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THE USE OF LOCAL PALM KERNEL MEAL (LPKM) AS APROTEIN SOURCE IN DIETS OF TILAPIA *(OREOCHROMIS SPILURUS G,)* CULTURED IN RED SEA WATER

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ABSTRACT

In Saudi Arabia, local Palm Kernel Meal (LPKM) was tested as a partial or a total replacement of fish meal in the different diets of the studied fish. The experiment was carried out on tilapia *(Oreochromis spilurus)* reared in fiber glass tank filled with water pumped from the Red Sea. Six diets were formulated, diet I without LPKM and its contents of protein was 35%. Diets, (II,III,IV and V) contained an increasing levels of LPKM which corresponded to 30%, 25%, 20% and 15% of proteins respectively. Diet VI consisted only of LPKM without the addition of any other ingredients and contained 5.83% protein.

The lowest increase in weight was observed with fish fed on diet VI, while the highest increase was observed with diet I. The best food conversion rate (FCR) was noticed with fish fed on diet I (1.73), while the worst FCR (4.4) was with diet VI.

Ash, dry materials, water, protein and fat contents in *0. spilurus* carcass muscles, showed no differences among experimental diets I to V. On the contrary, fat and protein contents were significantly lower in muscles of fish fed on diet VI, and their moisture and ash contents were relatively high compared to other diets tested.

INTRODUCTION

Tilapia *(Oreochromis* spp.) are widely cultured in the tropical and subtropical regions of the world and constitute the third largest group of farmed finfishes, after carps and salmonids, with an annual growth rate of about 11.5 % (El-Sayed, 1999).

Feeding usually represents over 50% of the operational costs of aquaculture (Atay, 1992). Fish meal is the main conventional protein source for cultivated fish. However, the shortage in world production of fish meal, coupled with the increased demand for it in feeding livestock and poultry is likely to reduce the dependence on it as a single protein source in aquafeeds. Therefore, fish nutritionists have made several attempts to partially or totally replace fish meal with less expensive, locally available protein sources. Recently, interest has been centered on the evaluation and use of unconventional protein sources such as aquatic macrophytes, poultry and agricultural by-products, invertebrate feed organisms, single-cell protein and protein hydrolysates (Omar, 1984 & 1986; Nour *et al.*, 1985; Tacon and Jackson, 1985; Shiau *et al.*, 1987; Olvera *et al.*, 1988; Omar *et al.*, 1989 & 1994; Muguel *et al.*, 1990; Yousif *et al.*, 1996; Belal and Al-Jasser, 1997; El-Sayed, 1999).

In the present study, a feeding trial was conducted to investigate the possibilty of using Local Palm Kernel Meal (LPKM) as a total or partial alternative source of protein to fish meal in the diet of tilapia *(O.spilurus)*.

In Indonesia and Malysia, PKM was found to contain 20-25% crude protein (Gohi, 1975). It also contains all amino acids essential for fishes except methionine. It also has a favourable ratio of calcium and phosphorus and contains no toxins (Gohi, 1975). Therefore, LPKM can be used as a cheap plant protein nutritional source for farmed fishes.

Tilapia are known to be able to utilize protein levels below the optimum recommended levels and still produce good growth (Jauncey, 1986). PKM has already been investigated as a substitute diet for tilapia *O.niloticus* (Adikwu, 1997; Omoregie and Ogbemudie, 1993) in fresh water. However, rearing and feeding acciemated *Oreochromis* species to sea water may have different response and performance. Less attention has been given to tilapia *(O.spilurus)* which has the advantage of tolerating and growing in sea water (Al-Amoudi, 1987). Thus, the present study investigated the possibility of using LPKM as a possible nutritional source for *O. spilurus* farmed in the water from the Red Sea.

