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UTILIZATION OF KOCHIA *Kochia indica* IN BLUE TILAPIA (*Oreochromis aureus*) DIETS.

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ABSTRACT

A 14-week feeding experiment was conducted in enclosure nets (each of 100 X 100 X 100 cm in diameter) in Merghem region from 1st August to 15th November. Five isonitrogenous diets (22.75 % protein) with different levels of *Kochia indica* dried leafs and soft branches (KDLS) being 0, 15, 30, 45 and 60 % instead of the dietary protein were prepared and their effects on growth performance, feed utilization and carcass composition were evaluated for blue tilapia *Oreochromis aureus* (11.5 g). Each of the experimental diets was fed to duplicate groups of fish at a feeding rate of 2.5 % of body weight. The results revealed that fish groups fed on the diet contained 15 % KDLS had significantly higher growth performance and feed utilization compared to the fish fed on other KDLS substitution levels. Carcass composition affected with different KDLS substitution levels. Economically, with increasing the KDLS substitution level the cost of one Kg fish gain decreased. The study demonstrated that KDLS could replace 15 % of blue tilapia diet to improve growth performance and feed utilization.

Keywords: *Tilapia, Kochia and Growth.*

INTRODUCTION

The increased intensification of fish culture in recent years depends mainly on complete rations to cover the nutrient requirements of fish. Sufficient level of dietary protein is needed for rapid growth. Protein is the most expensive component in artificial diets for fish (El-Ebiary, 2002). Also a shortage of inexpensive and readily available feed is a constraint for the development of aquaculture. On the other hand, as in most aquaculture endeavors, reducing feed cost is a persistent concern because feed cost significantly impacts production cost. High cost of protein from conventional feed stuffs has forced fish nutritionalists to consider alternate sources of protein. One approach for reducing feed cost is to substitute lower-cost feed ingredients, such as plant and herbs for more expensive ingredients such as fish meal and soybean meal. Jackson *et al.* (1982) reported that copra, groundnut, sunflower, rapeseed and cottonseed meals at low inclusion levels promoted growth rate of tilapia. Nour *et al.* (1985) recommended the use of leaf protein concentrate from berseem (*Trifolium alexandrenum*) and water hyacinth (*Echronia crassipes*) to replace 30 % of the fish meal in the diets of mirror carp (*Cyprinus carpio*) reared in intensive culture. Also, Nour *et al.* (1989) recommended using water hyacinth at level not more than 20 % of

diets containing a mixture of fish meal and soybean for feeding common carp fingerlings. Moreover, among the tested herbs as a protein source is *Kochia indica,* it is annual bushy herb which belongs to the family *Chenopodiaceae.* It have long stems (more than 3.5 meters) under favorable conditions (Zahran, 1986). Kochia grows in the salt affected and calcareous soils of Egypt (Sadek, 1974 and Abu Ziada, 1988). Also, *Kochia indica* grows rapidly during the cool season and widely adapted to many geographical zones as it serve under various temperature as grazing forage and for hay processing (Sherrod, 1973). Several studies (Finley and Sherrod, 1971 and Sherrod, 1971 and 1973) indicated that *Kochia* produces rapid foliar, containing relatively high crude protein and low crude fiber, and it has comparatively high nutritive value, particularly when harvested in earlier growth stage. The value of *Kochia* as a substitute protein scurce in formulated diets has been investigated for sheep and goats (Fahmy and Fayed, 2000). Tag El-Din *et al* (1991) mentioned also that *Kochia* could be used as a good green fodder for ruminants for its high content of crude protein compared to berseem hay, which is becoming scare and expensive. Literature on using *Kochia indica* as a protein replacer in fish feeding is scarce. Therefore, the present study was an attempt to evaluate the effect of partially replacement of *Kochia indica* instead of the dietary protein on growth performance, feed utilization and carcass composition of tilapia *Oreochromis aureus.*

MATERIALS AND METHODS

The experimental work of the present study was carried out in a private farm situated in Merghem region in west Alexandria to determine the influence of partially substituting of *Kochia indica* protein for the dietary protein of blue tilapia (*Oreochromis aureus*).

