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THE USE OF TOMATO SEEDS BY-PRODUCT MEAL SUPPLEMENTED WITH L. CARNITINE AS NON-CONVENTIONAL INGREDIENTS IN PRACTICAL DIETS FOR MONOSEX NILE TILAPIA, *Oreochromis niloticus*

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ABSTRACT

The present study was designed to evaluate the effect of replacing the protein source of soybean meal (SBM) by tomato seeds by-product meal supplemented with biogenic L. carnitine as a source of methionine plus lysine mixture (TSBPM) at a rate of 100mg/100g diet on growth performance, feed utilization and economic efficiency. Six experimental diets were formulated, control diet (T_0) contained 45.4% soybean meal. Tested Diets (T_1 -T_5) contained 15 to 75% replacing levels (in 15% increments) of soybean meal protein(SBM) by tomato seeds by-product meal supplemented with L-carnitine (TSBPM). All experimental diets were isonitrogenous (30% CP) and isocaloric (290.0 Kcal digestible energy/100g diet) and P/E ratio of 68.0 mg protein/Kcal gross energy) and each diet was fed to three replicated of fish groups (20 fish for each replicate). Diets were fed to monosex Nile tilapia (*O. niloticus*) 6 days/week (twice daily) at 5% of live body weight through 120-days (experimental period).Results of this study showed that, replacement of SBM by tomato seedss by-product meal (TSBPM) up to 60% significantly improved final body weight (BW). Increasing the replacing levels of SBM by TSBPM up to 75% decreased daily weight gain (DWG), specific growth rate (SGR), total feed intake (FI), feed conversion ratio (FCR) and protein efficiency ratio (PER) with insignificant differences ($P > 0.05$) compared with the control group. These results revealed the possibility of replacing 75% of the high cost SBM by the low cost TSBPM in monosex Nile tilapia diets.

Results of body composition indicated that ,fish group fed diet $TSBPM_{60}$ gained the highest percentages of protein content and the lower values of ash content, while the replacement of 75% of SBM by TSBPM released the lower percentages of protein, fat and dry matter contents, and higher ash content in whole fish bodies, with significant differences ($P < 0.05$) compared with control treatment.

From the economic point of view, replacing 75% of SBM by TSBPM in mono sex Nile tilapia diets reduces feed costs by 40.73%.

Keywords: Nile tilapia,Tomato seeds meal,carnitine,performance

INTRODUCTION

In Egypt, it is commonly known that, there is an observed shortage in the traditional feedstuffs rather than the continuous increase in their prices from time to time. Also, the high costs and/or fluctuating quality of soybean meal lead to identify alternative protein sources for use in fish feed formulation.Therefore, attempts have been carried out to search for alternative untraditional low price by-products, which could be used in fish diets.Hassanen (1991) demonstrated that the Nile catfish (*Clarias Lazera*) was able to utilize a diet containing 66% unconventional protein supplement (tomato, brewers dried grain and bean haulms). On the other hand tomato seeds by-product meal contains considerably amounts of crude fiber

(18.71%) compared to 4.8% in SBM (Table 1) and methionine and lysine are limiting essential amino acids in this by-product (Hassanen *et al*., 1995)

Tomato waste is one of the canning wastes which tried by many workers (Khadzhinikolova and Tomasyan, 1983 and 1984; Hassanen, 1986; Hassanen *et al*., 1995; El-Shamma *et al*., 1997 and Saad, 1998). The processing of tomatoes yields several by –products such as seeds and peels which are mostly classified as tomato pomace, tomato seeds meal, tomato seeds cake and tomato seeds oil. The total waste produced from tomato from world production was estimated roughly to be 3.7 million tons/year (FAO, 1991). According to the informations released by “Kaha” and “Edfina” companies, the two companies produce not less than 1080 tons of tomato waste/year (Saad, 1998).

The present study aimed to investigate the possibility of using the low price tomato seeds by product supplemented with L-carnitine as a source of methionine plus lysine mixture as non conventional protein source instead of the high price common sources, soybean in monosex Nile tilapia diets.

MATERIALS AND METHODS

The experimental work of the present study was carried out at The Central Laboratory for Aquaculture Research, Abbassa, Sharkia Governorate, Egypt. The study was conducted to evaluate the effect of replacing the protein source of SBM by TSBPM in monosex Nile tilapia diets.