MATERIAL AND METHODS

This study was carried out at the Fish Culture Research Farm of the Faculty of Marine Science in Southern Obhur, Jeddah City in Saudia Arabia. Fingerlings of *Oreochromis spilurus* used in the study were obtained from the faculty farm at age of one month and average weight of about 3.5 g. The ancestors of these fingerlings have been reproduced in water from the Red Sea water since 1985 (Al-Amoudi, *et al.*, 1992).

Circular fiber glass tanks of 200 L. volume each were used in the study. 200 fish were randomly distributed in each tank. Water was pumped from the Red sea and the total water volume in each tank was exchanged every 4 hours. The experimental tanks were arranged in triplicates for each experimental setup. Water was airated continuously during the course of the study, so that the oxygen level did not decrease below 5 mg/L.

The control diet (diet I) was prepared from fish meal (72% protein) with 35% total protein content (Jauancy and ross, 1982) in addition to minerals, vitamins, lipids, dextrin, Q-cellulose and carboxymethylcellulose, which were added as a binder. Five different experimental diets were formulated (diets II, III, IV, V and VI) as shown in (Table 1). The replacement percents of fish meal with LPKM were 0, 7.6, 15, 22, 30.2, and 100 in diets I, II, III, IV, V and VI respectively. Local Palm Kernel was ground to particles of 0.1 mm diameter and its composition and gross energy contents are presented (Table 1). It was fed to fishes as such or as a substitute to part of the fish meal content of the control diet.

Fish were fed three times daily for six days a week, at 5% of their body whight feeding rate (Mackintosh and DeSilva, 1984). At the beginning and the end of each experiment six fishes were randomly taken from each tank for chemical analysis of their carcass contents of moisture, protein, lipids and ash according to EL-Ghobashy (1990) methods.

The specific growth rate was calculated according to the equation: $\log w_2 - \log w_1 / t_2 - t_1 \times 100$

where, w_1 and w_2 were the fish weights at times t_1 and t_2 respectively. Food conversion ratio (FCR) was calculated as g dry food fed/g live weight gain.

Statistical analysis of the experimental results were conducted according to Snedecor and Cochran (1967).

RESULTS

Results of Table 2, showed that LPKM contents were 5.83, 11.18, 1.15, and 80.84% of crude protein, lipids, ash, and carbohydrates in its dry matter respectively. These results may indicate that LPKM is very poor in protein, however it could be used as source of energy.

The maximum average increase in fish weight was found with diet I (16.7 g). While the average increases in weight were 12.5, 11.5, 9.5 and 7 for diets II, III, IV and V respectively. These results indicate that the average increase in weight decreased gradually with increasing the percentage of LPKM in tested diets as shown in Figure (1). The lowest (1.12 g) average weight increase was recorded when LKPM fed to the fish as a sole feed stuff.

Food conversion ratio [FCR] increases with increasing LPKM in experimental diets, recording 1.73, 1.92, 2.02, 2.27, 2.77 and 4.4 for dites (I, II, III, IV, V and VI respectively, (Fig. 2).

On the other hand, mortality of *O. spilurus* was very low regardless of the used diet (Table 3) and all experimental fish was morphologically normal.

Higher residual amounts of unconsumed food was noticed with fishes fed on LPKM (30.3) compared to the residual amounts of fish fed on diet I (0.7%). The same phenomenon was also noticed with regard to the percent of faeces to total food and the percent of faeces to consumed food when the two types of diets were compared. (Table 4).

Fish carcass muscles were analysed for their percentage contents of ash, dry matter, moisture, protein and fat. Figure 3 showed that there were no significant differences noticed in chemical composition of fish carcass muscles among the experimental fishes fed on diets (I, II, III, IV, V), while fat and protein contents were significantly low in muscles of fishes fed on diet VI, and their moisture content was relatively high (P> 0.05)

DISCUSSION

Fish meal is expensive and is not locally produced in Saudi Arabia. Because it is imported there is a fluctuation in it`s quality and prices. Therefore, the use of locally available substitute which is less expensive would reduce the cost of fish production.

