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PARTIAL REPLACEMENT OF SOYBEAN MEAL WITH BLACK SEED AND ROQUETTE SEED MEALS IN NILE TILAPIA (*Oreochromis niloticus*) FINGERLINGS DIETS.

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ABSTRACT

Black seed meal (*Nigella sativa*) and roqutte seed meals (*Eruca sativa*) were tested to replace soybean meal (SBM) in diets for mono sex Nile tilapia fingerlings (*Orecreomis niloticus*). Nine isonitrogenous (30% CP), isocaloric (460 kcal GE/100g) diets were formulated to contain black seed (BSM) and roquette seed meals (RSM) as a partial replacement of soybean meal at different levels (0, 5, 10, 15 and 20%) forming 9 treatments, 4 with BSM and 4 with RSM and the control. The diets were fed daily at a rate of 4 % of fish body weight in triplicate groups with 15 Nile tilapia fingerlings each (3.14g/fish), in 80 l glass aquaria for 90 days period. Data collected were on growth rate, feed utilization and body composition along with simple economic evaluation. Results of growth performance showed that SBM substitution with BSM and RSM were nearly similar. Survival rate was not affected greatly but it seems that all levels of BSM substitution were more favorable than the other RSM substitutions. As for feed utilization most treatments used showed similar results to the control. The 20 % RSM replacement (instead of SBM) showed the lowest values. Carcass CP content was not affects by all levels of BSM and 5 to 15% levels of RSM that substituted SBM. Carcass fat content showed no significant differences among all groups and the control group. The highest ash content in fish body was obtained by fish fed T_9 diet which contained 20% RSM as a partial replacement of SBM. The present study suggest that BSM and RSM have were more economic efficiency when replacing SBM at levels of 20% and 15%, respectively in Nile tilapia fingerlings diets.

Keywords: Nile tilapia, black seed meal, requette seed meal, growth performance, feed utilization, body composition, economic efficiency.

INTRODUCTION

Fish feed costs represent almost 65 to 70% of the intensive fish culture imputes (Scharoder, 1977). Attempts have been done to reduce the feed costs by using cheaper alternative sources of protein and / or energy of that called non- traditional ingredients or by- products which may have a great value in producing cheap fish diets (Abd El-Hakim *et al.*, 2003). Tilapia are important freshwater fish species for aquaculture. They are native to Africa, but were introduced into many different regions of the world during the second half of the 20th century (Pillay, 1990). Tilapia are currently known as" aquatic chicken" due to their fast growth , adaptability to a wide range of environmental conditions, disease resistance, high flesh quality , ability to grow and reproduce in captivity and feed on low trophic levels. Thus, they have excellent candidates for aquaculture, especially in tropical and subtropical regions (El-Sayed, 2006). Plant oilseeds and their by products usually constitute major sources of dietary protein within aqua feeds for warm water omnivorous / herbivorous fish species (Akiyama, 1991 and Abdel-Hakim *et al,* 2008 a & b). Some factors limit incorporation of these ingredients at high levels in fish diets that are low protein content, amino acid imbalance and presence of anti-nutritional factors (Wee, 1991).

Soybean meal is one of the most commonly used legumes as a major plant protein sources in fish diet (Tonsy *et al.,* 2006). However, defatted soybean meal contains 45-48% crude protein whereas alcohol–washed protein concentrate contains 70-85% crude protein (Storebakkan and Refstie, 2000). Soybean meal is not only expensive but also difficult to be in steady current competition between fish and poultry. For these reasons, nutritionists try to replace part of soybean meal as plant protein by another unconventional plant protein sources (Abdelhamid *et al.,* 2004a & b, 2005a & b and 2006). More information is still required about the pattern of black seed meal and requette seed meal in the fish feeds. Therefore, the present study was undertaken to investigate the effect of using different levels of black seed meal and roquette seed meal as an unconventional plant protein sources on the growth performance, feed and nutrient utilization, body composition and cost benefit analysis of Nile tilapia fingerlings.