Tomato seeds by-product was obtained from Kaha factory, located in Kaha, Kalubia Governorate. Tomato seeds by-product was sun-dried for few days after that, dried in a drying oven (model Fisher oven 13-261-28A) for 24 hours at 65ºC, then ground to meal through a feed grinder to very small particle sizes (0.15 mm mesh). After that,saved in plastic bags and stored in refrigerator at 4ºC until adding for the experimental diets after the chemical analysis.

Experimental diets:

Six experimental diets were formulated to contain 0 to 75% (15% increment) tomato seeds by-product biogenic meal (TSBPM) as an unconventional replacement of soybean meal (SBM).Composition and proximate analysis of the experimental diets used in this study are presented in Table (1).

All experimental diets were isonitrogenous (30% CP), isocaloric (290.0 Kcal digestible energy/100g diet) and P/E ratio of 68.0 mg protein/Kcal gross energy). Each diet was fed to three replicated fish groups (20 fish for each replicate). Diets were fed to monosex Nile tilapia (*O. niloticus*) at a daily rate of 5% of total biomass during the experimental period 6 days/week (twice daily at 9 a.m and 3 p.m) and the amount of feed was bi-weekly readjusted according to the changes in body weight throughout the experimental period (120-days).

Experimental fish and management:

A total of 360 healthy monosex Nile tilapia fry (*Oreochromis niloticus*) with average body weight of 1.39 g/fish (± 0.23g) were obtained from the hatchery in Central lab.of Aquaculture Research, Agriculture Research

Center. The obtained fish were placed in a fiberglass tank inside the wet lab. and fed on the control diet ($TSBPM_0$) two weeks for acclimation. The fry were randomly divided in to six experimental groups (60 in each) in three replicates (20 in each), transferred into glass aquaria, measured (50 x 60 x 60cm) and it was supplied with dechlorinated aerated tap water. The aquaria were cleaned and 50% of water was changed weekly. Dissolved oxygen was at an acceptable level (5.5 - 6.6 mg/L). Water temperature was thermostatically controlled at the range of 27°C ± 2°C, with thermostatic heater and water pH was 7.4. All fish from each aquarium were bulk weighed at the beginning of the experiment and again every 15 days until the end of the feeding trial.

Table (1): Composition and proximate analysis of the experimental diets.

Ingredients, %	Diets					
	TSBPM 0	TSBPM 15	TSBPM 30	TSBPM 45	TSBPM 60	TSBPM 75
Fish meal (60%)	16.70	16.70	16.70	16.70	16.70	16.70
Soybean meal (43.8%)	45.70	38.80	32.00	25.11	18.27	11.42
Tomato seeds by-product (30.61%)	-	9.80	19.60	29.40	39.20	49.00
L-carnitine[1]	0.10	0.10	0.10	0.10	0.10	0.10
Corn starch	28.06	26.05	23.94	21.93	19.87	17.81
Fish oil	1.10	1.10	1.10	1.10	1.10	1.10
Corn oil	2.00	1.63	1.26	0.89	0.52	0.15
Vit. & Min. Mix.[2]	1.00	1.00	1.00	1.00	1.00	1.00
CMC[3]	1.50	1.50	1.50	1.50	1.50	1.50
Cellulose powder	2.64	2.12	1.60	1.07	0.54	0.02
Vit. C.	1.20	1.20	1.20	1.20	1.20	1.20
Total	100	100	100	100	100	100
Proximate analysis %on dry matter basis						
DM	89.12	88.45	88.98	88.65	88.42	88.30
CP	30.66	29.80	30.12	30.42	29.99	30.35
EE	5.14	5.04	5.12	5.22	5.42	5.24
CF	5.00	5.08	5.00	5.12	5.15	5.11
Ash	6.43	10.10	11.80	12.92	15.61	17.80
NFE[4]	52.77	49.98	47.96	46.32	43.83	41.50
Gross energy (Kcal/ 100 g diet)[5]	454.67	437.98	432.16	428.74	418.35	409.16
Digestible energy (Kcal/100 g diet)[6]	305.10	294.32	292.60	291.72	286.39	281.84
P/E ratio[7]	67.43	68.04	69.70	70.95	71.69	74.18

[1]L-carnitine: source of methionine and lysine mixture (1:1).