In the present study, Local Palm Kernel Meal (LPKM) was used as an alternative source of protein to fish meal. LPKM is abundant and cheap in Saudi Arabia. Gohl (1975) stated that LPKM used in Indonesia and Malysia contains 20 to 25 % crude protein. In the present study, however, analysis of local LPKM indicated that it contains only 5.83 % protein. Neverthless, the analysed LPKM was found to contain 12.18% lipids and a total energy equivalent to 5133 cal./gm. This suggests that LPKM used in this study would provide fishes with a substantial amount of energy and save proteins utilization for growth.

Oreochromis spilurus) was chosen for this study because, it can tolerate high salinety (40‰)of the Red sea water (Peacock, 1979) which is an advantage with the shortage of fresh water in Saudi Arabia. Of paramount importance is the fact that tilapia can utilize protein levels below the optimum recommended level and still grow well (Jauncey and Ross, 1982).

Six different diets were fed to *O. spilurus*. Diet I (the control) had 35 % protein. Diets II, III, IV and V contained increasing levels of LPKM to give 30, 25, 20 and 15% proteins respectively. Diet VI contained LPKM only with 5.83% protein. The control diet (diet I) contained 35% proteins as this level was suggested to achieve optimum tilapia growth (Mazid *et al.*, 1979; Jackson *et al.*, 1982; Siddiquie *et al.*, 1988).

The growth of *O. spilurus* decreased gradually with increase of LPKM in diets, the lowest growth was observed with fish fed diet VI. Similar observation was noticed by Adikwu (1997) who showed that growth performance and feed utilization of *O. niloticus* decreased with the increase of the percentage of substitution levels of fish meal with LPKM.

The FCR can serve, to a certain extent as an indicator of the nutritional value of a feed. FCR was high with fishes fed on pure LPKM. This is in agreement with data obtained when *O. niloticus* were fed on pure LPKM (Adikwu , 1997).

Generally, lower levels of fats and proteins were found in muscles of fish fed on pure LPKM compared to fishes fed on other exprimental diets. This might be attributed to the fact that LPKM lacks methionine, which is an essential amino acid for fish growth (Gohl, 1975). Therefore, LPKM should not be fed purely to fishes and rather it should be used as a partial substitute to other suitable protein sources.

Tilapia was found to utilize protein levels below the optimum level and still could produce good growth. For instance, tilapia (*O. mossabicus)* fed on diets containing 24% and 16% proteins produced 80% and 69% of the maximum growth rate (Jauncey and Ross, 1982). Also Jackson *et al.* (1982) found that diets containing 20% protein fed to *0. mossabicus* produced 80% of the growth rate observed when fishes were fed on diets containing 40% protein. Unfortunately we were not able to achieve similar levels of growth rates, in this study by using similar levels of protein in fish diets. This may be attributed to the use of a different species of fish, presence or absence of natural feeding, different environmental parameters, high salt contents of the Red Sea water and or the type of food used. However, still when 31% and 47% of fish meal were substituted with LPKM (diets III and IV) the increase in weight represented 67.3% and 54% of the weight gain of fishes fed on diet I (Table 5).

Therefore, although LPKM could not be used as a substitution for fish meal yet it can be used as a replacement of a substantial amount of fish meal and still we can get reasonable growth. It might be concluded that some formulated diets like, III and IV may possibly be used for rearing *O.spilurus,* in the Red sea water, taking into consideration the cheep marketing price of the fish and the importance of reducing the price of fish production.

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Table 1. Composition of the experimental diets.

