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Studies on Tilapia Feeding
II — Effect of different protein sources on growth performance and feed utilization of fry.

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GROWTH and feed utilization were studied in two experiments on red tilapia fry (**Sartherodon mossambica**, ♀ and **Sarotherodon nilotica**, ♂). Tilapia fry averaging 15 and 70 mg were monocultured in glass aquarium jars (105 L) for 9 weeks in experiments 1 and 2 respectively in order to study the effect of different protein sources (animal or plant proteins) as compared with the control diet containing fish meal on growth and feed utilization by fishes. Three diets were compared in each experiment. In the **1st** experiment animal proteins (blood meal and meat meal) and in the **2nd** experiment plant protein (gossypol free whole cottonseeds and soybean seeds) compared with fish meal containing diets.

Fish density was 10 fish/aquarium and fed on 20, 15 and 10% of its wet body weight during 0—3, 4—6 and 7—9 weeks of feeding respectively. It was concluded that tilapia fry with an initial weight of 15 mg or more imporved ability and survive upon the artificial diets. The specific growth rates (SGR%/day) of fishes were 6.42, 4.79 and 2.56% when fed on fish meal, meat meal and blood meal diets in the **1st** experiment, however, it was 5.40, 4.91 and 5.60% when fish fed on gossypol free whole cottonseed, whole soybean and fish meal diets in the **2nd** experiment, respectively. In both experiments, fish meal cotaining diet was superior to other protein sources in improving growth performance of tilapia fry. Whole cotton seed diet improved the SGR%/day however, the mortality rate was higher (48%) than the other tested proteins, this could restrict its use in formulation of the artificial diets of tilapia fry. Blood meal cotaining diet was poorly utilized than meat meal.

Feed utilization was significantly ($P < 0.05$) higher in fish meal containing diet than meat and blood meal respectively. The response of gossypol free cottonseed diet was comparable with fish meal diet, however, whole soybean diet decreased feed utilization.

It could be concluded that fish meal is superior to other tested protein sources in the artificial feeds for tilapia fry.

Key words : Fish, Tilopia, Protein Feed, Growth.

Through fish cultural practices are in vogue over Egypt, the matter of artificial feeding of fish to get enhanced production does not appear to have received the attention it deserverse. The main reasons for the omission of artificial feeding appear to be the feed cost as well as lack of sufficient information on suitable supplementary feeds for the various cultured fishes.

With recent initiation of intensive fish culture programes in Egypt, it was felt necessary to develop a more suitable and balanced diets for cultured the growing, fry, fingerlings and yearlings fishes.

Considerable attention has recently been focussed on the seed for rearing certain marine and fresh water fish larvae entirely on artificial diets (Girin, 1979 and Bryant and Matty, 1981).

The present work is mainly concerned with eveloving artificial diet with acceptable growth, surivival and feed utilization for rearing red tilapia (Sarotherodon mossambica ♀, and Sarotherodon nilotica ♂) through testing different proteins from animal and plant sources.

Material and Methods

Two experiments were conducted in 105 litre glass jars with equal quantities of tap water; this eliminated the possibility of introducing extraneous food items. Each jar was stocked with 10 fry of red tilapia (hybrid of Sarotherodon nilotica, ♂ with S. mossambica ♀) 21 and 3 days old after hatching in experiments 1 and 2 respectively).

Fish fry were reared for 9 weeks under controlled temperature (28°C), continous air supply and 12hrs daily light period. Water in each jar was partially replaced once in three days (one third daily) with fresh tap water, after cleaning and removal of accumulation of unused feed and excreta.. Three treatments (diets) in each experiment with variable protein sources are presented in table (1). Fish meal was used in the control diet in each experiment and hence, all the tested feeds were compared with the control diet. Decorticated gossypol free whole cottonseed (Bahteim 104) breed was obtained from Prof. Dr. A. ABD ELBARY Professor of plant breeding, Agronomy Dept., Fac. Agric. Alex.

TABLE 1 : Composition % of the tested diets.