[2] Vitamin & mineral mixture/Kg premix: Vitamin D_3, 0.8 million IU, A 4.8 million IU; E, 4g; K, 0.8g ; B_1 0.49; Riboflavin, 1.6 g; B_6, 0.6 g, B_{12} 4 mg; Pantothenic acid, 4g; Nicotinic acid, 8g; Folic acid 0.4g, Biotin,20mg, Mn,22g ,Zn,22g, Fe,12g, Cu,4g , I, 0.4g , Selenium, 0.4 g and Co, 4.8 mg.

[3]CMC: carboxymethylcellulose.

[4] Nitrogen free extract (NFE) = 100 – (CP + EE + CF + Ash).

[5] Gross energy in Kcal/100 g diet : based on 5.7 Kcal/g protein, 9.5 Kcal/g lipid, 4.0 Kcal/g carbohydrate (According to Jobling, 1983).

[6] Digestible energy in kcal/100g diet : based on 5.0 kcal/g protein,9.0kcal/g lipid,2.0 kcal/g carbohydrate (Wee and Shu, 1989).

[7] Protein/ energy ratio : based on mg protein per one kcal gross energy.

At the end of the experiment, fish in each aquarium were counted and weighed and economical efficiency, growth and feed efficiency were calculated, Also, chemical analysis of both diet and fish was carried out according to AOAC (1990).

Statistical analysis:

The statistical analysis of data was carried out by applying the computer program, SAS (2000) by adopting the following model.

$$Y_{ij} = \mu + \alpha_i + E_{ij}$$

Where, Y_{ij} = the observation on the ijth fish eaten the ith diet; μ = overall mean, th diet; μ = overall mean, α_i = the effect of Ith diet and E_{ij} = random error.

Differences among means were tested for significance, according to Duncan's multiple range test (1955).

RESULTS AND DISCUSSION

Proximate analysis of tomato seedss by-product meal:

Proximate analysis of TSBM is presented in Table (2). As described in this table, the high protein content (30.61%) of TSBPM indicates the possibility of incorporation of this cheap industrial by-product in fish diets as a replacement of the high cost SBM. Moreover, EE content in TSBPM is high compared to that in SBM being 8.30 and 2.2%, respectively. Alicata *et al*. (1988) found that, tomato waste contained 22.0 CP, 32.8 CF and 19.5% EE. El-Sayed (1994) found that, percentages of chemical composition of tomato by-product were 93.9 DM, 16.11 CP, 5.49 EE, 44.18 CF, 28.73 NFE, and 5.49% ash. Hassanen (1986) demonstrated that, the proximate analysis of tomato pulp was 95.61 DM, 24.38 CP, 6.43 EE, 25.94 CF, 31.50 NFE and 7.30% ash.

Table 2: Proximate analysis of TSBPM compared to SBM.

Item (%)	TSBPM	SBM
DM	92.72	93.2
CP	30.61	43.8
EE	8.30	2.20
CF	18.71	4.80
Ash	15.91	9.70
NFE	26.47	39.5

Tomato seeds by-product meal contains considerable amounts of crude fiber (18.71%) compared to 4.8% in SBM (Table 2). Methionine and lysine are limiting essential amino acids in this by-product as reported by Hassanen *et al.*(1995). In addition, Soltan (2002) demonstrated that higher replacing levels (60 to 80% of SBM by TBM) decreased all growth parameters of Nile tilapia fish. For these findings, using of L-carnitine as a source of methionine and lysine mixture with TSBPM treats this deficiency of amino acids to obtain superior growth performance of fish in higher replacing levels.

Growth performance:

Average initial BW and BL of monosex Nile tilapia, *Oreochromis niloticus* ranged between 1.38 and 1.40 g and 3.8 and 3.9 cm, respectively with insignificant differences between fish groups for both traits. Table 3 indicating the random distribution of fish among the different experimental treatments. Final body weight ranged between 25.51 ± 1.01 and 28.81 ± 1.05 g and the differences in body weight among the different treatments were significant (P < 0.001).

Table 3: Effects of replacing of SBM by TSBPM on the growth performance parameters (mean ± SE) of monosex Nile tilapia (*O. niloticus*).