Contents	% Compositions					
	Diet I	Diet II	Diet III	Diet IV	Diet V	Diet VI
Fish meal	48.6	41.0	33.5	25.9	18.4	--
Palm Kernel	--	7.6	15.1	22.7	30.2	100
Mineral mixtures	3.0	3.0	3.0	3.0	3.0	--
Vitamin mixtures	2.0	2.0	2.0	2.0	2.0	--
Lipids	5.5	5.3	5.1	4.8	4.6	--
Carboxymethylcellulose	2.0	2.0	2.0	2.0	2.0	--
α- Cellulose	14.6	14.8	15.0	15.3	15.5	--
Dextrin	24.3	24.3	24.3	24.3	24.3	--
Protein contents	35.0	30.0	25.0	20.0	15.0	5.83
Gross energy Kcal/Kgm	3984	4037	4251	4756	4932	5133

Table 2. Composition and total energy of Local Palm Kernel Meal (LPKM).

PKM	Contents					
	Water contents %	Crude protein %	Lipids %	Ash %	Carbohydrates %	Gross energy Kcal/ kgm
Wet	6.82	5.43	11.35	1.07	75.33	4783
Dry	--	5.83	11.18	1.15	80.84	5133

Table 3. Growth performance and mortalities of *O. spilurus* as affected with LPKM incorporation in diets.

Diets	Weight of fish (gm) at different times					Av. Inc. in wt (gm)	% of mortality
	0 time	2 weeks	4 weeks	6 weeks	8 weeks		
I	3.4 ± 0.08	6.2 ± 0.25	10.6 ±0.57	15.2 ±1.25	20.1 ±3.3	16.7	1.3
II	3.4 ± 0.02	5.3 ± 0.03	8.7 ±0.09	12.5 ±0.33	15.9 ±0.69	12.5	0.0
III	3.6 ± 0.12	5.5 ± 0.33	8.2 ±0.76	12.0 ±1.18	15.5 ±208	11.9	2.2
IV	3.6 ± 0.13	5.3 ± 0.17	7.5 ±0.17	10.5 ±0.21	13.1 ±0.37	9.5	--
V	3.5 ± 0.09	4.9 ± 0.25	6.4 ±0.57	8.8 ±0.21	10.5 ±0.41	7.0	2.5
VI	3.5 ± 0.08	3.77 ± 0.10	4.11 ±0.07	4.32 ±0.09	4.62 ±0.08	1.12	1.3

Table 4. Diet residues as affected with LPKM as sole foodstuff compared to the control diet.

Food	Residual food/total food X 100	Faeces/total Food X 100	Faeces/consumed food X 100
Diet I	0.7	6.1	6.2
Diet VI	30.3	20.2	29

Table 5. Effect of substitution of fish meal by LPKM on the increase in weight of fish in relation to total growth

Parameters	Diets					
	I	II	III	IV	V	VI
% of LPKM substitution	0	15.6	31.1	46.7	62.1	100
Inc.in wt/total growth x100	100%	75%	67.3%	53.8%	40.7%	38.1%
Protein content (%)	35	30	25	20	15	5.83

Fig 1: Effect of LPM at different level on body weight development of *O. spilurus*.

