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STUDIES ON THE INVESTIGATIONS OF FEEDING POTENTIALS FOR GRASS CARP FARMING IN MULTAN

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Abstract: Thirteen different types of aquatic and terrestrial plants proposed to be used as fodder for grass carp were collected for analysis of different nutritional elements like dry matter, proteins, lipids, carbohydrates and ash contents. Dry matter was significantly highest in *Zea mays* and lowest in *Marsilia quadrifolia*. *Sorghum bicolor* showed significantly highest protein while *Marsilia quadrifolia* had lowest. Lipid was significantly highest in *Sesbania sesban* and lowest in *Hydrilla* sp. and *Trifolium alexandrinum*. Carbohydrate was significantly highest in *Zea mays* and lowest in *Potamogeton* sp. Ash content was significantly highest in *Chara* sp. and lowest in *Typha angustifolia*. Economically, the cheap source of protein was calculated as *Sorghum bicolor* with a rate of Rs.6.29 per 1000 g of protein in the local market. But it has no advantage over other fodder due to non-availability throughout seasons.

Key words: Grass carp, *Ctenopharyngodon idella*, fodder, composition, economics, aquatic weeds.

INTRODUCTION

The population of the world is increasing by geometrical way while the available food resources are increasing arithmetically. This population explosion is going to threaten the mankind by causing food problem. A protein deficient diet has its own ill effects. Fish is the best source of animal protein (Sinha and Ramchandran, 1985). Therefore, to overcome food shortage, fish culture in the country requires to be promoted. Aquaculture is receiving world wide attention as many types of protein which are not directly consumed by man can be upgraded through this practice into highly acceptable and well relished products (Pillay, 1990).

Fish flesh is converted into body tissues more efficiently than all other meats of farm animals such as sheep, goat, cow etc. (Sinha and Ramchandran, 1985). Also the percentage of edible tissue in a fish is overall greater than cattle, pigs or chicken (Barnabe, 1994).

The main objective of fish culture is the production of high value products for human consumption, which are not obtained in sufficient quantity by fishing. Another

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objective of fish culture is to produce the maximum fish in a given volume of water in shortest time and at lowest possible cost. Achieving this objective required not only the management and optimization of growth of farm stock, but also obtaining them in first place (Barnabe, 1994). Fish culture can yield much more per acre per year than other animals without involving much of capital inputs, scientific and technical know-how (Pillay, 1990). Success in fish farming essentially lies on thorough knowledge about the food and feeding habits of the cultureable varieties of fishes taken for culture (Rath, 1993). The nutrients that fish require are the same as those required by other animals *i.e.*, proteins, carbohydrates, lipids, vitamins and minerals. The demand for these elements forms the basis for the preparation and selection of artificial fish feeds (NACA, 1989).

The grass carp, *Ctenopharyngodon idella* (Val.) along with three other species of fish namely, the snail carp, *Mylopharyngodon piceus* (Richardson), the silver carp, *Hypophthalmichthys molitrix* (Cuv. and Val.) and bighead, *Aristichthys nobilis* (Richardson) are most popular for pond culture in China now-a-days. In Pakistan grass carp was introduced in 1964, mainly for weed control purpose, at Halaji Lake, Sind (Naik, 1972). However, during the year 1986-87 grass carp and silver carp have been introduced for culture in Punjab under concept of polyculture system to increase the fish production per unit area (Javaid, 1990). Carps appear to be especially suited for pond culture as they feed on low trophic levels and it is possible to produce maximum food required through fertilization and maturing of ponds which reduce the production costs (Pillay, 1990).

Grass carp is a typical herbivorous fish, which is cultured in many countries of the world due to its tasty flesh and rapid growth rate. Its additional characteristics is that it can eat grasses and alagae more than its weight per day therefore, it is useful for prevention of water algae and weeds (NACA, 1989). The grass carp start feeding on macro vegetation when about 3 cm in length. It stops feeding at temperature 10-12°C. At temperature above 20°C, it eats large amount of grasses (Pillay, 1992, 1994). Due to its growing popularity in Pakistan, more attention is needed of the fisheries scientists because very little attempts were made in the past to collect biological data about grass carp in Pakistan.

The present study is one of a series (Salam *et al.*, 1993) deals with the composition of proposed natural and supplementary diet for grass carp in order to test their effect on growth rate under laboratory conditions. Furthermore, economics of the fodder has been calculated to determine its feasibility as a source of diet for this important herbivorous fish.