MATERIALS AND METHODS

Fish and experimental system

This work was started at the first of July 2007 and was carried out at the Central Laboratory for Aquaculture Research, Abbassa, Abou Hammad, Sharkia Governorate, Egypt. Fingerlings of healthy Nile tilapia (*Oreochromis niloticus*) were acclimated to laboratory conditions for 14 days and weighed (3.14g/fish) just before the start of the feeding trail (90 days period). At the beginning of the experiment, 27 glass aquaria (50 x 50 x 60 cm) were stocked with 15 fish each. The aquaria were supplied with dechlorinated fresh tap water (27.00±2.00°C) which was changed daily at a rate of 30% by such water and supplemented with continues aeration.

Diets and feed regime

The proximate composition of the ingredients used in the diets formulation is presented in Table (1). The nine experimental diets were formulated to contain 30% crude protein and about 4600 kcal GE/Kg diet (Table 2).

Table (1): Proximate composition of the ingredients (on DM basis) used in the formulation of the experimental diets.

Ingredients	Moisture	CP	EE	CF	Ash	NFE	GE kcal/g
Fish meal	٩,٠٠	72.00	8.40	00	10.50	9.10	5.133
Soybean meal	١١,٩٧	٤٤,٨٠	١,٢٠	٧,٣٠	٥,٤٠	٤١,٣٠	٤,٢٥٦
Black seed meal	٨,١١	٣٠,٤٠	١٦,٢٠	٣,٣٠	١٢,٧٠	٣٧,٤٠	٤,٨٢٦
Requette seed meal	٩,٣١	٣٥,٠٠	٩,٠٠	٢,٥٠	٦,٠٠	٤٧,٥٠	٤,٨٢٨
Yellow corn	١١,٠٠	٨,٥٠	٣,٨٠	٢,٦٠	١,٣٠	٨٣,٨٠	٤,١٣٣
Wheat bran	١١,٠٠	١٥,٢٠	٣,٩٠	١٢,٠٠	٦,٢٠	٦٢,٧٠	٤,٧٩٠

Table (2): Feed formulation and proximate composition of the experimental diets.

Items	Experimental diets								
	T_1 (control)	T_2 (5% BSM)	T_3 (10% BSM)	T_4 (15% BSM)	T_5 (20% BSM)	T_6 (5% RSM)	T_7 (10% RSM)	T_8 (15% RSM)	T_9 (20% RSM)
Ingredient (%)									
Fish meal	7.77	7.77	7.77	7.77	7.77	7.77	7.77	7.77	7.77
Soybean meal	٥٥,٥٥	٥٢,٧٧	٥٠,٠٠	٤٧,٢٢	٤٤,٤٤	٥٢,٧٧	٥٠,٠٠	٤٧,٢٢	٤٤,٤٤
BSM	-	٢,٧٧	٥,٥٥	٨,٣٣	١١,١١	-	-	-	-
RSM	-	-	-	-	-	٢,٧٧	٥,٥٥	٨,٣٣	١١,١١
Yellow corn	٢٢,٢٢	١٧,٧٧	١٢,٢٢	٧,٧٧	٣,٨٨	١٨,٨٨	١٣,٨٨	١٠,٥٥	٧,٧٧
Wheat bran	٩,٢١	١٣,٣٣	١٩,٤٤	٢٣,٦٦	٢٩,٤٠	١٢,٧١	١٧,٥٢	٢١,١٦	٢٣,٨٢
Cellulose	٢,٢٥	٢,٧١	٢,٣٦	٢,٨١	١,٨	٢,٢٢	٢,٦٢	٢,٥٣	٢,٨
Corn oil	١,٠	٠,٨٨	٠,٦٦	٠,٤٤	٠,٢٢	٠,٨٨	٠,٦٦	٠,٤٤	٠,٢٢
Fish oil	١,٠	١,٠	١,٠	١,٠	١,٠	١,٠	١,٠	١,٠	١,٠
Vit- Min.Premix***	١,٠	١,٠	١,٠	١,٠	١,٠	١,٠	١,٠	١,٠	١,٠
Total	١٠٠	١٠٠	١٠٠	١٠٠	١٠٠	١٠٠	١٠٠	١٠٠	١٠٠
Proximate analysis (%)									
DM	٩٠,١٦	90.68	٩٠,٣١	٩٠,٢٦	٩٠,٢١	٩٠,٥١	٩١,٠١	٩٠,٢٨	٩١,١١
CP	٣٠,٠٦	٣٠,٠٦	٣٠,٢٧	٣٠,١٨	٣٠,١٤	٢٤,٨٣	٢٤,٩٣	٣٠,٠٦	٢٩,٨٩
EE	٥,١١	٥,١٢	٥,١٤	٥,١٤	٥,٢٢	٥,١٥	٥,١٦	٥,٢٢	٥,٤٢
CF	٤,٥٨	٤,٩٧	٥,٤٠	٥,٨٧	٦,١٣	٤,٨٧	٥,٣١	٥,٦٢	٦,٠٦
Ash	٧,١٠	٦,٣٧	٦,٥١	٦,٩٤	٦,٣٢	٦,٣٧	٦,١١	٦,٨٣	٦,٤٣
NFE*	٥٣,١٥	٥٣,٤٨	٥٢,٦٨	٥١,٨٢	٥٢,١٤	٥٣,٧٨	٥٣,٤٩	٥٢,٢	٥٢,٣٨
GEkcal/100g	٤٥٧,١١	٤٦٠,٢١	٤٦٠,٠٨	٤٥٨,٤٤	٤٦١,٠٩	٤٦٠,٤٥	٤٦١,٢٩	٤٥٨,٨٦	٤٦٠,٣٤
P/E ratio**	٦٥,٧٦	٦٥,٣٢	٦٥,٧٩	٦٥,٨٣	٦٥,٣٧	٦٤,٧٨	٦٤,٨٨	٦٥,٥١	٦٤,٩٣