Fish and Culture Facilities

Tilapia (*O. aureus*) fingerlings averaging 11.5 g/fish (obtained from Maryot lake) were used in the present study. One earthen pond of 0.5 feddan, 1 meter in depth (80 cm depth of water allowance), contained 10 enclosure nets (100 X 100 X 100 cm in diameter) were used in the present experiment. Enclosure nets were randomly stocked into all treatments at a rate of 10 fish/enclosure net, with two replicates per treatment. Fish from each replicate were weighed at the start of each experiment and henceforth counted and weighed every 2 weeks. About 20 fish were frozen for initial proximate body chemical analysis. About 10 % of the earthen pond water were continuously changing every day. The experiment started at the 1st of Augus and lasted for fourteen weeks .

Experimental Diets

Herbs of *Kochia indica* were collected from various placeless in Alexandria, dried then leafs and soft branches were removed to be used in the present study. The *Kochia indica* dried leafs and soft branches (KDLS) were washed and dried again (70° C for 24 hrs) before incorporating into

various treatments. Five isonitrogenous experimental diets (22.75 % protein)were formulated, where KDLS protein was substituted by 0, 15, 30, 45, and 60 % of the dietary protein (Table 2). All ingredients (bought from the local market) were finely ground, mixed well and completed with essential vitamins and trace minerals (NRC, 1993). The oil was added drop wise during mixing and warm water (45° C) was slowly added under continuous mixing until the diets began to clump. The diets were formulated in small diameter (5.0 mm) pellets using a commercial meat mincer 3 times, and oven dried at 80° C for 24 hrs in a drying oven. The diets were fed to the experimental fish two times a day (10,00 and 14,00 hr) at a rate of 2.5 % of the actual live body weight (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 and counted per each replicate from each treatment 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 analysis of fish and feeds were performed using AOAC, (1990) methods. All data were analyzed for statistical significance by using analysis of variance (SPSS/PC program). Multiple comparisons among means were made with the Duncan Multiple range test (Puri and Mullen, 1980).

RESULTS AND DISCUSSION

The chemical composition of *Kochia indica* dried leafs and soft branches (KDLS) is shown in Table 1. The results of chemical analysis indicated that KDLS contained 22.67 % dry matter (DM), 22.75 % crude protein (CP), 4.29 % ether extract (EE), 15.36 ash, 17.5 crude fiber (CF), 40.1 % nitrogen free extract (NFE), 337.5 Kcal/100g DM gross energy (GE) and 67.41 protein to energy ratio. Draz (1954) found that the complete herb of *Kochia indica* contained 84.2, 1.6, 17, 35.9, 22.9 and 14.3 % of DM, EE, CP, NFE, CF and ash, respectively. Whilst, Tag El-Din *et al.* (1991) found that the complete herb of *Kochia indica* contained 44.03, 16.36, 15.82, 24.86, 2.24 and 40.72 % of DM, ash, CP, CF, EE and NFE, respectively.

The composition and proximate analysis (%) of the experimental diets used in the experiment are shown in Table 2. The experimental diets were almost isonitrogenous (about 22.75 % crude protein) and nearly isoenergetic, (the mean of gross energy was 413.12 Kcal/100 g). The mean value of protein to energy (P:E) ratio was 55.17 mg protein/Kcal gross energy. With increasing the inclusion of KDLS level into the diets DM, NFE and GE decreased while CF, ash and P : E ratio increased.

Table (1). Chemical composition (%) of *Kochia indica* dried leafs and soft branches (KDLS).

Item	Chemical composition %:
Dry matter	22.67
On dry matter basis:-	
Crude protein	22.75
Ether extract	4.29
Ash	15.36
Crude fiber	17.5
Nitrogen free extract	40.1
Gross energy (Kcal/100g)*	333.62

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

Table (2): Ingredient and nutrients composition (%) of the experimental diets containing different levels of *Kochia indica* dried leafs and soft branches (KDLS).

Ingredient	Diet 1	2	3	4	5
Soybean meal	41.00	34.85	28.70	22.55	16.40
Yellow corn	27.50	23.09	18.90	14.66	10.34
KDLS	-	14.51	28.80	43.04	57.21
Wheat bran	28.00	23.80	19.60	15.40	11.20
Corn oil	1.50	1.75	2.00	2.35	2.85
Vit. & Min mixture[1]	2.00	2.00	2.00	2.00	2.00
Chemical composition %:					
Dry matter	90.80	90.90	89.40	88.30	85.60
Nutrient (%) on dry matter basis:					
Crude protein	22.75	22.75	22.84	22.78	22.74
Ether extract	7.54	7.49	7.44	7.65	7.79
Ash	7.82	8.15	8.49	9.83	10.17
Crude fiber	7.20	8.62	10.04	11.46	12.46
Nitrogen free extract	54.69	52.99	51.19	48.28	46.84
Gross energy (Kcal/100g)[2]	424.26	416.81	409.44	399.13	394.30
Protein/Energy Ratio (mg/Kcal)	53.62	54.58	55.78	57.08	57.67

[1]Meveco premix Co. (Abou Sultan, El-Esmaaelia),Vit. & Min., every 1.5 kg contain 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, Pantothenic acid 10g, B_{12} 0.01g, Nicotinic acid 30g, , Folic acid 1.2 g, Fe 30g, Mn 60g, Cu 10g, I 300 mg, Cobalt 0.25 g, Se 10 g and Zn 55g.

