FEEDING OF CATFISH *CLARIAS LAZERA* IN EXPERIMENTAL PONDS

By

A.E. IMAM

Institute of Inland Waters and Fish Culture
Barrage Fish Farm

and

H.M. ROUSHDY

Department of Radiobiology, U.A.R. Atomic Energy Establishment

and

A. PHILISTEEN

Institute of Inland Waters and Fish Culture
Barrage Fish Farm

INTRODUCTION

In fish culture, the feeding problems constitute some of the major difficulties. It is known that a suitable diet is that which can provide the fish with the raw materials necessary for the production of flesh and to keep them in a healthy condition. From the point of view of pond cultivation economy, food metabolism in fish consists of two components: a part of the metabolism serves to sustain the body of the fish and its functions, and the other part enters into growth and further development. Naturally, the second function is the primary concern of the pond cultivator.

In order to fulfil abundance of the food requirements of the reared fish in the experimental ponds, either the basic production capacity of the ponds may be enhanced through artificial fertilizing methods and in this way the natural food for the fish may be multiplied; or the natural food may be supplimented or substituted with artificial and economic food. In both cases a knowledge of the basic nutritive requirements of the fish is needed.

The individual components of fish food must be evaluated according to their importance in the fish metabolism. Artificial food should in its composition be similar, as far as possible, to that of the natural food. For the composition, the same basic rules apply for fish as for other animals. The organic nutrients; protein, fat, carbohydrate, minerals and vitamins are the chief constituents.

Proteins and carbohydrates play a major part in determining the success or failure of any fish diet. Though few studies have been made on the functions of proteins in the fish body, yet it may be assumed that they are similar to those in the bodeis of higher animals (Phillips et al 1956).

It is known however, that the percentage of food protein that can be utilized to satisfy the protein needs of the fish body depends on the protein quality of the food. A protein food can be considered as highest protein quality if its analysis is approximating to that of the body protein, or if this protein food produces the best rate of growth (Wood, 1952).

Moreover, the digestibility of a protein determines the degree of its utilisation by a particular animal. Fresh meat products were found to be highly digestible by carnivorous fish. Fresh meat has been found to promote trout growth and provide it with certain dietary essentials (Phillips, 1956).

In contrast to the many functions of protein in the animal body, the role of carbohydrate is limited.

The amount of carbohydrate that may be added to fish diets seems to be limited by the physiology of the fish itself.

Moreover, fats and minerals are known to form two of the major groups of substances that must be represented in the diet of fishes. It is however assumed that the information about the role of fats in higher animals also applies to

fishes (Phillips et al, 1949, 50, 51, and 52). The deposition of fat within the fish body is not necessarily dependent upon dietary food alone, as body fat may be manufactured from dietary protein and carhobydrate. However, though fat in the diet is essential, and though fat within the animal body is necessary, excessive deposition of fat in the body increases the susceptibility to many diseases.

Although much is known about the role of minerals and the great diversity of their uses in the nutrition of higher animals, less is known about the mineral requirement of fishes. Yet, it has been found that all the minerals needed by higher animals are also needed by fishes (Phillips, et al, 1953, 54, 56 and 57). Excessive levels of dietary salts cause in the body an upset in the osmotic regulation which is characterized by an edema and eventually results in the death of the fish (Phillips et al, 1957).

The aim of the present studies is to determine a suitable and economic artificial food for *Clarias lazera* reared in experimental ponds.

In order to determine the nutritive efficiency of the diet, the growth rate of the experimental animals as well as the rate of production of new flesh were taken into consideration. In this concern the variation in protein, fat, and ash contents of the fish muscles were studied.

MATERIALS AND METHODS

Clarias lazera about one year old and ranging from 11-15 cm. in length were collected from the Experimental Fish Farm of the Institute of Inland waters and Fish Culture near the Barrage at the outskirts of Cairo City. The fish were reared in six special ciment ponds 24 square meters in capacity, furnished with clay bottoms. Normal environmental conditions were maintained inthe ponds.

In order to investigate the most favourable nutritive diet for our experimental animals, three types of feeds were tested. The first was of exculsively animal matter constituted of minced fresh forage fish meat. The other two diets were of exclusively plant matter ; one formed of rice bran while the other of fresh vegetables. The nutritive values of the different experimental diets were chemically investigated in accordance with the Official A.S.T.M. (1960).

For each experiment, two ponds were used each furnished with fifty animals. Equal weights of feeds were daily introduced to the experimental ponds. The fish in one pond were devoted to rate of growth measurements while those in the other were monthly sacrificed for chemical investigations.