*** calculated by differences.**

**** P/E ratio (protein to energy ratio) = mg CP/kcalGE.**

***** Fish premix (each 1kg contains: vit.A,25mlu; vit.D3,1.25mlu; vit.E,12500mg; vit.K,5000mg; vit.B1,5000mg;vit.B625000mg;vit.B12,10mg; pantathenic acid ,10000mg; Nicotinic acid, 100000Iu;Folic acid, 5000mg ; Biotin, 750mg;Cholinechloride, 2000000mg; Copper, 3000mg;Iodine, 125mg;Iron, 75000mg; Manganese, 65000mg and Selenium,150mg.**

The first diet was saved as a control diet containing protein from fishmeal and soybean meal (T_1). Soybean meal protein was replaced partially at 5, 10, 15 and 20% rate by black seed meal (T_2, T_3, T_4 and T_5) or roquette seed meal (T_6, T_7, T_8 and T_9), forming 9 treatments. The experimental diets were prepared by fine grinding of the dietary ingredients. After that, all ingredients of each experimental diet were mixed toughly and produced in pellets form (1mm, in diameter) using pelleting machine, thereafter dried and stored in a freezer (-20°C) until use. Fish were fed at a fixed feeding regime of 4% of the body weight daily (dry food / whole fish weight). The rations were offered four times at daily (9.00, 11.00, 13.00 and 15.00hr) at equal portions. Fish were bulk weighed (one aquarium at a time) biweekly and feed amounts were adjusted accordingly.

Growth performances were determined as follows:

SGR (specific growth rate) = 100 (ln final weight - ln initial weight) / experimental days.

FCR (feed conversion ratio) = dry feed intake (g)/wet weight gain (g).

PER (protein efficiency ratio) = weight gain (g)/protein intake (g).

Weight gain = Final body weight (g) – Initial body weight (g).

Relative growth rate (RGR) =100 x (Final body weight / Initial body weight).

Productive protein value (PPV %) =100 x [protein retained (g) / protein intake (g)].
Energy utilization (EU, Kcal) = 100 x (Gross energy of final fish body, Kcal – Gross energy of initial fish body, Kcal)/ Gross energy intake, Kcal.
Gross energy (GE), Kcal was calculated by multiplying CP x 5.65 + fat x 9.45 (Jobling, 1983).

Chemical and statistical analysis

Diets and fish samples were analyzed according to AOAC (1995) for dry matter (DM), crude protein (CP), crude fiber (CF), ether extract (EE) and ash. The chemical analysis on dry matter basis of the experimental diets is shown in Table (2). The economic efficiency was calculated as the cost of feed required for producing one kg fish weight gain. Data obtained were statistically analyzed using SAS program (1990) and the significant differences among means were evaluated by Duncan's multiple range test (Duncan, 1955).

