Egyptian J. Nutrition and Feeds (2009) 12 (3) : 519-529

RESPONSE OF NILE TILAPIA (*OREOCHROMIS NILOTICUS*) FINGERLINGS TO CANOLA MEAL AND PHYTASE ENZYME CONTAINING DIETS

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(Received 6/12/2009, Accepted 30/12/2009)

SUMMARY

A total number of 126 Nile Tilapia fingerlings of mono sex averaging 15.17± 0.18 g (mean ± SE) in wet body weight were allotted in to 6 dietary treatments. Such treatments were the combination of three levels of canola meal (CM) and two levels of Phytase enzyme (Ph). Canola meal levels were 0, 22 and 44% of the diet where it replaced 0, 50 and 100 of soybean meal protein. Phytase enzyme was added at 0 and 0.1% of the diet. Accordingly the dietary treatments were the control, control + Ph, 22% CM, 22% CM + Ph, 44% CM and 44% CM + Ph diets. All diets were formulated to be iso-nitrogenous (30.1± 0.2% CP) and iso-caloric (4339 ± 74 Kcal/kg diet). The trial was conducted in aquaria in 3 replicates/each treatment (7 fingerlings/ aquarium) and terminated after 90 days experimental period. Fish were fed the tested diets at a rate of 3% of their wet body weight / day, in three equal portions, 6 days a week. Provided feed was adjusted bi-weekly according to the changes in body weight. Representative samples of fish were taken for whole body chemical composition at the start and at the termination of the study. Canola meal chemical composition and diets ingredients and its chemical composition were performed. Data collected included growth performance parameters, feed intake, feed utilization and body chemical composition along with simple economic evaluation was conducted. Results revealed that canola meal has good protein quality comparable to soybean meal protein either without or with phytase. In addition, canola meal can replace up to 50 % of SBM protein with phytase supplementation in practical diets of Nile tilapia without any adverse effects on growth performance, feed utilization and whole body composition of fish. Also canola meals (as its protein is generally less expensive than soybean meal protein) and phytase enzyme can reduce feed cost and feed cost/kg gain. Under the experimental conditions it seems that the diet contained 22% canola meal + 0.1% phytase enzyme was the most promising diet.

Keywords: canola meal, phytase, Tilapia, performance, feed utilization, body chemical composition, economic evaluation.

INTRODUCTION

Canola is a genetically selected variety of rapeseed belonging to *Brassica napus* and *B. campesttis* species that are low in both glucosinolates or antithyroid factors, and erucic

acid. The cited global supplies of rapeseed/canola protein exceed those of fish meal (Higgs *et al.*, 1996).

Canola meal is a relevant protein replacement for fish as it has a relatively high protein content (38%) and a high protein digestibility in Salmonids (Cheng and Hardy, 2002) and it is costless than both fish and soybean meals (Higgs *et al.*, 1995). However, Canola meal contains up to 3.7% phytic acid, representing approximately two thirds of the total phosphorus (McCurdy and March, 1992) which shows a very low availability for fish (Saj Jadi and Carter, 2004). In addition, phytates may form complexes with plant protein in diets which reduce the availability of dietary protein and amino acids (Liu *et al.*, 1998; Sugiura *et al.*, 2001).

Francis *et al.* (2001) reviewed anti- nutritional factors for fish. They indicated that growth and feed efficiency in cultured fish species, like tilapia, trout, carp and salmon are negatively affected by the inclusion of phytate containing ingredients in the diets. The amount of released phosphorus depends on many factors such as phytate source and its solubility, type of phytase and phytase activity as well as physiological conditions in the gut of different fish species. Moreover, phytase is sensitive to feed processing and temperatures above 65°C may reduce its activity significantly (Hughes and Soares, 1998).

Furuya *et al.* (2001) reported that phytase supplementation between 500 and 1500 FTU/Kg for tilapia improved calcium and phosphorus availability, performance, bone mineralization and protein digestibility.

The present study aimed to determine the growth performance of tilapia fingerlings fed diets containing different canola meal levels as a substitute for soybean meal protein without or with Phytase enzyme supplements. A simple economic evaluation was considered also.