Prior to experimentation, fillets of fish muscles were taken, dried and then analysed for protein, fat and ash contents.

After dissection water content was determined by drying muscle samples to a constant weight at 105°C.

Protein content was determined by estimating the nitrogen content of the muscle using the method of Kjeldahl (Kirk, 1947), (Atwater, 1892 ; Steyermark, 1951).

Fat content of muscles were determined by Soxhlet continuous-extraction method. As for ash, this was determined by ashing muscle samples in muffle furnance at 1000°C till constent weight ; the residue being taken as the ash content of muscle sample.

RESULTS

1.—*Determination of the Nutritive Values of the Experimental Diets* :

Samples of each of the three experimental feeds used in the present studies were chemically analysed for their nutritive, values i.e. water, protein, fat, carbo hydrate and total minerals. In the course of these estimations, the vitamin contents have not been investigated. The data obtained are given in tables 1 and 11.

2.—*Determination of Protein Content in Fish Muscle Samples* :

As graphically represented in figure 1, remarkable variations in the protein content of the muscle samples can be traced due to different types of feeds. The results obtained suggest the following :

(*a*) The first group fed with fish meat diet does not show any significant change in the protein content of the muscle samples during the first experimentation month. Later, a rapid and remarkable increase is recorded which progressively proceeds till the end of the experimentation period.

(*b*) The second group which was fed with rice bran shows decreased protein value of muscle samples along the first experimentation month. This decreased value continues more or less unchanged till the third experimentation month after which some increase in the protein value takes place. Yet the protein value of the muscle samples remains far below those recorded in the other two groups.

(*c*) The third group fed with vegetable diet shows rapid and significant increase in the percentage of protein content of the muscle samples from the early begining of the experimentation period. This increase continues till the end of the second month after which the protein value remains more or less unchanged till the end of the experimentation period. During the first three months, the percentage protein value of the muscle samples of that group apparently realized the greatest increase as compared to the other two groups. Later, this value is surpassed by that recorded in the first group.

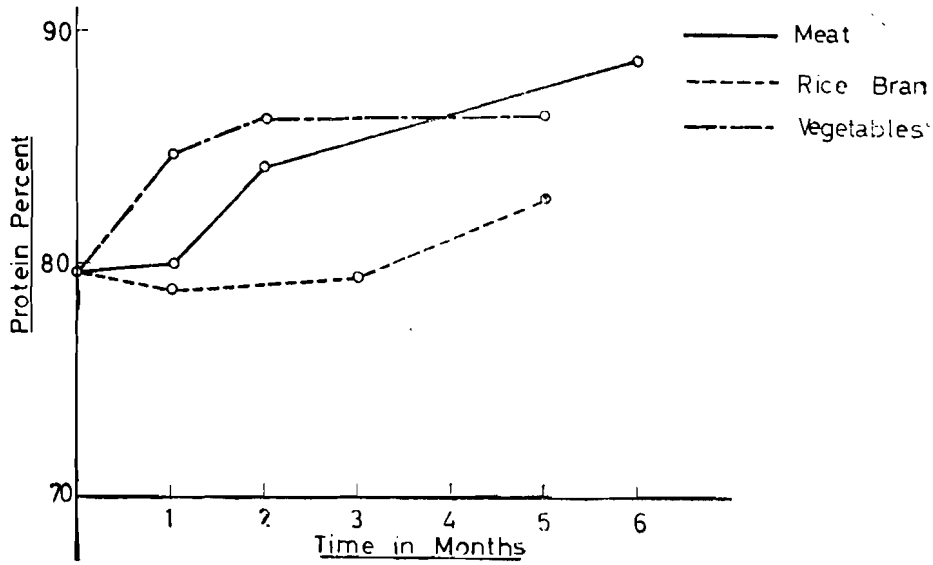

FIG 1 : Changes in Percentage Proter Dry Weight of Muscles Due to Different Types of Feeds.

3.—*Determination of Fat Content in Fish Muscle Samples*:

As graphically represented in figure 2, different types of feeds seems to exert remarkable effect on the fat content of the fish muscles. The results suggest the following:

(*a*) In the first group fed with fish meat diet, there is a progressive decrease in the fat content of the muscle samples all along the experimentation period till the fifth month. Later a drastic and serious fall is recorded which may be attributed to other intrinsic causes among which the factor of fish spawing at that time of the year (June) may be taken into consideration. Similar observations have been described in other fishes e.g. Cod where decreased fat content accompanied the spawning period (Dambergs, 1964).