Feed Ingredients	Diet No : 1 st Exp.			2nd Exp.		
	1	2	3	1	2	3
Blood meal	71.0	—	—	—	—	—
Meat meal	—	69.0	—	—	—	—
Fish meal	—	—	48.0	—	—	42.0
Whole cottonseeds*	—	—	—	96.0	—	—
Whole soybean seeds	—	—	—	—	96.0	—
Yellow corn	27.5	29.5	50.5	2.5	2.5	56.5
Salt	0.5	0.5	0.5	0.5	0.5	0.5
Vitamins and minerals mixture**	1.0	1.0	1.0	1.0	1.0	1.0

* Whole cottonseed of Bahteim 104 (Gossypol free breed).

** As descriped by Omar 1984.

Univ. The wholeseeds of cotton and soybean were autoclaved for 15 min. and air dried before using in diet formulation. The gossypol content in the decorticated whole cottonseed was 0.001% and 0.003% in free and hound gossypol respectively.

All ingredients were prepared by successive grinding through a commercial feed grinder (1/16 mesh) without any additional heat. Diets were mixed mechanically by horizontal mixture. The powder was sieved through a fine mesh wire metting and kept in air-tight plastic containers. Fish fry were fed four times daily. six days per week. Sampling was carried out at weekly intervals to determine the increase in body weight to facilitate adjustment in the feeding regime.

Fish were fed at the levels of 20%, 15% and 10% of its wet body weights during the 0 — 3, 4 — 6 and 7 — 9 weeks respectively, no attempt being made to determine the optimum requirements. Two replicates were used for each treatment.

Chemical analysis of the tested diets were carried according to the methods of the AOAC (1985).

The average feed conversion for each fish was calculated as the ratio of the average amount of feed given/fish to the average

of weight gained/fish. Average weight gain, mortality rate, and feed/gain ratio for each of the treatments were estimated.

The correlation between growth performance and feed utilization in the obtained results were estimated according to Snedecor and Cochran (1967).

Results and Discussion

Results in **Table (2)** shows the chemical analysis (%) of the tested diets used in **1st** and **2nd** experiments. Growth performance, mortality rate % and feed utilization data and growth curves of fish in experiment 1 were showed in **Table (3)** and **Fig. 1** respectively. It can be seen that the diet contained fish meal increased significantly ($P < 0.05$) the specific growth rate (SGR%/day) and improved feed utilization (Feed/gain ratio) than that of meat meal or blood meal containing diets. Meat meal containing diet better utilized than blood meal. The differences between the three tested sources of protein on the growth performance and feed utilization were significantly different at the 0.05 probability level. Fish fry fed on fish meal containing diet gained 2 and 12 times more than when fed on meat or blood meal diets respectively. The values of the SGR%/day were 6.42, 4.79 and 2.56%/day for fish fed on fish meal. meat meal and blood meal containing diets respectively. No mortalities were observed in the group received meat meal, however, 10% mortality rate was observed in groups fed on fish meal or blood meal containing diets. The values of feed conversion (Feed/gain ratio) were 1.64, 2.32 and 4.59 for fish

TABLE 2 : Chemical analysis (%) of the tested diet.

	Diet No :					
	Exp 1			Exp 2		
	1	2	3	1	2	3
Dry matter	93.95	92.5	89.93	87.49	92.67	50.98
% on DM basis :						
Ash	20.35	16.29	8.99	8.55	11.35	9.00
Crude protein	35.45	35.36	35.55	35.54	33.45	33.00
Crude fiber	2.60	3.10	1.60	3.80	4.75	1.31
Fat	3.36	9.60	2.70	21.85	19.05	2.80
Nitrogen free extract	38.24	35.65	51.16	32.26	31.40	53.89