Stages	Control	Tested diets					Signif-icance
	TSBPM 0	TSBPM 15	TSBPM 30	TSBPM 45	TSBPM 60	TSBPM 75	
Initial body weight /fish (g)	1.38 ± 0.01^a	1.39 ± 0.03^a	1.40 ± 0.01^a	1.39 ± 0.01^a	1.39 ± 0.01^a	1.39 ± 0.01^a	NS
Initial body **length/fish (cm)**	3.8 ± 0.16^a	3.8 ± 0.17^a	3.9 ± 0.17^a	3.9 ± 0.17^a	3.9 ± 0.17^a	3.8 ± 0.17^a	NS
15-day post-stocking (g)	2.81 ± 0.01^c	2.81 ± 0.01^c	3.30 ± 0.01^b	3.81 ± 0.01^a	3.95 ± 0.01^a	2.93 ± 0.01^c	***
30-day post-stocking (g)	4.53 ± 0.11^c	4.81 ± 0.03^c	5.20 ± 0.13^b	6.10 ± 0.11^a	6.81 ± 0.11^a	4.71 ± 0.13^c	***
45-day post-stocking (g)	6.35 ± 0.11^c	6.75 ± 0.13^c	7.11 ± 0.11^b	8.50 ± 0.11^a	9.00 ± 0.11^a	6.51 ± 0.11^c	***
60-day post-stocking (g)	8.85 ± 0.19^c	9.01 ± 0.19^c	10.50± 0.19^b	11.50± 0.19^a	11.90± 0.19^a	8.91 ± 0.19^c	***
75-day post-stocking (g)	11.93± 0.15^c	12.31± 0.15^c	13.50± 0.15^b	15.31± 0.15^a	16.50± 0.15^a	12.01± 0.15^c	***
90-day post-stocking (g)	15.80 ± 0.11^c	16.11± 0.13^c	18.00± 0.13^b	20.10± 0.13^a	20.51± 0.13^a	15.51± 0.13^c	***
105-day post-stocking (g)	20.60 ± 0.15^c	21.01± 0.15^b	22.90± 0.15^a	23.00± 0.15^a	24.21± 0.15^a	20.31± 0.15^c	***
120-day post-stocking (g)	25.90 ± 1.01^b	25.80± 1.01^b	28.31± 1.09^a	28.00± 1.09^a	28.81± 1.05^a	25.51± 1.01^b	***
Final body length/fish (cm)	11.50 ± 0.11^a	11.40± 0.11^a	11.50± 0.11^a	11.50± 0.11^a	11.60± 0.11^a	11.40± 0.11^a	NS
DWG (g/day/ fish)[1]	0.204 ± 0.01^b	0.203± 0.01^b	0.224± 0.01^a	0.222± 0.01^a	0.229± 0.01^a	0.201± 0.01^b	*
SGR[2]	2.44 ± 0.10^b	2.43 ± 0.10^b	2.51 ± 0.10^a	2.50 ± 0.10^a	2.53 ± 0.10^a	2.42 ± 0.10^b	*
RGR (%/d)[3]	17.77 ± 0.13^b	17.56± 0.13^b	19.22± 0.13^a	19.14± 0.13^a	19.73± 0.13^a	17.35± 0.13^b	*
Final condition factor[4]	1.70 ± 0.001^b	1.74± 0.001^b	1.86± 0.001^a	1.84± 0.001^a	1.85± 0.001^a	1.72± 0.001^b	*

a, b, c: Means within each row having different letters are significantly different at (P < 0.05).

NS = not significant (P < 0.05) *** = P< 0.001 *= P<0.05

[1]Daily weight gain = $(W_1 - W_o) \div T$

Where, W_0 = Initial body weight (g) , W_1 = Final body weight (g) and T= time (days).

[2]Specific growth rate (%) = $[(Ln_{w1} - Ln_{w0}) \div T] \times 100$.

Where, Ln = natural log, W_0 = Initial body weight (g) , W_1= Final body weight (g) and T= Time(day)

[3]Relative growth rate (%/day) = $(W_1 - W_0) \div W_0$. Where, W_0 = Initial body weight (g) , W1 = Final body weight (g)

[4]Condition factor (k) =$100 \times W/L^3$ where, W = fish body weight (g) and L = fish body length (cm).