(*b*) In the second group fed with rice bran diet, the decrease more or less parallels that recorded in the first group, only the values of the fat contents are kept slightly higher.

(*c*) In the third group fed with vegetable diet, there is a drastic decrease in the fat content of muscle samples. This being remarkably sharper during the first experimentation month and gets more gradual later on. The values are the least as compared with those recorded in the other two groups.

4.—*Determination of the Ash Content in Fish Muscle Samples*:

The ash content of the muscles are subjected to slight variations ranging from 5.7 to 6.5 per cent, due to different types of feeds. The results are graphically represented in figure 3. The results point to the following:

(*a*) In the first group fed with fish meat diet, no significant variation in the ash content can be traced along the whole experimentation period apart from a slight increase towards the first month after which the ash content returns to its initial value.

(*b*) In the second group fed with rice bran diet, there is a comparatively higher increase which can be recorded along the first experimentation month. Later, the value tends to decrease but keeps higher than that in the first group.

(*c*) In the third group, no measurable changes can be detected along the first month. Later, there seems to be a steady and prgoressive increase in the ash content of the muscle samples along the whole experimentation period. After the third month, the ash content values record the highest levels as compared to those estimated in the other experimental groups.

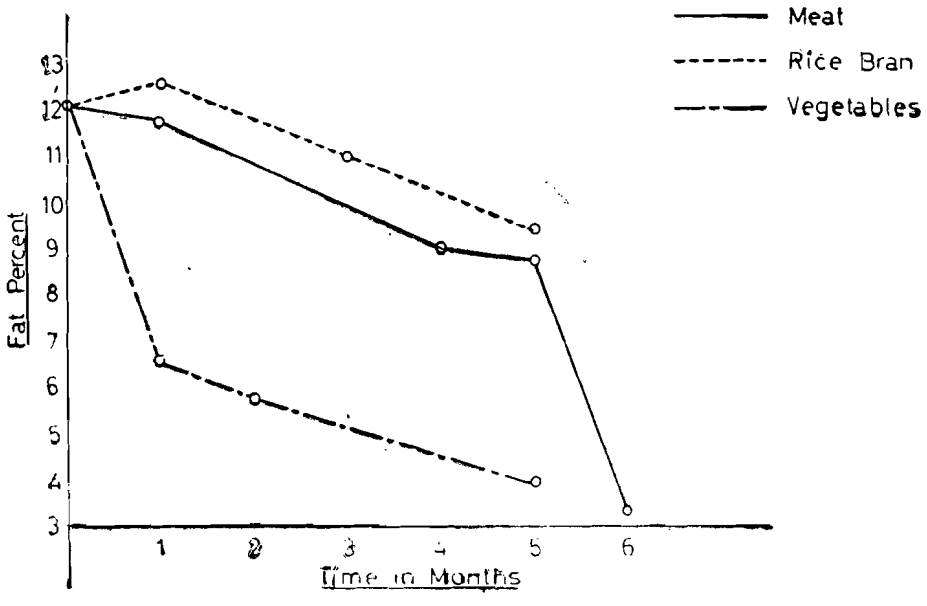

FIG. 2.—Changes in Percentage Fat Dry Weight of Muscles Due to Different Types of Feeds.

