

Growth and feed utilization of grass carp fingerlings.

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ABSTRACT

Fingerlings of grass carp *Ctenopharyngodon idella* (Val.), were fed on terrestrial grass (*Echinochola colonum*, *Lursia hexandra*, *Brachiaria mutica*, *Pennisetum* sp.) and tree leaves (*Parkia roxburghii*, *Litsaea polyantha*) in the laboratory for forty days. Growth and feed consumption of the fish showed significant ($P < 0.01$) variation with the type of feed. Maximum gain in average weight per individual was obtained with *Brachiaria* (2.6 ± 0.2 g) followed by *Pennisetum* (2.0 ± 0.4 g) among grass and with *Litsaea* (1.8 ± 0.3 g) among tree leaves for an average dry matter intake of 5.37, 4.98 and 4.81g respectively. Fecal output of the fishes on feeding with these forages varied between 43.2 and 70.1% of the average dry matter intake. Digestibility of protein, lipid and available carbohydrate was maximum for *Brachiaria* (61.31, 78.10 and 61.31% respectively) followed by *Pennisetum* (60.10, 75.89 and 59.94% respectively). Lowest feed conversion ratio (FCR) was obtained for *Brachiaria* (2.06) followed by *Pennisetum* (2.49) and *Litsaea* (2.67) indicating efficient conversion of these into body weight by the fishes. Survival was 100% on feeding with *Brachiaria*.

Introduction

Micro-watershed based aquaculture has been identified to have great scope in the north-eastern hilly areas (Prasad *et al.*, 1987). However, in the remote hilly areas of the region, availability of supplementary feed materials would be a major impediment in making such venture profitable. Composite fish farming, with grass carp, *Ctenopharyngodon idella*, as the major component, would cut supplementary feeding to a great extent as the fish feed on vegetation (Grygierik, 1973; Manissery and Verghese, 1988). Hence identification and maintenance of vegetation having high forage value for grass carp in aquaculture incorporated

watershed farming systems gain importance in this region. Earlier attempts to use terrestrial grass (Venkatesh and Shetty, 1978; Devaraj *et al.*, 1986) as grass carp feed showed encouraging results. Azad and Gupta (1990) and Azad (1992) reported better conversion ratio for terrestrial weeds than aquatic plants on feeding grass carp. Keeping these in view and the abundance of terrestrial grass, tree leaves as well as the potential for generating fodder through pastoral lands in watershed based farming systems on the hills, we attempted to screen four species of terrestrial grass (*Echinochola colonum*, *Lursia hexandra*, *Brachiaria mutica*, *Pennisetum* sp.) and

leaves of two tree species (*Parkia roxburghii*, *Litsaea polyantha*) for their nutritive value for grass carp in terms of their growth and feed utilization.

Materials and methods

Leaves of the grass and trees were collected locally and their proximate composition in respect of moisture, crude protein, ether extract, crude fibre, nitrogen free extract and ash content were analysed (AOAC, 1975). The feeding experiment was conducted in circular plastic containers with 100 l water. Ten grass carp fingerlings (8.80 to 9.50g size) each were stocked in the containers in six treatments (F₁ to F₆) with two replications.

The fishes were acclimatised in the containers for one week by feeding them on duck weed (*Lemna* sp.). The fishes were allowed to starve for 12 hours and weighed before the experiment. Fresh leaves of the grass and trees were collected daily, chopped into small pieces, taking into account the mouth size of the fishes, weighed and offered *ad lib.* to the fishes. The unfed feed residue and fecal matter were siphoned out next day morning before feeding. The fecal matter and feed residue were separated, dried in oven at 105°C and weighed to constant weight. Water in the containers was renewed every two days. Aeration was provided in all the containers. The water quality was monitored periodically (FAO, 1975). The weight increment was measured at 10 days interval in the morning before feeding. The wet feed consumed, fecal output and survival were recorded. The fecal matter collected daily were pooled, weighed and analysed for protein, lipid and carbohydrate. The feed consumed and fecal output were converted into equivalent of dry matter. From these values, growth, feed utilization, and nutritive values were worked out (Patterson

Edward *et al.*, 1996).