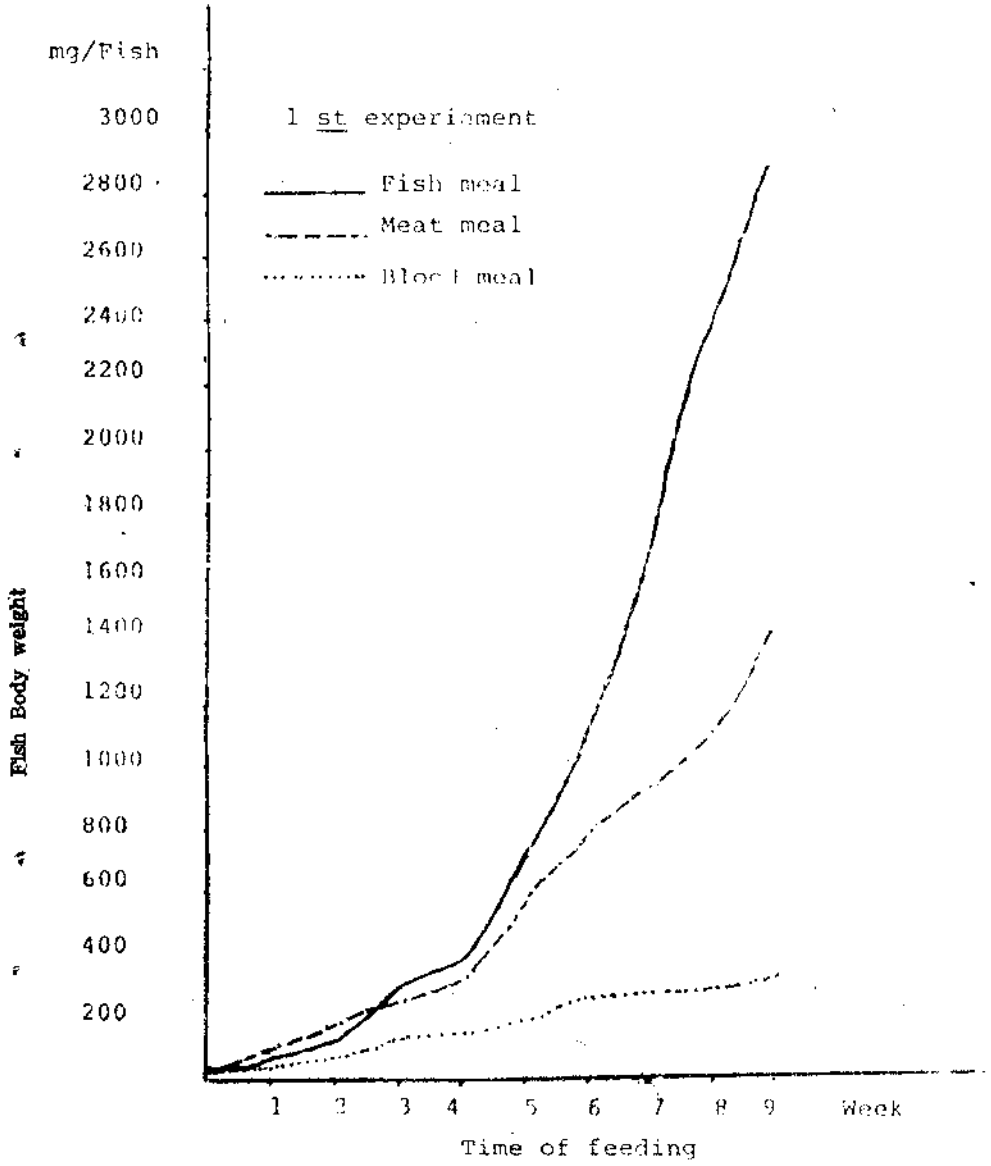

Fig. (1) : Effect of protein source in the diet on body weight of tilapia fry.

ATBLE 3 : Effect of animal protein sources on growth performance, mortality

Treatment	Average weight (mg/fish)		
	Initial	Final	Gain
Fish meal	50	2850a	2800a
Meat meal	70	1430b	1360b
Blood meal	60	300c	240c

a, b and c : Significant at $P < 0.05$).

meal, meat meal, and blood meal containing diets respectively. The differences between the tested diets were significant ($P<0.05$).