MATERIALS AND METHODS

The present work was carried out in Animal Production Research Institute, By-Product utilization Dept, .Agric. Res. Center, Dokki, Egypt and Tilapia fingerlings (*Oreochromis niloticus)* were brought from a fish hatchery at Abbassa, Sharkia Governorate.

A total number of 126 Nile Tilapia fingerlings averaging 15.17± 0.18 g in wet body weight were allotted in to 6 dietary treatments. Such treatments were the combination of three levels of canola meal (CM) and two levels of Phytase enzyme (Ph). Canola meal was obtained from ARC at Giza. Canola meal levels were 0, 22 and 44% of the diet where it replaced 0, 50, and 100 of soybean meal according to its protein content. Phytase enzyme was added at 0 and 0.1% of the diet. Accordingly the dietary treatments were the control, control + Ph, 22% CM, 22% CM + Ph, 44% CM and 44% CM + Ph diets. All diets were formulated to be iso-nitrogenous (30.1± 0.2% CP) and iso-caloric (4339 ± 74 Kcal/kg diet). Canola meal chemical composition and diets ingredients and its chemical composition are presented in Tables 1 and 2 respectively. The trial was conducted in aquaria (60 X 40 X 20 cm) in 3 replicates/each treatment (7 fingerlings/ aquarium) and terminated after 90 days period. Water temperature was 28± 2 °C throughout the period of the study. Fish were fed the tested diets at a rate of 3% of their wet body weight / day in

three equal portions at 9.00, 12.00 and 15.00 h, 6 days a week. The amount of feed was adjusted bi-weekly according to the change in body weight.

Diets were formulated by mixing thoroughly the dry ingredients. For Phytase enzyme treatments, Phytase was added in water first and mixed thoroughly. All diets were pressed through meat mincer (0.5 mm diameter) and sun dried for 3 days. Representative samples of fish were taken at the start and at the termination of the study and frozen at – 18 °C for chemical analysis. Chemical analyses of diets and fish were made as described by AOAC (1995) and for canola fiber fraction (NDF, ADF and ADL) was performed as indicated by Goering and Van Soest (1970). Data collected included growth performance parameters, feed intake (dry basis, Richardson *et al* (1985), feed utilization and body chemical composition. All calculations needed are footnoted in the corresponding tables. A simple economic evaluation was calculated by the cost of one kg of feed and weight gain of fish. Data was subjected to analysis of variance (ANOVA) using the general linear model procedure of SAS (1990). Differences among means were evaluated using Duncan's multiple range test, Duncan (1955). The statistical model used was: $Y_{ijk}=\mu + C_i + Ph_j + CP*h_{ij} + E_{ijk}$, Where Y_{ijk} = observation of the ijk fish ; μ = overall mean, common element to all observation; C_i = canola meal effect; Ph_j = Phytase enzyme supplementation effect; $CP*h_{ij}$ =Interaction effect between canola meal levels Phytase enzyme supplementation; and E_{ijk} = random error component assumed to be normally distributed.

Table (1): Proximate chemical composition of canola meal, (DM basis).

Item	%
DM,%	94.76
CP,%	30.00
EE,%	17.30
CF,%	12.73
Ash,%	5.99
NFE,%	33.98
GE[1], k cal / kg	5198
Ca[2],%	0.65
TP[3],%	1.20
NDF[4],%	26.03
ADF[5],%	17.98
ADL[6],%	6.66
Cellulose[7],%	11.32
Hemicellulose[8],%	8.05

DM = Dry matter; CP = Crude protein; EE = Ether extract; CF= Crude fiber; NFE (Nitrogen free extract) = 100 - (% CP + % EE + % CF + % ash).

[1]Gross energy was 5.65 kcal/g for protein; 9.45 kcal/g for lipid; 4.00 kcal/g for crude fiber & 4.10 kcal/g for carbohydrates (Jobling , 1983).

[2]Calcium; [3]Total phosphorus; [4]Neutral detergent fiber; [5]Acid detergent fiber; [6]Acid detergent lignin; [7]ADF-ADL, [8]NDF-ADF.