The highest body weight was recorded for the $TSBPM_{60}$ treatment when 60% of soybean meal was replaced by tomato seeds by-product meal supplemented with L-carnitine at the dose of 100 mg/100 g diet and the lowest body weight was shown by the (TSBPM 75) when 75% of soybean meal was replaced by tomato seeds by-product meal with insignificant effect on body weight as compared with that of the control group.

These results revealed the possibility of replacing 75% of the high cost SBM by the low cost TSBPM in tilapia diets. Moreover, results in Table (3) indicated that, there were insignificant differences in final body weight for fish fed the experimental diets contained 30, 45 and 60% of TSBPM. Also, daily weight gain (g/fish),specific growth rate(%/d), relative growth rate (%) and final condition factor (k), recorded the same trend of the final body weight wheres, no significant differinces were observed between fish fed the experimental diets contained 30, 45 and 60% of TSBPM. In this respect, Abou-Seif (2006) demonstrated that using L-carnitine in monosex Nile tilapia diet during a single stage nursery-rearing system improve growth performance and survival rate. The present results are in agreement with Saad (1998) who reported that replacement of soybean meal by tomato by-product meal up to 88.9% increased the final body weight of Nile tilapia fry while the complete replacement decreased the final body weight. In contrast, Soltan *et al*. (2005) found that the replacement of SBM by tomato by-product meal up to (50%) decreased the final body weight of Nile tilapia.

Final body length was not significantly affected by replacing of SBM by TSBPM from 0 to 75% (Table 3). The longest fish bodies were recorded for fish fed diets $TSBPM_{30}$ and $TSBPM_{45}$ (30 and 45% of SBM replaced by TSBPM) compared to other groups. These results are in agreement with those obtained by Soltan *et al*. (2005), they found that final body length of common carp was not significantly affected by increasing the replacing level of SBM by TBM up to 70%, while the higher replacing level (80%) significantly decreased the final body length.

With regard to daily weight gain (DWG), results in Table (3) showed that the higher DWG (0.229 g) was recorded by fish fed diet $TSBPM_{60}$ where 60% of SBM was replaced by TSBPM, while the lower DWG (0.201 g) was obtained by fish fed the $TSBPM_{75}$ diet with no significant effect on DWG as compacted with that of the control group. These results have good potential for the possibility of replacing 75% of the high cost SBM by the low cost TSBPM in Nile tilapia diets. These findings are in accordance with Khadzhinikolova and Tomasyan (1984), they cleared that partial or total replacement of sunflower meal by tomato waste showed an improvement in WG of carp fish. On the other hand, Soltan (2002) found that, weight gain of *O. niloticus* insignificantly increased until the replacing level of SBM by TBM reached to 50%, after that WG was significantly decreased. Also, Saad (1998) found that, WG of common carp was significantly decreased with increasing the replacing levels of SBM by TBM from 0 to 25, 50 and 100%.

As illustrated in Table (3), the higher SGR value (2.53%/d) was obtained with fish fed the diets contained 60% of TSBPM and the lowest one (2.42%/d) was obtained with fish fed the diets contained 75% of TSBPM. Statistical analysis of data (Table 3) also showed that, SGR values lie in two clusters, the first one included that diets with 0 (control), 15 and 75% and the second cluster involved the diets contained 30, 45 and 60% of SBM replaced by TSBPM and the differences between SGR of the two clusters were significant (P < 0.05) indicating the possibility of replacing 75% of SBM by TSBPM in *O. niloticus* diets.

It is noteworthy that, increasing the replacing level of SBM by TSBPM up to 75% in Nile tilapia diets had no adverse effect on all growth parameters (BL, BW, WG and SGR) comparing with the control, and this indicated the possibility of replacing 75% of SBM by TSBPM in Nile tilapia diets to reduce the feed costs.

Feed utilization:

As described in Table (4), feed intake (FI) in the present study increased significantly (compared to control) with increasing the replacing levels of SBM by TSBPM to 60%.These results indicated the improvement of growth parameters by feeding the diets contained TSBPM. The highest FI (70.66 g/fish) was recorded for fish fed the diet TSBPM$_{60}$ where 60% of SBM was replaced by TSBPM and the lowest one (54.15 g/fish) was obtained for fish fed the control diet with insignificant effect on FI as compared with that of the TSBPM$_{75}$ group.