RESULTS AND DISCUSSION

Data of the chemical composition of the tested ingredients shown in Table (1) showed that black seed meal (BSM) and roquette seed meal (RSM) were relatively low in crude fiber and crude protein contents. The opposite was true for ether extract and ash contents. Such results are useful indicator for ingredients used in fish diets. The RSM and BSM had similar values of gross energy being, 4.828 and 4.826 Kcal/g, respectively as compared with the control (SBM) which had lower gross energy content (4.256 Kcal /g). That may be due to high levels of ether extract that contained in RSM and BSM when compared with that of SBM. The chemical composition of SBM was nearly similar to that reported by (Zeweil, 1996 and Taha, 2009). Also, El Nather and El-Kady (2007) pointed out that RSM could be used as a rich protein meal (32%) and it contains Zn, Cu, Fe, Mg, Mn and other elements which increase immune response. The diets (Table 2) were formulated to contain the control and the tested levels of either BSM or RSM and all the tested diets were formulated to be isocaloric – isonitrogenus.

The growth performance of Nile tilapia fingerlings which fed the experimental diets are shown in table (3). At the start of the study the initial weights of fish among treatment diets not differ significantly, indicating that groups were homogenous. At the end of the feeding period (90 days), fish fed all tested diets exhibited no significant differences for final body weigh, SGR (%/d) and body weight gain (g/fish) values compared with the fish fed the control diet (T_1). However, the fish fed diet T_9 showed the lowest values of FBW (16.01 g/ fish), BWG (12.87g/fish) and SGR (1.81%/d). These results are similar to the findings of Abd Elmonem *et al.* (2002) who indicated that red tilapia fed both the black and roqutte seed meals exhibited better growth. The fish fed diets T_2, T_3 and T_4 had relative growth rate (RGR %) values not significantly differ from those fed the control diet (T_1) whereas, the RGR values of T_5, T_6, T_7, T_8 and T_9 differ significantly ($P \leq 0.05$). However, the lowest RGR values (509.70%) were observed in diet T_9 with significant differences as compared with control diet. The survival rates (SR) were higher being nearly 100% for all fish groups and the fish fed diet T_9 showed the lowest values (98.9%) showing clearly that the toxic substances in BSM and RSM are not lethal. Similar trend was found by Atwa (1997) with BSM in Nile tilapia diets and Abd Elmonem *et al.* (2002) with BSM and RSM in red tilapia fry diets. But, the present results are higher than those reported by Al Kenawy *et al*. (2008). Results obtained on growth performance revealed that, the values of all the growth parameters were decreased as the substitution level of SBM with BSM increased from 5% to 20% and with RSM from 5% to 15%. This may be due to increasing the level of antinutritional factors and deficiencies in some essential amino acid by increasing the level of substitution (Wee, 1991).

Table (4) showed that the differences between the control group compared with the all experimental groups of feed intake (FI), feed conversion ratio (FCR) and protein efficiency ratio (PER) were not significant. The lowest value of FCR was obtained by T_9 (1.61%) group (the highest level of RSM in Nile tilapia diet).

This means that the increasing FCR was related with increasing levels of BSM and RSM in Nile tilapia diets. Since, the amount of feed intake was increased for producing body weight gain. The same trend was observed in PPV% values whereas; the T_9 (32.63%) and T5 (32.96%) had the lowest values with significant differences with the other diets.

Concerning results in table (4) of incorporation of BSM and RSM in Nile tilapia fingerlings diet, the replacing rates of 20 and 15%, respectively of soybean meal by either feedstuffs had no negative effect on protein and energy efficiency ratios which is in complete agreement with the findings of Taha (2009) who reported that partial substituted of soybean meal had no significant effects on feed intake or feed conversion.

Energy utilization efficiency percent for the control, T_2, T_3, T_4, T_6, T_7, T_8 and T_9 groups were 18.07%, 19.42%, 20.33%, 23.18%, 20.16%, 20.30%, 21.70%, 21.83%, respectively, whereas, the differences among all groups and the control group were significantly ($P<0.05$) except T_5 (18.18%) which have no significant difference.