RESULTS AND DISCUSSION

As evident in Table (1) canola meal contained high levels of CP (30 %) and EE (17.3%). However, its CF content was about 13 %. In this connection CLFF (2001) reported that canola meal contains 36 % CP, 13% CF, 2% EE. Such differences may reflect the variations in environmental conditions, and the method of fat extraction as well

Table (2): Feed ingredients and proximate chemical composition of canola meal (CM) diets without or with phytase enzyme fed to Nile tilapia fingerlings.

Item	Treatments*					
	T_1	T_2	T_3	T_4	T_5	T_6
Feed ingredients,%:						
Yellow corn	32..0	31.9	29.0	28.9	21.0	20.9
Soybean meal	30.0	30.0	15.0	15.0	-	-
Wheat bran	12.0	12.0	12.0	12.0	13.0	13.0
Fish meal, 65%CP	20.0	20.0	20.0	20.0	20.0	20.0
Canola meal	-	-	22.0	22.0	44.0	44.0
Vegetable oil	4.0	4.0	-	-	-	-
Phytase enzyme	-	0.1	-	0.1	-	0.1
Vitamins and minerals**	2.0	2.0	2.0	2.0	2.0	2.0
Total	100.0	100.0	100.0	100.0	100.0	100.0
Proximate chemical composition:						
DM, %	93.45	94.86	94.87	93.23	93.87	92.78
On DM basis,						
CP, %	30.21	30.45	30.02	30.20	29.98	29.90
EE, %	6.31	5.72	6.30	6.22	7.21	7.43
CF, %	4.94	4.70	6.20	7.08	8.05	8.90
Ash, %	6.45	6.10	7.79	7.42	8.41	7.54
NFE, %	52.09	53.02	49.68	49.08	46.35	46.23
GE kcal/kg***	4584	4570	4527	4540	4551	4596
Ca, %	0.91	0.92	1.01	1.04	1.10	1.13
TP, %	0.98	1.14	1.30	1.53	1.41	1.61
CP/ GE, mg/kcal	62.24	66.63	66.31	66.52	65.89	65.06

*Percentage is from the diet ; Ph, Phytase enzyme (10000 IU/ g product); T_1: control without Ph, T_2: control with 0.1% Ph, T_3:22% canola meal diet without Ph, T_4:22% canola meal diet with 0.1% Ph, T_5:44% canola meal diet without Ph, T_6:44% canola meal diet with 0.1% Ph, other abbreviations are as footnoted in Table (1).

** Each 1Kg contains vitamin: B1,1.4g; B2 ,0.8g; B6, 3.8g, B12,4.2g; pantothenic acid, 7g; nicotinic acid, 400mg; folic acid, 25g; biotin, 150g ;choline chloride, 5g ; A, 5000 000, I. U; D3, 1000 000, I. U;4g; K,0.5g; copper, 0.5g; iodine, 10g; manganese, 20g and Zinc, 0.07g.

*** [1]Gross energy was 5.65 kcal/g for protein; 9.45 kcal/g for lipid; 4.00 kcal/g for crude fiber & 4.10 kcal/g for carbohydrates (Jobling , 1983).

as the species tested. On the other hand soybean meal contained lower EE (1.5%), CF (7.3%), lignin (1.5%) and cellulose (7.8%) and higher CP (44%) than canola meal, CLFF (2001). However substitution of SBM by canola meal did not result in high variations in the chemical composition of the tested diets (Table 2) as they were iso-nitrogenous (30.1 ± 0.2 % CP) and iso-caloric (4562 ± 27 k cal GE/ kg diet, DM basis. In the present study, canola meal replaced 0, 50 and 100% of soybean protein where it was added at a rate of 0, 22 and 44 % of the diet. To avoid phytates in canola meal, Phytase enzyme was used at levels of 0 and 0.1% of the diet aiming to alleviate phytates negative effect if present.