Table 4: Growth performance and feed utilization of Nile tilapia as affected by replacing of SBM with TSBPM.

Traits	Control	Tested diets					Signif-icance
	TSBPM 0	TSBPM 15	TSBPM 30	TSBPM 45	TSBPM 60	TSBPM 75	
Initial body weight/fish (g)	1.38 ± 0.01^{a}	1.39 ± 0.01^{a}	1.40 ± 0.01^{a}	1.39 ± 0.01^{a}	1.39 ± 0.01^{a}	1.39 ± 0.01^{a}	NS
Final body **weight/fish (g)**	25.90± 1.01^{b}	25.80± 1.01^{b}	28.31± 1.09^{a}	28.00± 1.09^{a}	28.81± 1.05^{a}	25.51± 1.01^{b}	***
Mass weight gain (g)	24.52 ± 1.01^{b}	24.41± 1.03^{b}	26.91± 1.05^{a}	26.61± 1.03^{a}	27.42± 1.01^{a}	24.12± 1.03^{b}	***
Total feed intake (g/fish)	54.15 ± 1.51^{c}	55.61± 1.51^{c}	60.67± 1.58^{b}	67.24± 1.48^{a}	70.66± 1.51^{a}	54.18± 1.53^{c}	***
Feed convers-ion ratio	2.21 ± 0.01^{b}	2.28 ± 0.01^{b}	2.26 ± 0.01^{b}	2.53 ± 0.01^{a}	2.58 ± 0.01^{a}	2.25 ± 0.01^{b}	***
Protein efficiency ratio	1.48 ± 0.01^{a}	1.47 ± 0.01^{a}	1.47 ± 0.01^{a}	1.30 ± 0.01^{b}	1.29 ± 0.01^{b}	1.47 ± 0.01^{a}	***

a, b, c: Means within each row having different letters are significantly different at (P < 0.05).

NS = non significance (P < 0.05) , *** = P < 0.001, *= P < 0.05

Mass weight gain (g/fish) = Final body weight (g/fish) – Initial body weight (g/fish)

Protein efficiency ratio (PER): Live weight gain (g) ÷ Protein consumed (g)

Feed conversion ratio (FCR): Dry feed consumed (g)/Total weight gain (g)

Average of feed conversion ratio (FCR, g feed per g of live mass gain) during the whole experimental period had ranged from 2.21 to 2.58 (Table 4). The highest (worse) FCR value was recorded with TSBPM$_{60}$ (2.58) when 60% of the high price SBM was replaced by the low price TSBPM, while the lowest (best) FCR rate (2.21) was obtained when fish fed TSBPM$_{0}$ (control) with insignificant effect on FCR compared with TSBPM$_{75}$ (75% of SBM replaced by TSBPM) (highest replacing level) due to supplementation with L-carnitine that maximized the utilization of protein content in this tested diet. These results indicate the possibility of replacing SBM by TSBPM$_{75}$ for the best FCR value. These results are in agreement with Khadzhinikolova and Tomasyan (1984) who found that, carp fish fed a control diet containing sunflower meal partially or completely replaced by tomato waste showed improved feed efficiency values. Also, Soltan *et al*. (2005) cleared that increasing the levels of TBM as a replacement of SBM in common carp diets to 50% had no significant effect on neither FCR or PER values.

Also, results in Table (4) indicated that increasing the replacing level of SBM by TSBPM from 30 to 60% (with an increment of 15%) in Nile tilapia diets significantly increased ($P < 0.001$) FCR. While a reverse trend was true with protein efficiency ratio (PER) (improved) values, due to supplementation with L-carnitine. In this respect, Abou-Seif (2006) pointed out that using L-carnitine (Lysine and methionine mixture) in monosex Nile tilapia diet during a singlestage nursery-rearing system improved FCR gradually with increasing the dose of L-carnitine, while PER increased gradually with increasing the dose of L-carnitine.

