05	**25.89^A**
Mean	**25.48^{ab}**	**26.10^a**	**24.35^b**	**26.45^a**	25.60
		Crude protein			
15	54.90	54.54	53.32	52.57	**53.83^A**
30	53.90	53.83	52.68	51.78	**53.05^A**
Mean	**54.40^a**	**54.19^{ab}**	**53.00b^c**	**52.18^{bc}**	53.44
		Ether extract			
15	28.71	28.79	25.28	27.75	**27.63^A**
30	27.75	27.56	24.05	26.56	**26.48^B**
Mean	**28.23^a**	**28.18^a**	**24.67^b**	**27.16^a**	27.06
		Ash			
15	16.39	16.68	21.41	19.67	**18.53^B**
30	18.36	19.12	23.27	21.66	**20.60^A**
Mean	**17.38^c**	**17.90^c**	**22.34^a**	**20.67^b**	19.57
		Gross energy (Kcal/100g)			
15	580.66	579.36	539.33	558.46	**564.45^A**
30	565.88	563.70	524.15	542.77	**549.12^B**
Mean	**573.27^a**	**571.53^a**	**531.74^c**	**550.62^b**	556.79

Means in the same row with different superscripts are significantly different (p < .05).
*** Means in this column having the same superscript are not significantly different (p > 0.05).**

Values of feed cost required for production of one Kg fish gain of blue tilapia fed the two levels of KDLB with various protein sources are presented in Table 6. When the different diets were compared to the diets contained FM, results revealed that diet of 30 % KDLB with PVM had the higher change in feed cost/Kg fish gain. While, the diet of 15 % KDLB with PVM occupied the second arrangement of higher change in feed cost/Kg fish gain. Diets contained 15 and 30 % KDLB with yeast and the BD, respectively showed the lower change in feed cost/ Kg fish gain.

On the other hand, the lower values of crude protein, ether extract and energy contents were observed in fish fed the yeast in their diet. The results of FM and PVM are in partial agreement with the findings of Fowler (1991), and Steffens (1994) on chinook salmon and rainbow trout, respectively as well as Srour (2003) on Nile tilapia and African catfish. Inversely, Omar *et al.* (1989) and Abd El-Rahman (1991) found that replacing FM with yeast had no effect on carcass composition of Nile tilapia. In relation to interaction, the higher values of dry matter, crude protein, ether extract, ash and energy contents were noticed in the fish fed the BD with 30 % KDLB, 15 % KDLB with FM, 15 % KDLB with PVM, 30 % KDLB with yeast and 15 % KDLB with FM, respectively. Whereas, the lower values of dry matter was observed in the fish fed the diet contained 15 % KDLB with yeast, while the lower values of ether extract and energy contents were observed in the fish fed the 30 % KDLB with yeast. Similarly, the lower values of crude protein and ash contents were remarked in fish received the BD with 30 % KDLB and 15 % KDLB with FM, respectively.

Table (6): Cost (L.E.) of feed required for production of one Kg gain of blue tilapia (*O. aureus*) fed diet containing two levels of Kochia with different protein sources.

Item	Diets							
	15 % Kochia				30 % Kochia			
	FM	PVM	Yeast	Plant	FM	PVM	Yeast	Plant
Feed cost (LE/ton feed)	2123.5	1678.7	1785.6	1670.3	1980.2	1529.8	1633.3	1452.9
Amount of feed/kg gain	1.33	1.42	1.54	1.57	1.39	1.43	1.44	1.79
Cost of Kg fish gain (LE)	2.824	2.388	2.75	2.622	2.753	2.188	2.35	2.600
Change in feed cost/kg gain (%)	*	15.44	2.62	7.15	*	20.52	14.638	5.557

*These diets were used as a base for calculation.

Cost in LE/ton: Fish meal: 6000, Soybean meal: 2500, Yellow corn: 1050, Kochia: 200, poultry viscera meal: 4000, Yeast: 2800, Wheat bran: 850, Corn oil: 4500 and Min. & Vit.: 8000

In conclusion, it could be suggested that the inclusion of 15 % KDLB with Poultry viscera meal as animal protein source could be used in the diet of blue tilapia without any adverse effect on either growth performance or feed and nutrient utilization. However, diet contained 30 % KDLB with PVM economically is the best.

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الاستفادة من بعض مصادر البروتينات الغير تقليدية فى علائق البلطى الحسانى المستزرع فى سياجات شبكية

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أجريت هذه الدراسة خلال ١٦ أسبوع لدراسة أثر تغذية أسماك البلطى الحسانى المستزرع فى سياجات شبكية على علائق تحتوى على أوراق وبراعم الكوخيا المجففة مع مصادر مختلفة من البروتينات الغير تقليدية على كفاءة النمو والاستفادة من الغذاء والتحليل الكيماوى لجسم الأسماك. تم استخدام مستويين من الكوخيا فى العليقة هما ١٥ و ٣٠ % مع أربعة مصادر بروتين هى: مسحوق السمك ومصارين الدواجن المجففة والخميرة و بروتين العليقة الأساسية وتم تكوين ثمانية علائق متساوية تقريبا فى المحتوى من البروتين (٢٣ %) والطاقة حيث تمت تغذية أسماك البلطى التى كان متوسط وزنها ١٥,٥ جم فى مكررتين على العلائق المختبرة بمعدل تغذية ٢,٥ % من الوزن الحى لكل معاملة. وقد أشارت النتائج الى أن كفاءة النمو والاستفادة من الغذاء للأسماك المغذاة على علائق تحتوى على ١٥ % كوخيا كانت أعلى من مثيلتها المغذاة على علائق تحتوى على ٣٠ % كوخيا. أيضا تفوق معدل التحويل الغذائى للأسماك المغذاة على علائق تحتوى على مسحوق السمك على غيره من المعاملات وقد تبعه فى الترتيب تلك المغذاة على مسحوق مصارين الدواجن ثم المغذاة على الخميرة وأخيرا المغذاة على العليقة الأساسية. لم تكن هناك فروق معنوية بين الأسماك المغذاة على علائق تحتوى مسحوق السمك وتلك التى احتوت علائقها على مسحوق مصارين الدواجن فيما يتعلق بمعدل استهلاك الغذاء وإنتاجية أو الاستفادة من البروتين والاستفادة من الطاقة. بينما كانت هناك فروق جوهرية بين الأسماك المغذاة على علائق تحتوى علىالخميرة والمغذاة على العليقة الأساسية. هذا وقد تأثر المحتوى الكيماوى للأسماك فى المعاملات المختلفة نتيجة التغذية على الكوخيا والمصادر المختلفة من البروتين. اقتصاديا أشارت النتائج إلى أن العليقة التى أحتوت على ٣٠ % كوخيا ومسحوق مصارين الدواجن كانت الأجدى اقتصاديا وتبعتها فى ذلك تلك الى احتوت على ١٥ % كوخيا مع مسحوق مصارين الدواجن أيضا مقارنة بباقى العلائق. وبناءا على ما سبق توصى نتائج هذه الدراسة بأنه يمكن استخدام علائق تحتوى على ١٥ % كوخيا مع مسحوق مصارين الدواجن فى تغذية أسماك البلطى الحسانى بدون تأثير سلبى.