Table (3) presents average initial and final body weight; specific growth rate (SGR) and weight gain (g/fish) of fish fed the experimental diets. Replacing SBM by canola meal up to 22% of tilapia diets (50% on protein basis) had no significant effect on final body weight, specific growth rate (SGR) and weight gain (g/fish) while the complete replacement levels significantly ($P=0.05$) reduced these parameters. Also, growth performance was improved significantly ($P<0.05$) by phytase supplementation. Such result is not in line with Saj Jadi and Carter (2004) who reported insignificant differences in weight gain of Atlantic salmon fed canola based diets with or without phytase The interaction effect showed significant differences in favor of 22% canola diet + 0.1% phytase enzyme (T_4) followed by the control with such enzyme (T_2). El-Kholy (2006) reported that canola meal can be included up to 100% substitution level of soybean meal without any adverse effect on tilapia fingerlings performance. In the present study phytase supplement was effective especially when canola meal substituted 50% of soybean meal protein. The differences between the obtained results herein and that of may reflect canola species differences and consequently its chemical composition.

Table (3): Growth performance parameters of Nile tilapia as affected by canola meal and phytase supplementation.

Item	Initial weight (g/fish)	Final weight (g/fish)	Weight gain (g/fish)	SGR (%/ day)
Canola meal (CM) level effect:				
0% CM in the diet.	15.25	42.08^{a}	26.83^{a}	1.13^{a}
22% CM in the diet.	15.11	44.46^{a}	29.36^{a}	1.20^{a}
44% CM in the diet.	15.18	35.03^{b}	19.85^{b}	0.93^{b}
Phytase (ph) effect:				
0g / kg diet (0%)	15.27	38.41^{b}	23.13^{b}	1.02^{b}
1g / kg diet (0.1%)	15.08	42.64^{a}	27.55^{a}	1.15^{a}
Ph*CM interaction:				
0 % CM +0%Ph , (T_1)	15.35	40.59^{bc}	25.24^{bc}	1.08^{bc}
0% CM +0.1%Ph,(T_2)	15.15	43.57^{ab}	28.42^{ab}	1.17^{ab}
22% CM +0%Ph , (T_3)	15.05	42.15^{bc}	27.10^{b}	1.14^{b}
22% CM +0.1%Ph,(T_4)	15.16	46.77^{a}	31.61^{a}	1.25^{a}
44% CM +0%Ph , (T_5)	15.42	32.48^{d}	17.06^{d}	0.85^{d}
44% CM +0.1%Ph,(T_6)	14.94	37.57^{c}	22.63^{c}	1.02^{c}

a, b, c means with different superscripts in the same column within each item differ significantly(5% level). Ph, Phytase enzyme.

SGR, specific growth rate, (%/d) = 100(ln final weight – ln initial weight)/period in days

NB, no mortalities were detected throughout the study and fish was in good conditions.

Feed utilization parameters are shown in Table (4). Feed intake (FI) was not affected when tilapia fingerlings fed the control diet or that contained 22% canola meal instead of soybean meal and both diets showed higher FI than that contained 44% canola meal instead of soybean meal (at a rate of 3% of fish weight). Feed conversion ratio (FCR), protein efficiency ratio (PER), protein productive value (PPV) and energy utilization (EU) were significantly (P=0.05) better with the control diet and that contained 22% canola meal than that contained 44% canola meal instead of soybean meal. Webster *et al.* (1997) reported that channel catfish fed a diet with 48% canola meal had inferior FCR (2.24) than fish fed diets containing 12, 24 and 36% canola meal which recorded FCR values of 1.75, 1.82 and 1.89 respectively, confirming the obtained results. Such results may be related to the presence of identified or unidentified anti-nutritional factors (Luo *et al.*, 2006) which increased as the level of canola meal increased in the diet. Also Canola meal contains phenolic compounds (such as sinapine and tannine) that may reduce protein digestibility (Krogdahl, 1989) and reduce the utilization of minerals as they become less easily absorbed in the intestine (NRC, 1998). Also, it contains glucosinolates which act as anti-thyroid factors (Teskeredzic *et al.*, 1995).

The highest FI and the best FCR, PER, PPV and EU were obtained by fish fed diets supplemented with phytase, with significant (P=0.05) differences. However, Saj Jadi and Carter (2004) reported insignificant differences in the feed intake of Atlantic salmon fed diets with or without phytase.