Body composition:

Results in Table (5) showed that, as the inclusion level of TSBPM in the experimental diets increased the percentage of dry matter in whole fish in- significantly decreased up to the replacing levels of SBM by TSBPM reached to 60% but the higher replacing level (75%) significantly decreased the dry matter content of Nile tilapia bodies and the same trend was also observed for fat content of Nile tilapia bodies. In this concern, Soltan (2002) noted that as the inclusion level of TBM in the experimental diets increased, protein and fat contents of whole fish significantly decreased and ash increased but moisture content was not significantly changed. Saad (1998) found that the addition of TBM at low levels (25% substitution) significantly decreased fat content of carp carcasses.

Data presented in Table (5) showed also that fish fed the experimental diet $TSBPM_{60}$ gained the higher (62.81%) protein and the lower (29.86) ash contents whereas, fish fed the experimental diet $TSBPM_{75}$ gained the lower (60.40%) protein content and the higher (33.01%) ash percentage. The differences in percentages of protein and ash were significant ($P < 0.001$ and $P < 0.05$).

Table 5: Effects of replacing levels of SBM by TSBPM on whole body composition (mean ± SE) of Nile tilapia(% dry matter basis).

Traits	Control	Tested diets					Signif-icance
	TSBPM 0	TSBPM 15	TSBPM 30	TSBPM 45	TSBPM 60	TSBPM 75	
Dry matter (%)	28.71 ± 0.15[a]	28.62± 0.15[a]	28.62± 0.19[a]	28.54± 0.19[a]	28.50± 0.16[a]	27.31 ± 0.16	*
Protein (%)	61.31 ± 0.42[b]	61.50± 0.42[b]	62.11± 0.45[a]	62.31± 0.43[a]	62.81 ± 0.42	60.40± 0.42[c]	***
Fat (%)	7.92 ± 0.18[a]	7.83 ± 0.18[a]	7.80 ± 0.15[a]	7.53 ± 0.18[a]	7.31 ± 0.15[a]	6.51 ± 0.15[b]	*
Ash (%)	30.56 ± 0.42[b]	30.35± 0.58[b]	30.05± 0.58[b]	30.08± 0.48[b]	29.86± 0.45[b]	33.01± 0.45[a]	*

a, b, c: Means within each row having different letters are significantly different at ($P < 0.05$).
***** = $P < 0.001$, *= $P < 0.05$**

Economical efficiency:

The current investigation highlights the potential of using TSBPM for partial replacement of SBM in Nile tilapia diets. Generally, results of the present study showed the possibility of replacing SBM by TSBPM up to 75% with no adverse effect on growth performance and feed utilization.

Feed cost is considered to be the highest recurrent cost in aquaculture, often ranging from 30 to 60% (D'Abromo and Sheen,1994), depending on the intensity of the operation. Any reduction in feed costs either through diet development, improved husbandry or other direct or indirect means decreased therefore the total production investment and increased the net return (Collins and Delmendo, 1979; Green; 1992 and De Silva and Anderson, 1995). All other costs are almost constant; therefore the feeding costs required to produce one Kg gain in weight could be used to compare the economical efficiency of different experimental treatments. The calculated figures Table 6. Showed that, feed costs (LE/ton) decreased gradually with increasing substitution level of SBM by TSBPM. Data presented in the same table showed that, increasing substitution level decreased feed costs by 7.95, 16.22, 24.17, 32.45 and 40.73%, respectively.

Table 6: Feed costs (L.E) for producing one Kg WG by fish fed the experimental diets.

Items	Control TSBPM 0	Tested diets				
		TSBPM 15	TSBPM 30	TSBPM 45	TSBPM 60	TSBPM 75
Costs, LE/ton	3020	2780	2530	2290	2040	1790
Relative to control (%)	100	92.05	83.78	75.83	67.55	59.27
Decreased in feed cost (%)	0.00	7.95	16.22	24.17	32.45	40.73
FCR	2.21	2.28	2.26	2.53	2.58	2.25
Feed costs, LE/Kg WG	6.67	6.34	5.72	5.79	5.26	4.03
Relative to control (%)	100	95.05	85.76	86.81	78.86	60.42

The price of each diet was estimated according to the price of ingredient based on local market price at the time of the study, which were 5.0 , 3.0 , 2.0 , 0.20 , 5.0 , and 10.0 Egyptian pound (L.E) per one Kg of fish meal, soybean meal, corn starch, tomato seeds by-product meal, corn and fish oil and vitamins and minerals premix, respectively.