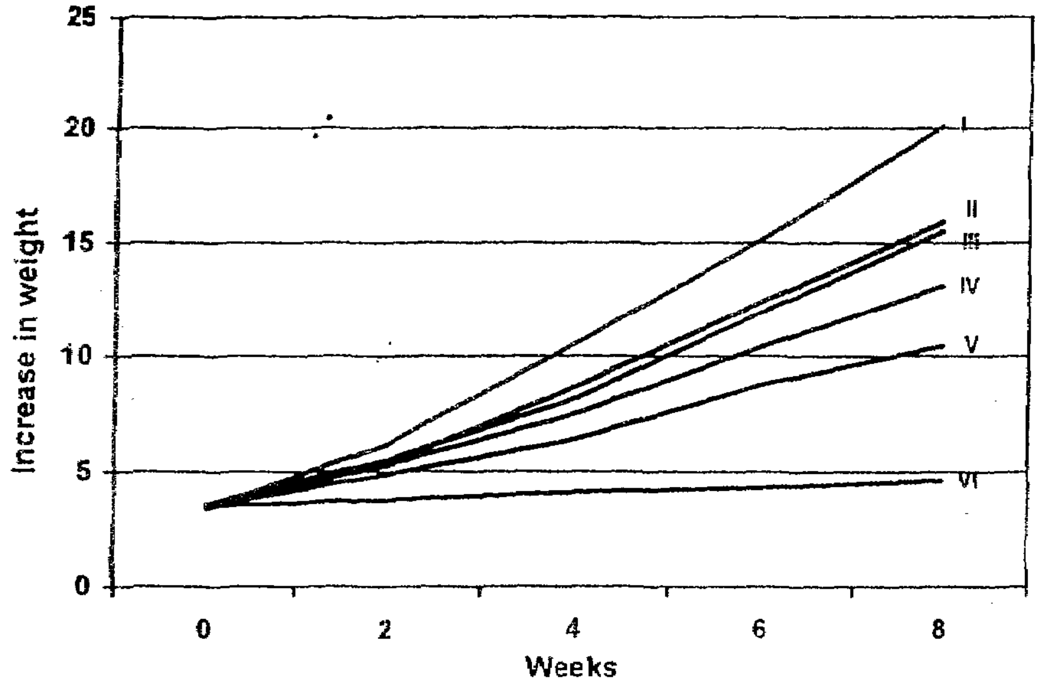

Fig. 2: Food conversion ratio (FCR) as affected with LPKM levels

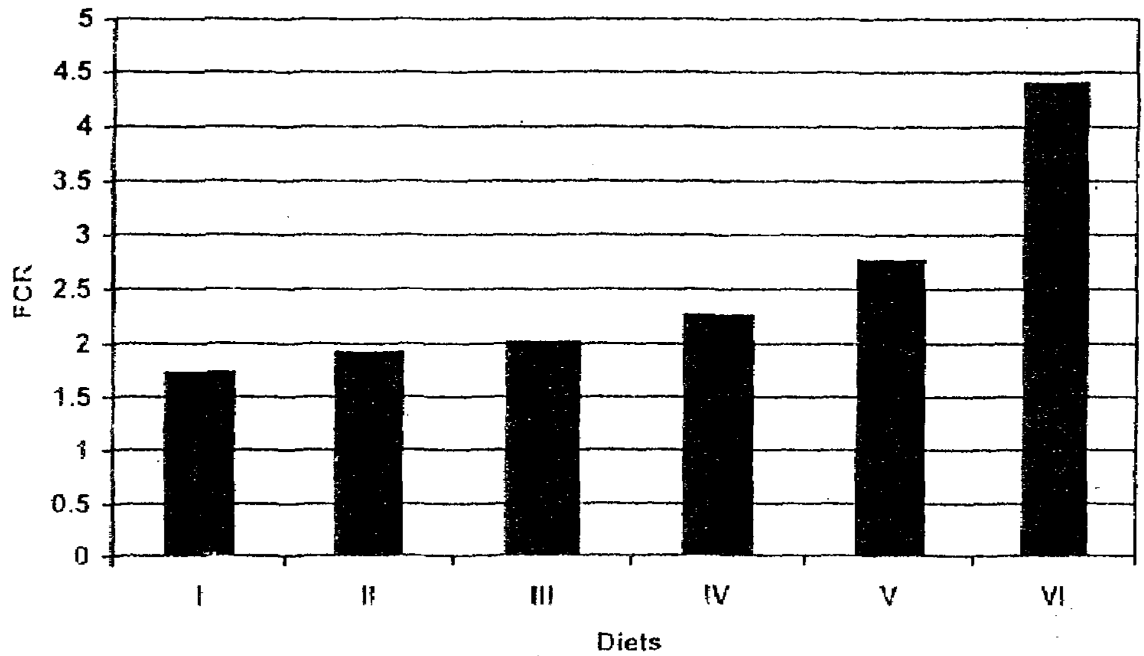

Fig 3 .Ash, dry material, water, protein and fat contents in the muscle of *O.spilurus* fed on different tested diets