The interaction between phytase supplementation and canola meal replacement levels differed significantly (P=0.05) and were in favor of the diet contained 22% canola meal + 0.1% phytase enzyme (T_4). The worst effect was with the diet contained 44% canola meal + 0% phytase enzyme (T_5).

The proximate chemical composition of the whole fish bodies at the start and the termination of the feeding trial are shown in Table (5). As for the main effects, canola meal diets increased body fat (EE) significantly (P=0.05) than the control. The 44% canola meal diets increased (P=0.05) body DM, EE and energy compared to the controls. The high fat content in tilapia bodies may reflect the increase in dietary fat due to the high level of fat in canola meal especially in the 44% canola meal diets (tables 2 & 1). However, crude protein and ash contents were not significantly affected (P>0.05) in all canola meal diets (0, 22, 44% canola meal).

The inclusion of phytase enzyme in the diet resulted in increasing CP and EE in tilapia bodies significantly. However it affected tilapia DM, ash and GE insignificantly. In this respect, Storebakken *et al.* (1998) reported that pretreatment of soy concentrate with phytase significantly increased the whole body minerals (P, Ca and Mg) of Atlantic salmon. Such findings may support the insignificant increase in ash content due to the addition of phytase enzyme in tilapia diets in the present study.

As for the interaction for the incorporation of canola meal and phytase supplementation in the diets, significant (P<0.05) differences were obtained in whole body composition in favor of the diet contained 22% canola meal + 0.1% phytase enzyme (T_4) in general. The obtained results may support the finding that protein quality of fish fed diets with phytase supplementation is higher than that of canola meal substitutions.

Table (6) presents a simple economic evaluation for the replacement of 0%, 50% and 100% SBM protein by canola meal protein (0, 22, 44 % of canola in the diet) along with the addition of 0 and 0.1% phytase to the diet of tilapia. Replacing SBM by canola meal reduced feed costs/kg diet. Feed costs/kg weight gain was reduced with canola meal diets with or without phytase enzyme addition. The only exception is that the diet contained canola meal without phytase enzyme increased feed costs required for kg weight gain compared to the control. The relative percentage of feed cost / kg weight gain was in favor of the diet contained 22% canola meal + 0.1% phytase enzyme (T_4) followed by the diet contained 22% canola meal without phytase enzyme (T_3), 0% canola meal + 0.1% phytase enzyme (T_2), 44% canola meal + 0.1% phytase enzyme (T_6) and the control. The worst was with 44% canola meal without phytase enzyme. These results showed that phytase addition can eliminate the action of phytates content in the diet. Deshpande and Damodaran (1989) showed that eliminating phytates will encourage the use of more plant materials in animal feeds, which will reduce feed cost and environmental pollution in animal nutrition. The economic analysis showed that diets containing levels of canola meal were less expensive and produced fish at lower cost per unit of weight (kg) than diets containing higher levels of soybean meal in the diets. Therefore, canola meal in tilapia diets appears to be the most effective and economical substitute for soybean meal protein especially when phytase enzyme was added. Under the experimental conditions it seems that the diet contained 22% canola meal + 0.1% phytase enzyme (T_4) was the most effective as it reduced feed cost/kg gain by about 37% as well as its reduction in formulated feed cost.

Table (4): Feed utilization parameters of Nile tilapia as affected by canola meal and phytase supplements.

Item	FI	FCR	PER	PPV	EU
Canola meal (CM)level effect:					
0% CM in the diet.	54.34^{a}	2.04^{b}	1.64^{a}	24.77^{a}	15.19^{a}
22% CM in the diet.	55.47^{a}	1.90^{b}	1.76^{a}	26.32^{a}	17.46^{a}
44% CM in the diet.	51.22^{b}	2.64^{a}	1.28^{b}	21.79^{b}	14.75^{b}
Phytase (ph) effect:					
0g / kg diet (0%)	52.72^{b}	2.36^{a}	1.45^{b}	22.55^{b}	14.83^{b}
1g / kg diet (0.1%)	54.64^{a}	2.02^{b}	1.67^{a}	26.18^{a}	16.76^{a}
Ph* CM interaction:					
0 % CM + 0%Ph , (T_1)	53.43^{a}	$2.12b^{c}$	1.58^{bc}	23.96^{b}	14.52^{cd}
0% CM + 0.1%Ph,(T_2)	55.25^{a}	1.96^{c}	1.71^{ab}	25.58^{ab}	15.85^{bc}
22% CM + 0%Ph , (T_3)	55.06^{a}	2.03^{bc}	1.64^{b}	24.45^{ab}	16.69^{ab}
22% CM + 0.1%Ph,(T_4)	55.92^{a}	1.77^{c}	1.88^{a}	28.63^{a}	18.22^{a}
44% CM + 0%Ph , (T_5)	49.69^{b}	2.94^{a}	1.14^{d}	19.25^{c}	13.29^{d}
44% CM + 0.1%Ph,(T_6)	52.76^{ab}	2.34^{b}	1.43^{c}	24.32^{ab}	16.20^{abc}