Final body composition results of fish fed the experimental diets are presented in Table (5) which indicates that the composition of fish diets has a great influence on their chemical composition. However, the body fat content was high with T_9, T_8, T_7, T_6, T_2 and T_1 where the differences among these groups were not significant. Whereas, diets T_3, T_4 and T_5 had significantly lower EE content. The lowest value of EE content was obtained by fish fed on T_5 diet which contained 20% BSM as a partial replacement of SBM. Body moisture content of fish given 20% BSM or RSM as a partial replacement of SBM was higher than other treatments (Table, 5). However, the differences among T_9, T_8, T_7, T_4, T_3, T_2 and T_1 groups were not significant. The results for the body crude protein contents of fish fed the experimental diets indicated that the substituting level of RSM or BSM with SBM caused no significant differences in crude protein content except T_9 which differs significantly difference ($P \leq 0.05$).

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Table (5): Initial and final whole body composition (% on dry matter basis) of Nile tilapia fed experimental diets (Mean ± SE of triplicate analysis).

		Diets								
Parameters	**Initial**	**T_1**	**T٢**	**T٣**	**T٤**	**T٥**	**T٦**	**T_7**	**T٨**	**T٩**
Moisture	81.0	74.20^{bc} ±1.97	74.23^{bc} ±1.03b	75.60^{b} ±2.00	75.80^{b} ±2.00	77.60^{a} ±1.54	72.44^{d} ±1.00	75.21^{ab} ±2.01	76.31^{ab} ±3.2	76.56^{ab} ±2.61
Protein	٧٢,٠١	67.47^{a} ±0.70	67.63^{a} ±0.11	67.87^{a} ±0.23	67.83^{a} ±1.34	67.47^{a} ±0.12	66.93^{ab} ±0.45	66.91^{ab} ±0.01	66.55^{ab} ±0.03	65.28^{b} ±0.35
Fat	٧,٣٢	18.58^{ab} ±0.92	18.89^{ab} ±0.81	18.30^{b} ±0.34	18.26^{b} ±0.60	18.10^{b} ±0.30	18.94^{ab} ±0.76	18.96^{ab} ±0.32	18.96^{ab} ±0.11	19.01^{a} ±0.36
Ash	٢٠,٦٧	12.95^{ab} ±0.14	12.84^{ab} ±0.13	12.81^{ab} ±0.23	11.92^{bc} ±0.91	11.36^{c} ±0.15	12.33^{b} ±0.31	12.41^{b} ±0.24	12.51^{ab} ±0.12	13.73^{a} ±0.19

a, b, c,….. Means within column with different letter are significant (P<0.05).

The whole body ash content increased with increasing RSM levels, while it decreased in fish body with increasing BSM in Nile tilapia fingerling diets with significant differences ($P \le 0.05$). The highest ash content in fish body was obtained by fish fed T_9 diet which contained 20% RSM as a partial replacement of SBM. These results are in agreement with Tibaldi *et al. (*2006) and did not agree with the results obtained by Abd Elmonem *et al.* (2002) who reported that, the body composition was not affected by BSM and RSM inclusion levels in the diet of red tilapia fry diet.

From the present study , BSM and RSM can be used in Nile tilapia diets at 20% and 15% levels (replacing partially SBM), without advance effect on growth performance, nutrients utilization and protein content in whole body of Nile tilapia fingerling. This may be due to its digestive and stimulant effects through their aromatic substances at 20% level of polyunsaturated fatty acids which are the building blocks of cells and help the body to produce prostaglandin (Babayan *et al .,* 1978). In addition, SBM contains nutrients such as thiamin, riboflavin, pyridoxine, niacin, Ca, Fe, Cu, Zn and P (Khalifeh, 1995).

The economic efficiency of the experimental diets is presented in Table (6). Prices of experimental diets based on feed ingredients in the local market during 2008 were 2.55, 2.50, 2.45, 2.40 and 2.35 LE/kg diet for the control , 5%, 10%, 15% and 20% BSM diets, respectively which indicated that incorporation of BSM at 20% as a partial replacement of SBM reduced diet cost by 0.2٥ LE.

Table (6): Feed Cost and relative % of feed cost per Kg fish of Nile tilapia fed the experimental diet.