With th rising cost of the fish meal protein in the diets, researchers searching for a fish which can utilize other cheeper protein sources. The unique value of feeds of animal origin in upgrading the nutritional qualities of diets for monogastric animals is well recognised (Gohl, 1975). In diets based on plant products it is often difficult to avoid a deficiency in essential amino acids and some vitamins. Feeds of animal origin can supply these amino acids and vitamins and or this reason animal products, even used in small amounts, can vastly improve the nutritional value of the entire diet (Jauncey and Ross, 1982). Fish meal remains as an important but expensive ingredient in most fish diets. It is especially rich in essential amino acids (lysine and methionine) and minerals, and is highly digestible for fish (FAO, 1983). On the other hand, meat meal is frequently used as an animal protein source in compound fish feed manufacture, although its feed value is generally considered inferior to that of fish meal (Fowler and Banks, 1976).

Growth performance, mortality rate % and feed utilization data for the 2nd experiment are presented in Table (4) and growth curves data in Fig. (2). The results showed that fish meal was significantly ($P<0.05$) higher than the whole cottonseed or whole soybean seed diet in body weight gain SGR%/day, feed utilization (Table 4). Whole cottonseed diet was better utilized by tilapia fry than whole soybean containing deit. However, the higher mortality rate with cottonseed diet (48%) as compared to

rate and feed utilization by tilapia fry.

Specific growth rate %/dry	Mortality rate %	Feed intake mg/fish	Feed/gain
6.42a	10	4586a	1.64c
4.79b	0.0	3155b	2.32b
2.56c	10	1103c	4.59a

(30%) in soybean diet, the higher mortality rates will be the more limiting factor in using cottonseed in formulation of fish fry diets.

Many species of tilapia become strictly phytophagous after reaching a certain size (Spetoru and Zorn. 1976). However, it remains to be explored in detail to what extent vegetable protein affects fish growth while compared to animal dietary protein. In general one plant protein can on its own be a complete substitute for fish meal in tilapia diets as most are deficient in at least one essential amino acid. Whole soybean or cotton seeds contains about 35% protein and 18% fat. Fat can be used by a feed formulator to add appreciable amount of essential fatty acids to a diet, and can also be used as a source of protein sparing energy (Brandt, 1979). Soybean protein contains all of the essential amino acids and compared with other plant protein sources, its lysine content is high However, its levels of cystine and methionine are sub-optimal, methionine being the chief limiting amino acid (Jauncey and Ross, 1982). Also it is a very poor source of the B vitamins and some minerals are present only in small quantities, necessitating their provision as supplement. Therefore in the present study it was tried to use the whole soybean seeds or cottonseed after heat treatment and supplementation with minerals and vitamines as a complete diet for feeding fish fry. The obtained results was good with whole soybean. On the other hand, protein of whole cotton seed is of good quality but it has the common disadvantage of oilseed residues of having low content of cystine, methionine lysine. The tested cottonseeds obtained from a cotton plant breed (Bahteim 104) which contain a low levels of gossypol. Gossypol

TABLE 4 : Effect of plant protein sources as compared with fish meal containing

	Average Liveweight		
	Initial (mg)	Final (mg)	Gain (mg)
Whole cottonseed	15	450a	435a
Whole soybean	15	330b	315b
Fish meal	15	510a	495a

a, b and c : significant at $P < 0.05$.

TABLE 5 : Effect of period of feeding on different protein sources on growth

Treatment	Protein Level %	0 — 3	
		SGR %/day	Feed/gain
1 st experiment			
Fish meal	35.55	8.53a	1.39c
Meat meal	35.36	6.16b	2.49b
Blod meal	35.45	3.50c	3.97a
2 nd experiment			
Fish meal	33.20	7.27a	3.60a
Whole cottonseed	33.54	4.67b	2.88b
Whole soybean meal	33.45	5.20b	2.20c
Mean ± SD		5.89	2.76
		±1.82	± .94

a, b and c : Significant at $P < 0.05$.

has an inhibitory effect on digestive enzymes and contain a biological anti-oxidant which diminishes appetite and causes constipation in a wide range of animals. Jackson (Personal communication) has suggested that gossypol does not seriously affect growth rates of tilapia in the short term but its long term effects are as yet unknow Jauncey and Ross, 1982). In trout it certainley has some long term toxic effects, particularly on the kidney (Herman, 1970). Therefore, the using of whole cottonseed as a complete feed for tilapia fry in the present study is not advisable. However, Dixon (1981) and JaJckson *et al.*, (1982) indicated that

diets on growth and utilization by tilapia fry.