a, b, c means with different superscripts in the same column within each item differ significantly (5% level).

FI, feed intake in g/fish; FCR, feed conversion ratio= FI/ weight gain, g/g; PER, protein efficiency ratio = weight gain/ CP intake, g/g; %PPV, protein productive value = 100(body

protein at the end – body protein at the start) protein intake; %EU, energy utilization = 100(body energy at the end – body energy at the start)/energy intake.

Table (5): Whole body composition as affected by canola meal and Phytase supplements for the Nile tilapia fingerlings.

Item	DM (%)	CP (%)	EE (%)	Ash (%)	GE* (kcal/kg)
Canola level effect:					
0% canola in the diet.	26.22^{b}	53.41	10.92c	16.03	4836^{b}
22% canola in the diet.	26.69^{ab}	52.17	16.30a	18.21	4979^{ab}
44% canola in the diet.	28.39^{a}	52.55	17.98a	19.84	5096^{a}
Phytase (ph) effect:					
0g / kg diet (0%)	27.52^{a}	51.81^{b}	13.84^{b}	17.33	4916
1g / kg diet (0.1%)	26.68^{ab}	53.61^{a}	16.30^{a}	18.72	5024
Ph*CM interaction:					
0 % Canola +0%Ph, (T1)	26.10^{b}	53.29^{a}	10.85^{c}	15.16^{b}	4874^{b}
0% Canola + 0.1% Ph, (T2)	26.33^{b}	52.92^{ab}	11.00^{c}	16.90^{ab}	4797^{b}
22% Canola +0%Ph , (T3)	27.30^{ab}	50.59^{b}	14.92^{b}	17.84^{ab}	4935^{b}
22% Canola +0.1%Ph,(T4)	26.08^{b}	53.75^{a}	17.67^{ab}	18.85^{ab}	5023^{ab}
44% Canola +0%Ph , (T5)	29.15^{a}	50.95^{b}	15.74^{b}	18.98^{ab}	4939^{b}
44% Canola +0.1%Ph,(T6)	27.64^{ab}	54.16^{a}	20.22^{a}	20.69^{a}	5096^{a}
Initial body composition	23.11^{c}	52.70^{a}	13.76^{cd}	17.66^{a}	4963^{ab}

a, b, c means with different superscripts in the same column within each item differ significantly (5% level).

* Gross energy was 5.65 kcal/g for protein; 9.45 kcal/g for lipid; 4.00 kcal/g for crude fiber & 4.10 kcal/g for carbohydrates (Jobling, 1983).

Table (6): Feed costs in Egyptian pound (L.E) for producing one kg weight gain by Nile tilapia fed the experimental diets.

Item	Feed intake (g/fish)	Cost (L.E / ton)	Total gain (g)	Feed cost (L.E /Kg gain)	Relative% of feed cost / kg gain
0 % CM + 0%Ph , T_1	53.34	3560	25.24	7.54	137
0% CM + 0.1%Ph ,T_2	55.25	3399	28.42	6.41	116
22% CM + 0%Ph , T_3	55.06	3121	27.10	6.34	115
22% CM + 0.1%Ph, T_4	55.92	3120	31.61	5.52	100
44% CM + 0%Ph , T_5	49.69	2857	17.06	8.32	151
44% CM + 0.1%Ph,T_6	52.76	2856	22.63	6.65	120

Local market price (L.E /ton) for feed ingredients used for formulating the experimental diets when the experiment was started (2008); 800 L.E, soybean meal = 2200 L.E, fish meal L.E, yellow corn= 1500 L.E, wheat bran = 1000 L.E, corn oil = L.E, vitamin and minerals mix = 13000 L.E.