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

The effect of dietary KDLS protein substitution levels instead of the dietary protein on the growth performance of blue tilapia *O. aureus* is illustrated in Table 3. The results showed that at 15 % KDLS protein substitution level, the growth performance of fish was significantly ($P < 0.05$) higher than fisn fed on the other diets contained KDLS protein substitution levels or the control diet. The lowest growth performance values were recorded by fish received the control diet followed by 60 % KDLS protein diet. However, except for final weight, insignificant ($P > 0.05$) difference was noticed between the groups of fish received 30 and 45 % KDLS protein in

growth performance. Also, insignificant ($P > 0.05$) difference was detected between fish received diets contained 45 and 60 % KDLS protein in growth performance. Therefore, the inclusion of KDLS into the diet at 15 % level enhanced the performance of the fish. The inclusion of KDLS with high level in the diet resulted in growth depletion. The reduced growth performance at higher inclusion levels of KDLS was probably due to the higher crude fiber content in KDLS. Miguel *et al.* (1990) found that diets containing alfalfa leaf protein gave the best results, with growth rates higher than those obtained with a fish meal-based diet when the plant protein replaced up to 35 % of the fish meal protein in the diet of *O. mossambicus.* Mohamad and Peter (1992) found that the optimal daily feeding rates of duckweed (*Lemna perpusilla*) were 5, 4 and 3 % of the total fish body weight on a duckweed dry weight basis for Nile tilapia of 25 to 44, 45 to 74 g and 75 to 105 g in weight, respectively. The present results are in partial agreement with the finding of El-Ebiary (2002) with azolla and some other seaweeds. The latest author found that the replacing plant proteins (soybean meal and fine wheat bran) with aquatic plant protein increased growth performance of rabbit fish at 10 and 20% levels of seaweeds and azolla meal, respectively.

Table (3): Effect of dietary replacement of different levels of *Kochia indica* dried leafs and soft branches (KDLS) protein instead of the dietary protein on growth performance of tilapia *O. aureus*.

Diet No.	KDLS levels %	Initial Weight (g/fish)	Final weight (g/fish)	Gain (g/fish)	ADG[1] (mg/fish/day)	SGR[2] (%/day)
1	0	11.5	30.65^{d}	19.15^{d}	195.41^{d}	1.00^{d}
2	15	11.5	34.35^{a}	22.85^{a}	233.16^{a}	1.12^{a}
3	30	11.5	32.90^{b}	21.40^{b}	218.37^{b}	1.08^{b}
4	45	11.5	$32.2b^{c}$	20.70^{bc}	211.23^{bc}	1.05^{bc}
5	60	11.5	31.90^{c}	20.40^{c}	208.16^{c}	1.04^{c}

Means in each column not sharing the same superscript are significantly different ($P< 0.05$).
ADG[1] = Average daily gain (mg/fish/day): gain/experimental period.
SGR[2] = Specific growth rate (%/day): *(ln wt-ln wi/T) x 100*, 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.

Data presented in Table 4 reveal the effect of dietary KDLS protein substitution levels instead of the dietary protein on the feed and nutrients utilization of blue tilapia *O. aureus*. The results indicated that feed intake was not significantly ($P > 0.05$) affected by different KDLS protein substation levels in the diets. Insignificant ($P > 0.05$) difference was recorded in fish had diets contained 30 and 45 % KDLS protein. However, the higher values of feed and nutrients utilization were recorded by fish received diets contained 15 and 30 % KDLS protein. There were significant ($P < 0.05$) differences among this group and the fish groups had other KDLS protein substation levels in the diets. Also, insignificant ($P > 0.05$) difference was observed between fish received diets contained 45 and 60% KDLS protein. The lowest values of feed and nutrients utilization were observed in the control group

(without KDLS). The results of feed utilization are slightly lower than those obtained by Ogino *et al.* (1978) working with carp and trout, using leaf protein concentrate from rye grass. Nour *et al.* (1989) reported that the efficiency of feed utilization and protein efficiency ratio were greatly improved by increasing the level of water hyacinth leaf protein in the diet. Feed digestibilities were adversely affected when the level of plant protein was increased in the diets (Miguel *et al.*, 1990).