	Diets								
Items	**T_1**	**T_2**	**T_3**	**T_4**	**T_5**	**T_6**	**T_7**	**T_8**	**T_9**
Diet cost LE	٢,٥٥	٢,٥٠	٢,٤٥	٢,٤٠	٢,٣٥	٢,٤٥	٢,٤٠	٢,٣٥	٢,٣٠
FCR	1.55	1.56	1.55	1.55	1.56	1.57	1.58	1.57	1.61
BWG (g/fish)	١٣,٣٢٠	١٣,٣١١	١٣,٣٠٧	١٣,٢٩٩	١٣,٢٨٧	١٣,٢٧٦	١٣,٢٥٦	١٣,٢٤٥	١٢,٨٦٦
Feed cost/kg fish LE	3.95	3.90	3.81	3.72	3.67	3.85	3.79	3.69	3.70
Relative % of feed cost per Kg fish	١٠٠	٩٨,٧٣	٩٦,٤٦	٩٤,١٨	٩٢,٩١	٩٧,٤٧	٩٥,٩٥	٩٣,٤٢	٩٣,٦٧

Egypt feed ingredients price at start of 2008
***Feed cost /Kg fish = FCR x Diet cost LE**

Also, incorporation RSM up to 20% as a partial replacement of SBM reduced diet cost from 2.55 LE to 2.30LE. Total feed costs during the whole feeding experiment to produce one Kg body weight gain decreased with increasing BSM and RSM in Nile tilapia diets. The maximum economic efficiency rates were obtained by fish received 20% BSM or RSM, while Abd Elmonem *et al.* (2002) showed that the maximum profitability was obtained with diet containing 6% BSM and 3% RSM in red tilapia diet. On the other hand, Zeweil (1996) stated that there were economic benefits at lower inclusion level of BSM, but at higher levels, the economic efficiency was reduced significantly.

These results indicated that, black seed meal and roquette seed meal can be incorporated in Nile tilapia fingerlings diet to replace 20% of soybean meal for better economical efficiency as well as better growth performance and nutrients utilization.

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الاحلال الجزئى لكسب فول الصويا بكسب الحبة السوداء وكسب الجرجير فى علائق اصبعيات البلطى النيلى.

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*** المعمل المركز لبحوث الثروة السمكية بالعباسة – مركز أبو حماد – محافظة الشرقية – مركز البحوث الزراعية - مصر.**

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صممت هذة التجربة لدراسة تأثير الاحلال الجزئى لكسب فول الصويا بكل من كسب حبة البركة وكسب الجرجير فى علائق اصباعيات البلطى النيلى وحيد الجنس على اداء النمو والكفاءة الغذائية وتحليل جسم الاسماك والكفاءة الاقتصادية للعلائق .

تم تكوين تسعة علائق تجريبية متساوية فى محتواها البروتينى (٣٠% بروتين خام) وكذلك محتواها من الطاقة ٤٦٠ كيلو كالورى /١٠٠جم طاقة كلية وذلك بالاحلال الجزئى لكسب فول الصويا بمستويات مختلفة (٥، ١٠، ١٥، ٢٠ %) وتم تغذية العلائق (بمعدل ٤% من وزن الجسم) بثلاث مكررات لكل من المجموعات المختبرة والمكونة من ١٥ سمكة بكل مكرر (بمتوسط وزن بداية ٣,١٤ جم) بالاضافة الى عليقة الكنترول التى تحتوى على كسب فول الصويا.

تشير النتائج ان قيم اداء النمو كانت جيدة ومتقاربة بالنسبة لجميع المعاملات. و لم تختلف نسبة النفوق معنويا بين جميع المعاملات حيث ان افضل القيم ظهرت مع مجموعات كسب حبة البركة عن كسب الجرجير وكانت اقل قيمة مع المعاملة التى تحتوى على٢٠% كسب الجرجير. كما ان الكفأة الغذائية كانت مماثلة لعليقة الكنترول لجميع المعاملات حيث ان مستوى احلال ٢٠% احلال كسب الجرجير اظهر اقل القييم.

كما اوضحت نتائج تحليل جسم الاسماك ان مستويات الاحلال المختبرة لم تؤثر على محتوى جسم الاسماك من البروتين بالنسبة لجميع مستويات الاحلال لكسب حبة البركة ومستويات الاحلال حتى ١٥% بالنسبة لكسب الجرجير . كما ان محتوى الدهن فى جسم الاسماك لم يتأثر فى كلا من الاسماك التى غذيت على جميع مستويات الاحلال من كلا من كسب حبة البركة و كسب الجرجير . واعلى قيمة للرماد ظهرت فى المعاملة التى تحتوى على ٢٠% من كسب الجرجير.