MATERIALS AND METHODS

Composition

For composition some aquatic weeds and terrestrial grasses proposed to be used as fodder/ supplementary food for grass carp were collected. The list of samples collected is as under, local names are in parenthesis:

1. *Chara* sp. (Funjali patta)
2. *Hydrilla* sp. (Jalla)
3. *Marsilia quadrifolia* (Tripattra godhi)
4. *Potamogeton* sp. (Phus)
5. *Typha angustifolia* (Pan bori)
6. *Trianthema petendra* (It-sit)
7. *Stellaria media* (Morlia).
8. *Eragrostis* sp. (Dub)
9. *Avena sativum* (Javvi)
10. *Trifolium alexendrinum* (Barsheem)
11. *Sesbania sesban* (Jantar)
12. *Sorghum bicolor* (Juar)
13. *Zea mays* (Makki)

To estimate the water content in each sample the pre-weighed sample was placed in pre-weighed aluminum foil tray for drying in as electric oven (Memmert-laborerate 8540) at 70-80°C till the weight became constant. The dried sample was crushed in a pestle and morter and powdered in a Moulinex electric blender. To calculate ash content in each individual sample, 1 g of the sub sample was taken in a pre-weighed, heat resistant, China clay crucible and ashed in a muffle furnace (RJM 1.8-10, China) for 6 hours at 550°C and weighed after cooling.

The fat content was estimated from dry tissues using dry extraction method in which 0.5-1.0 g of powdered dry tissue was mixed well into 10 ml of chloroform and methanol mixture in a ratio 1:2 (Bligh and Dyer, 1959; Cui and Wootton, 1988; Salam and Davies, 1994). The said mixture was left overnight and then centrifuged at 1000 rpm. (Centrifuge-YJ03-043-4000) for 2 minutes. After centrifugation, the clear supernatant was removed carefully into washed, dried and pre-weighed small bottle. The bottle was then placed in an electric oven at 40-45°C for evaporating the mixture till dryness. Lipid fraction left after evaporation was weighed on an electric balance (MP-3000) to nearest 0.01 g. A weighed sample (0.3-0.4 g) of the material is homogenized, with a volume of alcohol chloroform mixture of 2:1 ratio, centrifuged and supernatant discarded. The residue was dried at room temperature. Then the protein was extracted by 1N NaOH solution. The estimation of protein in the plant material was done by Biurete method is given below as described by Gornall *et al.* (1949).

The carbohydrate content was determined by the difference from the mass of other main sample constituents like ash, fat, water and protein following Salam and Davies (1994).

Economics

Economics of the fodder was calculated on the basis of data collected from the local market. The economic feasibility was calculated for 1 kg of protein by the following formula:

$$\text{Rate kg} = \text{Protein (Rs.)} \quad \frac{\text{Price kg of sample}}{\text{Protein/kg of sample}} \quad \times 100$$

Excel 97 and Minitab 11 were used for all data and statistical analysis.

RESULTS

Composition

The significantly highest % protein (wet weight) ($P<0.001$) was found in *Typha angustifolia* (aquatic plant) and *Sorghum bicolor* (Fodder) basis and in dry weight was found in *Hydrilla* sp. (aquatic plant) and *Sorghum bicolor* (fodder). The significantly highest % fat (wet weight) ($P<0.001$) was found in *Typha angustifolia* (aquatic plant) and *Sesbania sesban* (fodder) and in dry weight were found in *Typha angustifolia* (aquatic plant) and *Eragrostis* sp. and *Settleria media* (fodder). The significantly highest % carbohydrate ($P<0.001$) (wet weight) was present in *Typha angustifolia* and *Zea mays* and in dry weight was present *Marsilia quadrifolia* and *Avena sativum* (fodder).

The significantly highest % ash (wet weight) ($P<0.001$) was found in *Chara* sp. and *Zea mays* and in dry weight was found in *Chara* sp. and *Trianthema petendra*. The significantly highest % water ($P<0.001$) was present in *Marsilia quadrifolia* and *Stellaria media* and lowest in *Typha angustifolia* and *Sorghum bicolor* (Table I, II; Fig.1,2).

Table I: Composition of samples on wet weight basis.

Fodder	water (%)	Protein (%)	Lipids (%)	Carbohy-drates (%)	Ash (%)
Chara sp.	84.51	1.37	0.92	6.08	7.12
Hydrilla sp.	90.00	2.48	0.2	4.72	2.60
Marsilia quadrifolia	94.30	0.10	0.56	3.57	1.47
Potamogeton sp.	92.57	1.29	0.07	3.1	2.97
Typha angustifolia	83.55	3.44	1.97	10.08	0.96
Trianthema petendra	88.74	2.06	0.89	5.84	2.47
Stellaria media	89.61	3.52	1.55	3.46	1.86
Eragrostis sp.	86.89	2.54	1.96	7.04	1.57
Avena sativum	82.69	3.69	1.03	11.04	1.55
Trifolium alexandrinum	88.80	3.25	0.22	6.05	1.68
Sesbania sesban	79.42	6.97	2.88	9.09	1.64
Sorghum bicolor	74.60	10.33	1.01	11.52	2.54
Zea mays	76.30	3.97	2.37	14.52	2.84

The significantly lowest % protein (wet weight) was present in *Marsilia quadrifolia* and *Trianthema petendra* and in dry weight were present in *Marsilia quadrifolia* and *Zea mays*. The significantly lowest % fat (wet weight) ($P<0.001$) as well as in dry weight was present in *Potamogeton* sp. and *Trifolium alexendrinum*. The significantly lowest % carbohydrate (wet weight) ($P<0.001$) was present in *Potamogeton* sp. and *Trianthema petendra* and in dry weight was present in *Chara* sp. and *Stellaria media*. The significantly lowest % ash (wet weight) ($P<0.001$) was found in *Typha angustifolia* and *avena sativum* and in dry weight was found in *Typha angustifolia* and *Sesbania sesban* (Table I, II; Fig.1,2).