Table (4): Effect of dietary replacement of different levels of *Kochia indica* dried leafs and soft branches (KDLS) protein instead of the dietary protein on feed and nutrients utilization of tilapia *O. aureus*.

Diet No.	KDLS levels %	Feed intake (g/fish)	FCR[1]	Protein utilization		
				PER[2]	PPV[3] %	EU[4] %
1	0	32.42[a]	1.695[c]	2.60[c]	38.24[c]	21.99[c]
2	15	33.84[a]	1.480[a]	2.97[a]	44.35[a]	25.76[a]
3	30	32.53[a]	1.530b[a]	2.88[ab]	43.68[a]	25.44[a]
4	45	32.32[a]	1.560[b]	2.815[b]	40.84[b]	23.61[b]
5	60	32.17[a]	1.575[b]	2.79[b]	40.28[b]	23.09[b]

Means in each column not sharing the same superscript are significantly different ($P< 0.05$).

[1]FCR = Feed conversion ratio: total dry diet fed (g)/total wet weight gain (g).

[2]PER = Protein efficiency ratio: wet weight gain (g)/amount of protein fed (g).

[3]PPV = Protein productive value (%): $(P-P_o)\ 100/P_i$ where P is protein content in fish carcass at the end of the experiment, P_o is the protein content in fish carcass at start of the experiment and P_i is the protein in feed intake.

[4]EU = Energy utilization (%): $(E-E_o)\ 100/E_i$ where E is the energy in fish carcass (Kcal) at the end of the experiment, E_o is the energy in fish carcass (Kcal) at the start of the experiment, and E_i is the energy in feed intake (Kcal).

The present results are in partial agreement with the findings of Michal *et al.* (1988) and El-Sayed (1992). These authors found that the addition of dried azolla in the diets of O. *niloticus* and *Tilapia rendalli* fingerlings (5 g), *O. niloticus* adult (40 g) and fingerlings (2.5 g), respectively resulted in suppressing fish growth and feed conversion efficiency, protein and energy retention. Gomes *et al.* (1993) demonstrated the possibility of partial replacement of fish meal by vegetable protein up to 66 % without negative effects on feed and nutrient utilization. Likewise, Zaki and El-Ebiary (1997) recommended the use of 10 % of seaweed or algae and 20 % of azolla in diets containing a mixture of fish meal and soybean meal to increasing feed and nutrients utilization of Florida red tilapia. Additionally, the replacing of plant protein with aquatic plant protein resulted in increasing feed utilization of rabbit fish (*Siganus rivulatus*) at 10 % of sea weed and 20 % azolla meal (El-Ebiary. 2002).

Data presented in Table 5 show the effect of dietary KDLS protein substitution levels on carcass composition of blue tilapia *O. aureus*. The results revealed that the differences of carcass DM and CP among fish fed diets contained 0, 15 and 30 % or between fish fed diets contained 45 and 60 % KDLS protein were insignificant.

Table (5): Effect of dietary replacement of different levels of *Kochia indica* dried leafs and soft branches (KDLS) protein instead of the dietary protein on carcass composition of tilapia *O. aureus*.

Diets No.	KDLS levels %	Dry matter	% on dry matter basis			Gross energy (Kcal/100g)*
			Crude protein	Ether extract	Ash	
Initial		23.80	52.80	27.48	19.72	557.2
1	0	26.55^{a}	52.50^{b}	28.30^{a}	19.20^{ab}	563.25^{b}
2	15	26.85^{a}	52.70^{b}	28.20^{a}	18.60^{bc}	563.44^{b}
3	30	27.00^{a}	52.80^{b}	27.45^{b}	19.70^{a}	556.92^{c}
4	45	25.2^{b}	54.85^{a}	27.25^{b}	17.90^{c}	566.59^{a}
5	60	24.85^{b}	55.45^{a}	26.50^{c}	17.85^{c}	562.90^{b}

Means in each column not sharing the same superscript are significantly different ($P<$ 0.05).