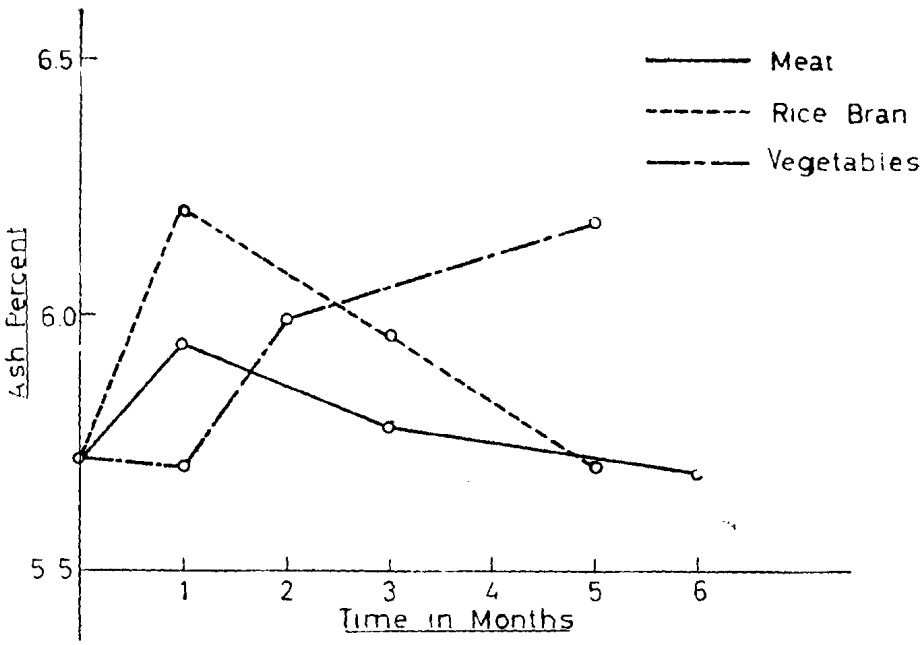

FIG. 5.—Changes in Percentage Ash of Muscles Due to Different Types of Feeds.

5.—*Determination of the Percentage of Water Content in the Fish Muscle Samples*:

The data obtained for the water content fluctuations due to different types of feeds are graphically represented in figure 4.

It can be noticed that the variations in the water content of the muscles are minor and ranging in all the different treatments from 79.5 to 80.5 per cent.

However, it seems likely that the water content of the muscle samples decrease slightly along the first three experimentation months. The decrease being more pronounced in those animals fed with rice bran. After the third month, the water content values progressively increase till the end of the experimentation period. The increase is least in those animals fed with rice bran.

6. *Growth Rate Measurements*:

In table III, average values for length measurements, weight estimations and the weight/length ratios are given. The ratios are graphically represented in figure 5. The results point to significant variations in growth measurements due to different types of feeds.

(*a*) In the first group fed with fish meat diet, the maximal increase in the weight estimations and in the weight/length ratio has been recorded. After six month duration, the increase in weight reaches about 195 per cent and the weight/length ratio amounts to 2.18 and the animal look healthy.

(*b*) In the second group fed with rice bran diet, the increase in weight is moderate. After six month duration, it reaches about 148 per cent and the weight/length ratio amounts to only 1.69. The animals look less healthy than those of the first group.

(*c*) In the third group fed with vegetable diet, the gain in weight is very slight reaching only about 8 per cent after six month duration. At that time, the weight/length ratio does not record measurable changes and amounts to only 0.91. The animals look lean and unhealthy.

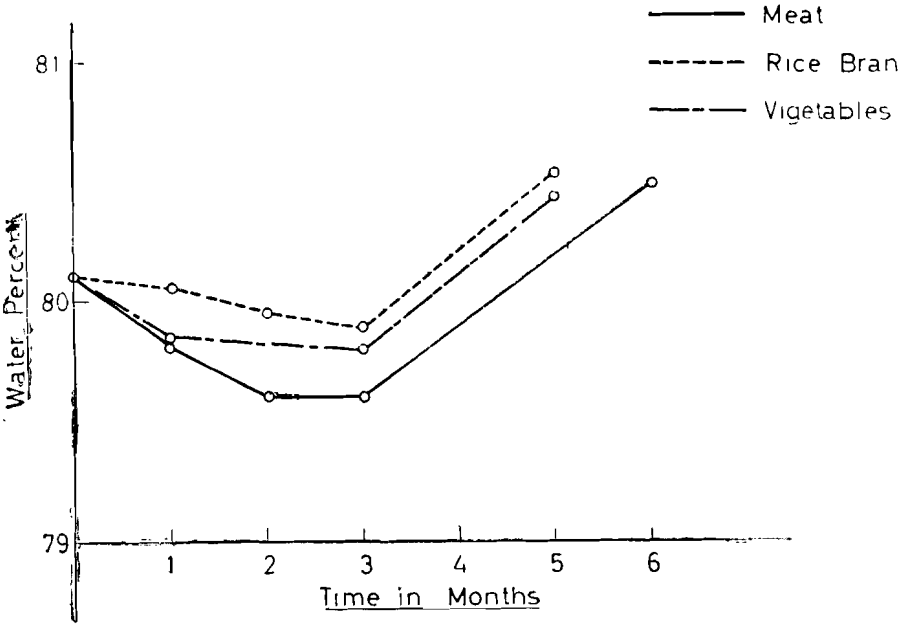

FIG. 4.—Changes in Percentage Water Content of Muscles Due to Different Types of Feeds.