Specific growth rate SGR%/day	Mortality rate %	Feed intake (mg)	Feed/gain ratio
5.40a	48	666a	1.53b
4.91b	3	539b	1.71a
5.60a	0	711a	1.44b

Performance and feed utilization of tilapia fry.

Period of feeding (weeks)			
4 — 6		7 — 9	
SGR %/day	Feed/gain	SGR %/day	Feed/gain
6.19a	1.55b	4.53a	1.71b
5.32b	1.97b	2.89b	2.32b
3.11c	3.48a	1.06c	7.40a
6.93a	1.48b	5.83	1.26
5.79b	1.85b	5.73	1.33
4.04c	2.70a	5.45	1.38°
5.23	2.17	4.75	2.57
±1.42	±0.77	±1.91	±1.4

conttonseed meal is a promising source of protein in tilapia diets, even at the 100% level of inclusion.

Table (5) show the effect of time of feeding on growth performance and feed utilization in the **1st** and **2nd** experiments. The SGR%/day was higher in the first three weeks of feeding than other times after feeding (4-6 and 7-9 weeks respectively). The forgoing date indicate that tilapia fry better utilized fish meal in the **1st** than the **2nd** experiments and the differences between the results in the two experiments could be attributed to the initial liveweight of fish. The present results are similar to the results