Economics

Rates per kg proteins obtained from fodder are given in Table III on wet and dry weight basis respectively.

Results clearly show that *Sorghum bicolor* is the cheapest source of protein among fodders both on wet and dry weight basis.

Table II: Composition of samples on dry weight basis.

Fodder	Proteins (%)	Lipids (%)	Carbohydrates (%)	Ash (%)
Chara sp.	9.00	6	39.00	46
Hydrilla sp.	24.24	2	47.76	26
Marsilia quadrifolia	2.45	10	61.55	26
Potamogeton sp.	17.25	1	41.78	40
Typha angustifolia	20.93	12	61.07	6
Trianthema petendra	18.32	8	51.68	22
Stellaria media	34.03	15	32.97	18
Eragrostis sp.	19.92	15	53.08	12
Avena sativum	21.49	6	63.56	9
Trifolium alexandrinum	29.08	2	53.92	15
Sesbania sesban	33.87	14	44.13	8
Sorghum bicolor	40.69	4	45.31	10
Zea mays	16.77	10	61.23	12

Table III: Economic feasibility of fodders proposed to be used as food for grass carp on wet and dry weight basis.

Fodder	Rate/kg (Rs.) Dry wt.	Protein content/kg (g)	Rate/1000g protein (Rs.)
Avena sativum (wet)	0.60	36.9	16.26
Trifolium alexandrinum (wet)	0.60	32.5	18.46
Sorghum bicolor (wet)	0.65	103.3	6.29
Sesbania sesban (wet)	1.00	69.7	14.34
Zea mays (wet)	0.70	39.7	17.63
Avena sativum (dry)	0.60	214.9	2.79
Trifolium alexandrinum (dry)	0.60	290.5	2.06
Sorghum bicolor (dry)	0.65	406.9	1.59
Sesbania sesban (dry)	1.00	338.7	2.95
Zea mays (dry)	0.70	167.7	4.17

Economics feasibility of aquatic plants to be used as fodder for grass carp has not been calculated due to non-availability for sale in the market, however they could be utilized as a cheap source.

DISCUSSION

Green fodders include aquatic plants and terrestrial plants mainly used as feed for grass carp and some times for common carp, crucian carp and tilapia. Green fodders contain mostly water and cellulose. However, they also contain the principle nutrients, *i.e.*, fat, protein and carbohydrate and are rich in vitamins. Green fodders are the principle feed for grass carp and wuchang fish and serves as supplementary feed for other cultivable fish (NACA, 1989).

Little attempts have been made to investigate the composition of fodders in Pakistan. However, percentage composition of some fodders used as food for grass carp has been reported in China (NACA, 1989). In the present study water content of fodders range between 74.6-94.3% similar in range as reported earlier *i.e.*, 74.61-96.77%. These results however, show higher protein contents 0.1-10.33% than reported earlier *i.e.*, 0.61-4.17%. While fats in the present study range between 0.2-2.88%, similar to previous studies *i.e.*, 0.09-1.27%. Carbohydrates have the values between 3.1-14.52% which is in agreement to the studies reported earlier *i.e.*, 1.65-14.24% (Table I; NACA, 1989).

Results of the present study are in line with earlier researches, however slight difference may be due to differences in sampling or experimental methods adopted. However, efforts have been made to minimize the error. The fodders analyzed in this study belong to the different species, varieties and localities.

A certain proportion of plant material in the diet apparently plays an important role in facilitating ingestion and digestion of food and in supplying vitamins and carbohydrates necessary for respiration and proper growth (Shireman and Smith, 1983).

Sutton (1977) reported that grass carp fed on duck weed (Lemna sp.) show significantly higher growth than fed on Naajas quadalupensis or Chara sp. Proximate analysis revealed that duck weed had 22.8% crude protein compared to 9.2-13.1% in other plants. Therefore, protein rich diet promotes growth in fish than any other feed.

Economically among fodders Sorghum bicolor is the cheapest source of protein with a rate of Rupees 6.29 per 1000 g of protein. Sesbania sesban, Avena sativum, Zea mays and Trifolium alexandrinum have the rates of 1000 g protein as Rupees 14.34, 16.26, 17.63 and 18.46 respectively (Table III). Cattle are said to be very fond of this fodder and from its manifesting a power to survive for more than one year and is perhaps better suited than any other form for the purpose of fodder (Watt, 1972). It is, therefore, recommended on the basis of present analysis that Sorghum bicolor may be used as a very effective fodder for grass carp farming in Pakistan. However, due to non-availability of all the fodders in one season, each has its own merits to be used as food for grass carp.

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