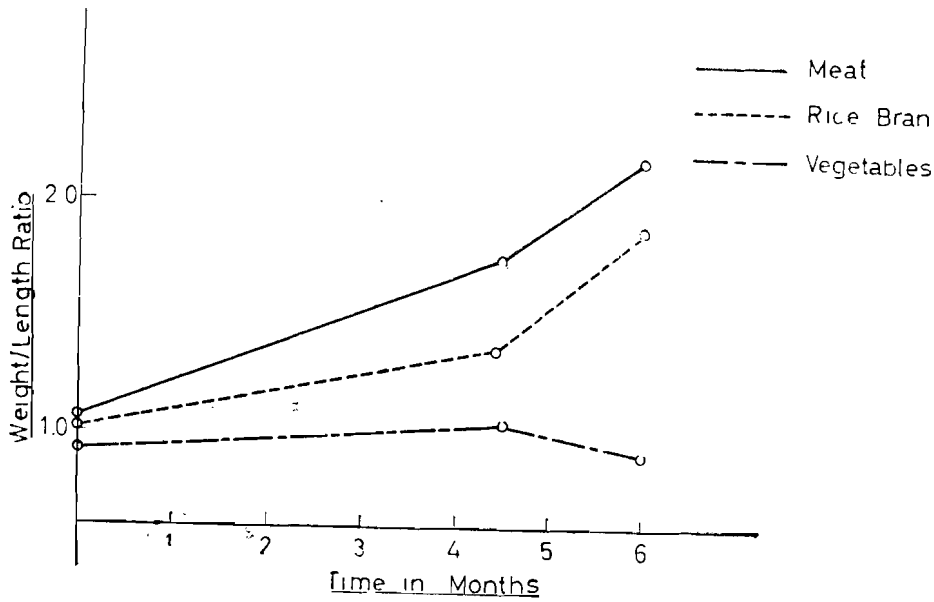

FIG. 5.—Changes in Weight / Length Ration Due to Different Types of Feeds.

TABLE 1.—WATER CONTENT OF EXPERIMENTAL FISH FOODS
(EXPRESSED AS PERCENTAGE OF FRESH WEIGHT)

kind of Diet	Fish Meat	Rice Bran	Vegetables
Percentage	79.56	8 43	88 94

TABLE 2.—CHEMICAL COMPOSITION OF EXPERIMENTAL FISH FOODS
(EXPRESSED AS PERCENTAGE OF FRESH WEIGHT)

Nutritive Component	Fish Meat	Rice Bran	Vegetables
Protein	91.87	14.44	25.07
Fat	4.62	15.09	1.86
Carbohydrates . . .		47.60	48.01
Total Minerals. . . .	3.51	11.73	15.01
Crude Fibers		11.14	10.05

TABLE 3.—CHANGES IN GROWTH RATE MEASUREMENTS IN EXPERIMENTAL FISHES DUE TO DIFFERENT KINDS OF FOODS

Month of Experimentation	On Fish Meat Diet				On Rice Bran Diet				On Vegetable Diet			
	Average Length	Average Weight	Increase in Weight	Weight / Length Ratio	Average Length	Average Weight	Increase in Weight	Weight / Length Ratio	Average Length	Average Weight	Increase in Weight	Weight / Length Ratio
	(cm)	(gm)	%		(cm)	(gm)	%		(cm)	(gm)	%	
December	13.0	13.8	0	1.06	12.7	12.9	0	1.01	12.6	11.5	0	0.91
April	16.1	28.3	105	1.75	15.6	21.3	65	1.36	13.0	13.6	18	1.04
June	18.7	40.8	195	2.18	16.9	32.0	148	1.69	13.7	12.5	8	0.91

DISCUSSION

The tested fresh forage fish meat has proved to be the most suitable experimental diet for *Clarias lazera*. This is expected in accordance to its carnivorous feeding habit. This rich protein diet seems to supply the fish with abundance of proteins which are apparently highly digestible and easily utilizable for flesh production. This is reflected by the higher growth rate of the feeded fish and the rapid addition of protein matter to their muscles. The relatively smaller percentages of fat and minerals in that diet seem to be enough for providing the fish with their essential growth and health factors. Deficiency of carbohydrate matter in this type of diet seems to exert no harmful effect on the fish. It is well known that the production of energy is the principal use of carbohydrate in the body. However, since the energy requirements of an aimal may be satisfied by either fat or protein other than carbohydrates, the amount of the latter that is actually needed for life is relatively low. The rich protein value in this experimental diet seems to provide the fish with the necessary energy not at the expense of growth and tissue repair in the body. The chemical analysis of the muscle samples of such animals showed that there was a progressive increase in the protein value correlated with a gradual decrease in fat content, while the water and ash contents remain almost unchanged. However, the decrease in the percentage of fat content may not be directly attributed to decreased fat deposition, but to the relatively more rapid addition of proteins in the muscles.