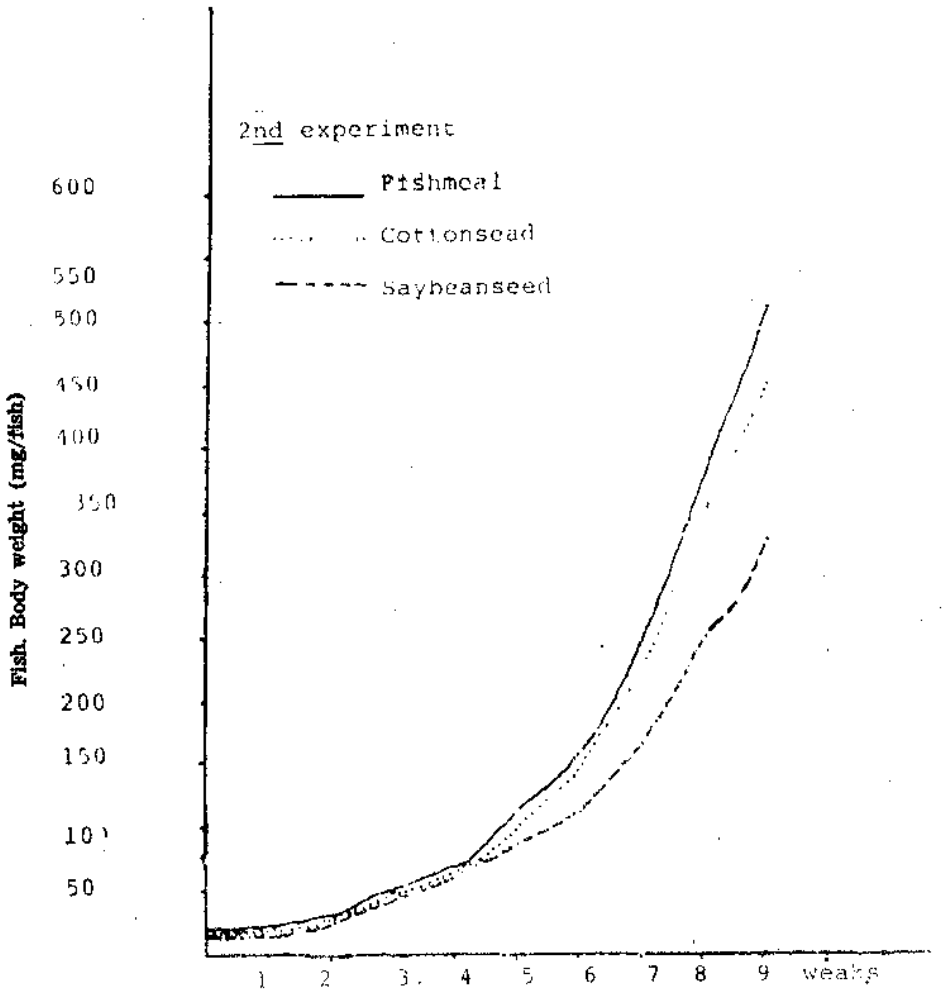

Fig. (2) : Effect of plant protein sources on body weight of tilapia fry as compared with fish meal.

obtained by Oberst *et al.*, (1983). The low protein content in the diet of tilapia fry could help in reduce the cost of feed formulation.

The relation between the SGR% / day and feed conversion (Feed/gain ratio) were estimated and the following equation was obtained :

$$Y = 5.246 - 0.610 \times \quad (R = 0.7149)$$

where Y = Feed/gain ratio and

X = growth rate (SGR % / day).

The obtained equation is useful for estimating the feed utilization of the tested diets or natural feeds from the growth criteria The coefficient of determination for this equation is 0.5111.

It could be concluded from the present study that fish meal as a protein source in the diets of tilapia fry is superior to other tested proteins, however, the utilizlation of the cheeper sources from meat meal or whole soybean seeds are promising and need further investigations. On the other hand blood meal is not a good source of protein in feeding tilapia fry. Whole cotton seed in a complete diet for tilapia fry is potential, however,. more research work still needed in order to avoid its toxic effects.

References

Association of Official Analytical Chemists. AOAC. (1985) Official methods of analysis. Washington, DC. USA.

Brandt, T. M. (1979) Use of heat treated full-fat soybeans in channel catfish and golden shiner feeds. Texas Fish Farming Conf., January, 1979.

Bryant, P. L. and Matty, A. J. (1980) Optimisation of Artemia feeding rate for carp **(Cyprinus carpio** L.) larva. **Aquaculture; 21** : 203-212. pp.

Dixon, M. W. (1981) Asse sment of six different feeds for **Sarotherodon** Spp. in Kenya. M. Sc. **Thesis,** Univ. of **Sterling.**

FAO. (1983) Fish feeds and feeding in developing countries. Aquaculture Development and Coordination Programe ADCP/REP 83/18 **Rome.**

Fowler, L. G. and Banks, J. L. (1976) Animal and vegetable substitutes for fish meal in the Abernathy diet. **Progr. Fish cult., 38** : 123-126.

Cirin, M. (1979) Feeding problems and the technology of rearing marine fish larvae. **In : Halver. J. E. and Tiews, K. (Edit). "Finfish Nutrition and Fish Feed Technology" 1.** Neenmann and Co., Berlin, pp. 360-366.

Cohi, B. (1975) Tropical feeds. Food and Agricultural Organisation of the United Nations, **Rome.**

Herman, R. L. (1970) Effects of gossypol on rainbow trout **Salmo gairdenri** richardson. J. **Fish Biol 2** (4) : 293-304 PP.

richardson. **J. Fish Biol., 2** (4) : 293-304. pp.

Jackson, A. J., Capper. B. S. and Matty, A. J. (1982) Evaluation of some plant protein in compleic diets for the tilapia, **(Sarotherodon mossambicus). Aquaculture, 27** : 97-109. pp.

Jauncey, K. and Ress, B. (1982) A guide to tilapia feeds and feeding. Sterling Univ. Sterling, FK 94 LA, Scattland; U. K.