توضح التجربة ان كلا من كسب حبة البركة وكسب الجرجير يمكن احلالهما بدون اى اثار سلبية على مقاييس النمو وبصورة اكثر كفاءة من الناحية الاقتصادية عند احلالهم بكسب فول الصويا حتى مستوى ٢٠% لكسب حبة البركة و١٥% لكسب الجرجير فى علائق اصباعيات البلطى النيلى.

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Table (3): Growth performance of Nile tilapia fed the experimental diets.

Parameters	Experimental diets								
	T_1 (control)	T_2 (5%BMS)	T_3 (10%BMS)	T_4 (15%BMS)	T_5 (20%BMS)	T_6 (5%RMS)	T_7 (10%RMS)	T_8 (15%RMS)	T_9 (20%RMS)
IW(g/fish)	3.14^a ±0.04	3.14^a ±0.03	3.14^a 0.05±	3.14^a ±0.04	3.14^a ±0.02	3.14^a ±0.04	3.14^a ±0.03	3.14^a ±0.02	3.14^a ±0.03
FW(g/fish)	16.46^a ±0.11	16.45^a ±0.20	16.45^a ±0.21	16.44^a ±0.31	16.43^a ±0.14	16.42^a ±0.11	16.40^a ±0.22	16.39^a ±0.09	16.01^a ±0.23
BWG(g/fish)	13.32^a ±0.17	13.31^a ±0.14	13.31^a ±0.18	13.30^a ±0.28	13.29^a ±0.17	13.28^a ±0.18	13.28^a ±0.10	13.25^a ±0.13	12.87^a ±0.25
SGR (%)	1.84^a ±0.05	1.84^a ±0.03	1.84^a ±0.02	1.84^a ±0.03	1.84^a ±0.02	1.84^a ±0.05	1.84^a ±0.03	1.84^a ±0.02	1.81^a ±0.02
RGR (%)	523.80^{ab} ±0.10	524.10^a ±0.41	523.70^{ab} ±0.22	523.50^{ab} ±0.16	523.20^b ±0.11	522.50^c ±0.10	522.20^{cd} ±0.18	521.70^d +0.13	509.70^e ±0.19
Survival rate %	100.0^a ±0.01	100.0^a ±0.11	100.0^a ±0.21	100.0^a ±0.23	99.8^a ±0.31	99.7^a ±0.20	99.7^a ±0.34	99.6^a ±0.25	98.9^a ±0.16

a, b, c,…. Means within column with different letters are significantly (P<0.05) different.

Table (4): Feed and nutrients utilization of Nile tilapia (*Oreochromis niloticus Lin*.) fingerlings fed on the experimental diets.

Parameters	Experimental diets								
	T_1 (control)	T_2 (5%BMS)	T_3 (10%BMS)	T_4 (15%BMS)	T_5 (20%BMS)	T_6 (5%RMS)	T_7 (10%RMS)	T_8 (15%RMS)	T_9 (20%RMS)
FI (g/fish)	20.76^a ±0.41	20.77^a ±0.31	20.68^a ±0.39	20.67^a ±0.24	20.67^a ±0.14	20.79^a ±0.30	20.93^a ±0.31	20.81^a ±0.10	20.71^a ±0.21
FCR (%)	1.55^a ±0.03	1.56^a ±0.04	1.55^a ±0.02	1.55^a ±0.01	1.56^a ±0.04	1.57^a ±0.02	1.58^a ±0.03	1.57^a ±0.04	1.61^a ±0.05
PER (%)	2.14^a ±0.04	2.13^a 0.05±	2.13^a ±0.02	2.13^a ±0.02	2.13^a ±0.03	2.14^a ±0.02	2.12^a ±0.02	2.12^a ±0.01	2.08^a ±0.03
PPV (%)	39.21^b ±0.15	39.03^b ±0.21	36.65^c ±0.40	36.37^c ±0.33	32.96^e ±0.19	41.90^a ±0.31	36.55^c ±0.24	34.43^d ±0.37	32.63^e ±0.28
EU (%)	18.07^d ±0.58	19.42^c ±0.31	20.33^c ±0.49	23.18^a ±0.54	18.18^d ±0.24	20.16^c ±0.30	20.30^c ±0.31	21.70^b ±0.11	21.83^b ±0.21

a, b, c… Means within column with different letter are significant (P<0.05).