CONCLUSION

The present study revealed that canola meal has good protein quality comparable to soybean meal protein either without or with phytase and is generally less expensive than soybean meal protein. In addition, canola meal can replace up to 50 % of SBM with phytase supplementations in practical diets of Nile tilapia without any adverse effects on growth performance, feed utilization and whole body chemical composition of fish. Also it can reduce feed cost and feed cost/kg gain. Under the experimental conditions it seems that the diet contained 22% canola meal + 0.1% phytase enzyme (T_4) was the economically most promising diet.

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استجابة اصبعيات البلطى النيلى (*OREOCHROMIS NILOTICUS*) للعلائق المحتوية كسب الكانولا وانزيم الفيتيز.

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اجريت هذة التجربة بهدف دراسة تأثير احلال كسب الكانولا محل كسب فول الصويا فى علائق اصبعيات البلطى النيلى بمستويات مختلفة (صفر و ٥٠ و١٠٠% من بروتين كسب فول الصويا والذى يمثل صفر ، ٢٢ ، ٤٤% من العليقه) وذلك بدون اضافة او باضافة انزيم الفيتيز (صفر او ٠،١ % من العليقة) ، وعليه تم تكوين ستة علائق تجريبية متماثلة فى محتوها من البروتين الخام(٣٠% بروتين) وطاقة كلية (٤٣٣٩ كيلو كالورى /كجم عليقة) كالتالى:

١-عليقة الكنترول

٢- عليقة الكنترول +٠،١ % انزيم الفيتيز

٣- ٢٢% كسب الكانولا من العليقة

٤- ٢٢ % كسب الكانولا من العليقة+ ٠،١% انزيم الفيتيز

٥-٤٤ % كسب الكانولا من العليقة

٦- ٤٤% كسب الكانولا من العليقة+ ٠،١% انزيم الفيتيز

وقد تم اجراء التجربة باستخدام ١٢٦ من اصبعيات البلطى النيلى بمتوسط وزن عند بداية التجربة ١٥،١٧ جم ، والتى وزعت عشوئيا فى احواض زجاجية بمعدل ٧ سمكات / حوض (٣ مكررات لكل معاملة) وبمعدل تغذية ٣% من وزن الجسم مقسمة الى ثلاث وجبات متساوية الحجم يوميا (٦ أيام فى الاسبوع) خلال مدة التجربة التى استمرت ٩٠ يوم ، وتم تعديل معدل التغذية كل اسبوعين تبعا للتغير فى الوزن. كما تم تقدير التركيب الكيماوى لكل من كسب فول الصويا والمكونات المختلفة الداخلة فى تركيب العلائق وايضا عينات من الاسماك فى بدية ونهاية التجربة. وتم دراسة النمو والكفاءة الغذائية ومكونات جسم السمكة الكيماوية مع اجراء دراسة اقتصادية بسيطة.

اظهرت النتائج ان كسب الكانولا يعد مصدر جيد للبروتين مقارنة بكسب فول الصويا خاصة مع اضافة انزيم الفيتيز. وكان افضل استبدال لكسب فول الصويا هو مستوى ٥٠% من كسب الكانولا على اساس المحتوى البروتينى باضافة انزيم الفيتيز(٢٢% كسب كانولا من العليقة + ٠،١% انزيم الفيتيز) فى علائق البلطى النيلى دون تاثيرات سلبية على اداء النمو او الكفاءة الغذائية اوالتركيب الكيماوى لاجسام الاسماك. ووجد ان كسب الكانولا مصدر للبروتين ذو كفاءة اقتصادية افضل من بروتين فول الصويا و ان اضافة انزيم الفيتيز عمل على خفض تكاليف العليقة وكذلكا تكاليف العليقة / كجم عائد وزنى للاصبعيات.