Oberst, S., W, Villwock. and Rosenthal, H. (1983) Growth and food conversion in Tilapia under two different rearing conditions. In : **International Symposium on tilapia in aquaculture.** Nazareth, **Nazareth, Israel 8-13 May** (1983)..

Omar, Eglal Ali (1984) Effect of type of feed, level and frequency of feeding on growth performance and feed utilization by mirror carp **(Cyprinus carpio** L.). **Thesis, Dr. Agric. Sci.** Gottingen Univ.

Snedecor, G. A. and Cochran, W. H. (1967) "Statistical Methods". **6th** Edit., Press Ames. Iowa, USA.

Spetoru, P. and M, Zorn. (1976) Some aspects of natural feed and feeding habits of **Tilapia galilea** (ARTEDI) and **Tilapia aurea** (STAINDACHNER) in lake kineret. **Bamidegh 28. 12-17. pp.**

دراسات على تغـذية البلطى : ـــ
٢ ـــ تأثير المصادر المختلفة من البروتينات على كفاءة النمو والتحويل الغـذائى للبرقات

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تم دراسة النمو وكفاءة تحويل الغذاء فى تجربتين غذائين ليرقات البلطى الاحمر (هجين البلطى الموزمبيقى والنيلى) وكان وزن اليرقات عند البداية ١٥ ، ٧٠ ملليجم على التوالى فى التجربتين الأولى والثانية حيث أجريت فى أحواض زجاجية (١٠٥ لتر للحوض) لمدة ٩ أسابيع فى كل تجربة بهدف دراسة أثر مصـادر البروتين (حيوانية ونباتية) مقارنة ببروتين قياسى (مسحوق السمك) على النمو وكفاءة تحويل الغذاء .

التجربة الأولى : ـــ تم دراسة أثر احلال بروتينات مسحوق اللحم أو الدم محل مسحوق السمك فى العليقة ووضعت الأسـماك بمعدل ١٠ سمكات للحوض وغذيت بمعدلات ٢٠ ، ١٥ ، ١٠٪ من وزنها فى خلال الأسابيع الأولى والثانية والثالثة على التوالى . وتشـير نتـائج التجـارب الى أن اليرقات من وزن ١٥ ملليجم أظهرت تحسنا كبيرا فى قدرتها على الاستفادة من الاعلاف الصناعية وكانت معدلات النمو النوعى هى ٦ر٤٢٪ ، ٧٩ر٤٪ ، ٦٪ ٥ر٢ عندما غذيت على مسـحوق السـمك اللحم والدم على التوالى فى التجربة الأولى .

التجربة الثانية : ـــ تم دراسة احلال بذور القطن الخالية من الجوسيبول أو بذورفول الصويا محل مسحوق السمك وتشير النتائج أن معدلات النمو النوعى هى ٥ر٤٪ ، ٩ر٤٪ ، ٦ر٥٪ عندما غذيت اليرقات على بذور القطن الكاملة الخالية من الجوسيبول وبذور فول الصويا ومسحوق السمك على التوالى . وفى كلا التجربتين أتضح أن مسحوق السمك كان متفوقا عن غيره من مصادر البروتينات فى تحسين نمو يرقات البلطى . وبالرغم من أن البذور الكاملة للقطن والخالية من الجوسيبول أعطت معدلات عالية الا أن نسبة التفوق كانت مرتفعة (٤٨٪) وهذا يمكن أن يقلل من فرصة استخداما فى تكوين العلائق الصناعية لتغذية اليرقات أما بالنسبة لمسحوق الدم فكان اقل مصادر البروتين فعالية فى زيادة نمو يرقات البلطى الأحمر .

أما كفاءة الاستفادة من مصادر البروتين فوجد أنها مرتفعة فى حالة التغذية على مسحوق السمك عن مسحوق اللحم والدم على التوالى فى حين أن نتائج مسحوق السمك كانت متساوية مع بذرة القطن الكاملة .

من النتائج السابقة يمكن استخلاص أن مسحوق السمك كان الأفضل فى تغذية يرقات البلطى الأحمر عن غيره من مصادر البروتينات المستخدمة فى هذا البحث .