The other two tested diets seem to play their role in a different manner Being rich in carbohydrates, they seem to furnish the fish with higher carbohydrate stores which are mainly used for energy production. This may indirectly save the protein for flesh production : what is generally known as the "sparing action of carbohydrates".

The rice bran diet, having the lowest protein content showed the least rate of protein addition in fish muscles. However, the greater growth ratio recorded with rice bran diet as compared to that in case of vegetable diet may be attributed to higher deposition of fats in the muscles which add to the weight of the animals. This can be correlated with the high concentration of fat content in rice bran diet. The greater deposition of fats seems to be not quite favourable for the fish. Regardless the relatively higher growth rate as compared to the third group, the animals were sluggish and not healthy looking.

The vegetable diet with its higher protein content realized a comparat vely greater percentage increase in muscle proteins. Yet the diet, being very poor in fat content, caused a drastic depletion in the fat percentage of the muscles. This seems to keep the growth ratio to minimal. However, it seems that the percentage increase in deposition of muscle proteins in this case is only relative and does not imply a more rapid deposition of proteins than in those fed with fresh meat diet. The percentage of protein in muscles apparently increased in this case as fat was metabolically removed from the muscles. Accordingly, such phenomenon reflects an increasing percentage of the protein fraction as the fat component decreases. The absolute data and the rate of growth measurements clearly indicate a more deposition of proteins with the fresh meat diet as compared with the other two tested feeds.

However, it is noticeable that the percentage of the nutritive components in each diet correlates well with the addition of the respective component in the fish muscles. For the proteins, the highest rate of protein addition was recorded with fish meat which contains the greatest concentration of protein (91.87%). The least with rice bran diet which contains the minimal protein content (14.44%).

As for fats, the greatest deposition of fats were recorded with rice bran diet which contains the highest level of fat content (15.09%). The least deposition was recorded with vegetable diet containing the minimal fat content (1.86%).

As to ash content, the greatest addition of minerals were recorded with vegetable diet containing the highest concentration of minerals (15.01%). The least addition being recorded with meat diet containing the minimal content (3.51%). The initial better addition of minerals with rice bran diet seems to be correlated wih some unkown factors amongst which may be the high fat deposition in muscles.

The lowest rate of growth recorded with the vegetable diet may be correlated to the drastic depletion of the fat stores which apparently result in depriving the fish from numerous important growth factors and causes the relative increase in the water content of the muscles. Moreover, the food protein, being of plant origion, seem to be poorly digestible by carnivorous fishes as *Clarias lazera.*

The poor protein addition with the rice bran diet seems to be enhanced after about 3 months from the start of the experiment. This seems to take place through the possible utilization of such given protein diet and the possible transformations of the nutritive stores in the body.

It is regretable, however, that the role and conecntration of vitamins in our experimental diets were not estimated. Nevertheless, it is well known that the role played by vitamins is very important. It can, however, be expected that vegetable diet is rich in water-soluble vitamins while that of rice bran is rich in fat-soluble vitamins. The fresh meat diet seems to provide both of them. Such a role awaits further investigations in the future.

It can be thus concluded that the fresh meat diet, is the most suitable for *Clarias lazera.* It provides the fish with an abundant protein supply of high quality, and contains the necessary dietary essentials to promote its growth. The higher efficiency of this diet is confirmed by the better growth rate, the greater addition of flesh as well as by the better healthy condition of the feeded experimental fishes.

SUMMARY

Attempts have been made to determine a suitable artificial food for *Clarias lazera* reared in experimenal ponds. In this concern the nutrivive value of those types of feeds were tested. The first was of exclusively animal matter constituted of minced fresh forage fish meat. The other two diets were of exclusively plant matter; one formed of rice bran and the other of fresh vegetables. The nutritive values of the different experimental diets were chemically investigated. The nutritive efficiency of each diet was then estimated on the basis of the change in rate of growth of feeded animals as well as the rate of production of new flesh. In this concern, the increase in protein, fat and ash content of fish muscles were studied.

The tested fresh forage fish meat has proved to be the most suitable experimental diet for *Clarias lazera*. It provides the fish with an abundant protein supply and contain the necessary dietary essentials to promote its growth. The higher efficiency of this diet is confirmed by the better growth rate, the greater addition of flesh as well as by better healthy condition of the feeded experimental fishes.

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