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

Furthermore, there were insignificant ($P > 0.05$) differences between fish had the control diet and 15 % or between fish had diets contained 30 and 45 % KDLS protein in carcass ether extract. Fish received diets contained 0 and 30 % KDLS protein had the highest carcass ash compared to the fish received other diets contained different levels of KDLS, while the lowest carcass ash value recorded by fish received diets contained 45 and 60 % KDLS levels. On the other hand, fish received 45 % KDLS had significantly ($P < 0.05$) higher gross energy followed by fish fed diets contained 0, 15 and 60 % and finally the fish fed diet contained 30 % KDLS protein. The present results are in partial agreement with the findings of Miguel *et al.* (1990) who used alfalfa in the diet of O. *mcssambicus.* Feeding duckweed to tilapia had profound effect on carcass composition. There was an increase in carcass moisture and decrease in carcass lipid content from the initial to harvested fish while crude protein was similar in *O. niloticus* fed duckweed (Mohamad and Peter, 1992). Moreover, El-Ebiary (2002) recorded that rabbit fish (*Siganus rivulatus*) fed a control diet had higher crud protein, dry matter, ether extract and energy contents than those fed the formulated diets with azolla or sea weeds. Apart from crude protein and gross energy, similar results with other fish and plant protein were reported by Michal *et al.* (1988), El-Sayed (1992) and Zaki and El-Ebiary (1997).

Data of feed cost required for production of one Kg gain of tilapia O. *aureus* fed various levels of KDLS protein instead of the dietary protein are presented in Table 6. From the obtained results it was clear that as the KDLS protein levels increased, the cost of feeds to produce one Kg gain of fish decreased while the change (%) in feed cost/ kg gain increased. The lowest cost of feed /Kg gain value (1.44 LE) and the higher value of the change (%) in feed cost/ kg gain were (48.94 %) obtained with the diet containing 60 % KDLS protein.

Thus, it could be concluded that *Kochia indica* could be successfully used as a partial protein source up to 15 % in the complete diet of tilapia *O.*

aureus without growth depletion due to its high protein content and high palatability.

Table (6). Cost (L.E) of feed required for production of one Kg gain of blue tilapia *O. aureus* fed diets containing different levels of *Kochia indica* dried leafs and soft branches (KDLS) protein instead of the dietary protein.

Diets No.	KDLS levels %	Amount of feed /one Kg gain (Kg)	Cost of one kg fish gain (LE)	% Change in feed cost/ kg gain
1	0	1.70	2.82	*
2	15	1.48	2.19	22.34
3	30	1.53	1.96	30.50
4	45	1.56	1.72	39.01
5	60	1.58	1.44	48.94

*** Diet 1 used as a base for calculation.**
Cost in LE/ton: Soybean meal 2300, Yellow corn 1100, Wheat bran 650, KDLS 100, Corn oil 5000 and Min. & Vit. mix. 8000.

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الاستفادة من الكوخيا في عليقة البلطي الحساني

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أجريت تجربة تغذية لمدة ١٤ أسبوعا في سياجات شبكية ذات أبعاد ١٠٠ X ١٠٠ X ١٠٠ سم في منطقة مرغم في الفترة من أول أغسطس إلى منتصف نوفمبر. تم استخدام ٥ علائق متوازنة في نسبة البروتين (٢٢,٧٥ % بروتين) حلت فيهم أوراق الكوخيا المجففة محل البروتين الكلي للعليقة بنسب إحلال ٠ و١٥ و٣٠ و٤٥ و٦٠ % وذلك لدراسة اثر هذا الإحلال على كفاءة النمو ومعدل الاستفادة من الغذاء والتحليل الكيماوى للجسم وذلك في أسماك البلطي الحساني بمتوسط وزن أولي ١١,٥ جم. تم تغذية الأسماك في مكررتين وبمعدل تغذية ٢,٥ % من وزن الجسم يوميا. وقد أظهرت النتائج أن معدل الإحلال بنسبة ١٥ % تفوق جوهريا على العليقة المقارنة وباقي مستويات إحلال أوراق الكوخيا المجففة محل بروتين العليقة في كفاءة النمو والاستفادة من الغذاء. وقد تأثر محتوى جسم الأسماك من العناصر الغذائية باختلاف نسب الإحلال. ومن وجهة النظر الاقتصادية فانه كلما زادت نسبة الإحلال كلما انخفضت تكلفة إنتاج الكيلو جرام من الأسماك. وعليه توصى نتائج هذه الدراسة باستخدام المستوى ١٥ % كنسبة إحلال لأوراق الكوخيا المجففة محل بروتين العليقة لأسماك البلطي الحساني وذلك لتحسين كفاءة النمو والاستفادة من الغذاء.