It is note worthy that, increasing the replacing levels of SBM by TSBPM up to 75% did not significantly affect all growth parameters (BW, BL, DWG and SGR). Feed costs (LE/Kg WG) decreased for all substitution levels of SBM by TSBPM and the experimental diet $TSBPM_{75}$ released the lowest feed costs (LE/Kg WG) while the control diet ($TSBPM_0$) released the highest one. In conclusion, replacing 75% of SBM by TSBPM reduced feeding costs by 40.73%.

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استخدام مخلفات بذور الطماطم المدعمة بالكارنتين كمواد غير تقليدية فى العلائق التطبيقية لأسماك البلطى النيلى وحيد الجنس٠

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فى دراسة لتقييم تأثير إحلال كسب بروتين فول الصويا بواسطة مسحوق مخلفات تصنيع الطماطم (البذور) والمدعمة بالكارنتين كمصدر لليسين والميثونين (١٠٠ ملجم/١٠٠ جم عليقة) على أداء النمو والاستفادة الغذائية وكذلك الكفاءة الاقتصادية٠ تم تكوين ٦ علائق تجريبية، العليقة الأولى (العليقة الضابطة) المدعمة بالكارنتين والخالية من بذور الطماطم ، احتوت العلائق المختبرة ($T_1 – T_5$) على نسب متزايدة من بذور الطماطم (١٥ – ٧٥%) المدعمة بالكارنتين كبديل لكسب بروتين فول الصويا (بفاصل ١٥%)، وكانت هذه العلائق متماثلة فى محتواها من البروتين (٣٠% بروتين خام) والطاقة (٢٩٠٠ كيلو كالورى طاقة مهضمومة/كجم عليقة) وكانت نسبة البروتين إلى الطاقة بها ٦٨ ملجم بروتين/كيلو كالورى طاقة كلية ، تمثلت كل معاملة فى ثلاثة مكررات، وتم تغذية الأسماك ٦ أيام/أسبوع (مرتين فى اليوم) بمعدل ٥% من وزن الجسم خلال فترة التجربة (١٢٠ يوما)٠ أظهرت نتائج هذه الدراسة:

أن إحلال مخلفات تصنيع الطماطم (البذور) المدعمة بالكارنتين محل كسب فول الصويا بنسبة وصلت إلى ٦٠% أدى إلى تحسن فى وزن الجسم النهائى، زيادة مستويات الإحلال إلى ٧٥% أدى إلى نقص غير معنوى ($P > 0.05$) فى مقدار الزيادة اليومية فى وزن الجسم ومعدل النمو وكمية الغذاء المأكول، وكذلك معدل تحويل الغذاء وكفاءة البروتين بالمقارنة بالعليقة الضابطة٠ وتشير هذه النتائج إلى إمكانية إحلال بذور الطماطم رخيصة الثمن المدعمة بالكارنتين محل بروتين كسب فول الصويا مرتفع الثمن بنسبة تصل إلى ٧٥% فى علائق البلطى النيلى٠

أظهرت نتائج التحليل الكيماوى لجسم السمكة أن العليقة التى تم فيها الإحلال بنسبة ٦٠% من مخلفات تصنيع الطماطم (البذور) المدعمة بالكارنتين قد أدت إلى الحصول على أعلى نسبة للبروتين وأقل نسبة للرماد فى جسم السمكة، بينما أظهرت العليقة التى وصلت نسبة الإحلال بها إلى ٧٥% إلى نتائج عكسية لهذه المقاييس٠

من الناحية الاقتصادية وجد أن إحلال ٧٥% من بروتين كسب فول الصويا بمخلفات بذور الطماطم المدعمة بالكارنتين فى علائق البلطى النيلى قد أدى إلى تقليل تكاليف التغذية بنسبة ٧٣ر٤٠%٠ يستنتج من هذة الدراسة أن مخلفات بذور الطماطم المدعمة بالكارنتين يمكن أن تحل محل من ٦٠ ـ ٧٥% من بروتين فول الصويا فى العليقة التطبيقية لسمكة البلطى النيلى وحيد الجنس دون تأثير ضار على معدل النمو أو التحويل الغذائى بالإضافة إلى أنة أرخص كثيرا وأكثر إقتصادية من كسب فول الصويا تحت الظروف التجريبية لهذا البحث.