Results and discussion

The range of variations in water temperature, pH, alkalinity and dissolved oxygen was 18 to 24°C, 6.8 to 7.3, 38 to 62 ppm and 7.5 to 8.7 ml/l respectively during the experiment. The proximate composition of the plant materials, F₁ (*Echinochola*), F₂ (*Lursia*), F₃ (*Brachiaria*), F₄ (*Pennisetum*) F₅ (*Parkia*) and F₆ (*Litsaea*) are shown in Table 1. Maximum percentage of protein, was in F₃ (12.5) among grass and F₅ (18.5) among tree leaves.

Results showed that finely chopped grass and tree leaves were accepted by grass carp. The average weight increment per individual are shown in Fig. 1.

Faster growth rate was recorded with F₃ followed by F₄ and F₆ (Table 2). Growth in terms of weight gain per individual for 40 days and percentage of growth showed significant ($P < 0.01$) variation among the forages. Maximum weight gain per individual was obtained with F₃ (2.6 ± 0.2 g) followed by F₄ ($2.0 \pm$

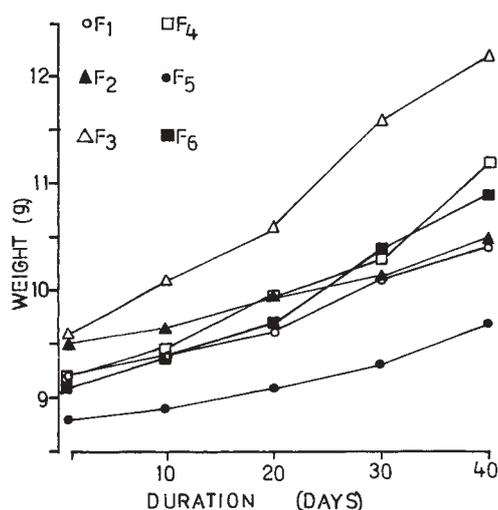


Fig. 1. Average individual weight gain in *C. idella* fed on different forages.

0.4g), amounting to 0.065 and 0.05g/day respectively. The percentage gain in body weight was also high for F₃ (27.08) followed by F₄ (21.73). However, growth was comparatively lower in this study than that obtained with aquatic weed *Spirodela polyrhiza* (Hajra and Tripathi, 1985) and higher for F₃, F₄ and F₆ than with that reported with *Azolla* sp. and *Alternanthera philoxeroides* (Azad and Gupta, 1990), *Lemna* sp. and *Agaratum conizoides* (Azad, 1992).

Growth and feed utilization parameters are shown in Table 3. Average dry matter intake of the fishes varied significantly (P<0.01) among the forages, with highest values for F₃ (5.37g) and lowest for F₅ (4.01g), equal to 1.44 and 1.14g/100g fish/day, which is lower than that obtained for *Azolla* sp. (Azad and Gupta, 1990), *Lemna* sp. and *Agaratum* sp. (Azad, 1992). When expressed on fresh weight basis, the average wet feed intake/100g fish/day was 5.49g and 3.0g for F₃ and F₅ respectively. Weight gain in relation to dry matter intake was better in all the forages in this study than that of aquatic plants (*Lemna* and *Azolla*) and marshy weeds (*Agaratum* and *Alternanthera*) reported by Azad and Gupta (1990) and Azad (1992) and better than that obtained with *Spirodela* (Hajra and Tripathi, 1985) for F₃, F₄ and F₆ in this study. This may be due to the lower moisture content in these forages than the aquatic and marshy plants.

Fecal output in terms of percentage of dry matter consumed was higher in all the forages (43.2 to 70.07%) than that reported for *Agaratum* (24.9%) by Azad (1992) and lower than that for *Lemna* (61.1%) with F₁, F₃, F₄ and F₆ which ranged from 43.2 to 59.5%, indicating better assimilation than *Lemna*. Assimilation and assimilation efficiency of the fish showed difference (P<0.05 and

TABLE 1. Bio-chemical composition of the forages fed to grass carp (Percentage dry matter basis).

Forages	Dry matter	Crude Protein	Ether extract	Crude fibre	Nitrogen free extract	Total ash
F ₁	37.45	5.2	1.8	34.8	45.7	12.4
F ₂	38.90	5.8	2.1	28.4	47.0	16.7
F ₃	26.50	12.5	2.9	28.9	45.2	11.2
F ₄	34.50	6.2	2.3	28.1	19.5	4.0
F ₅	37.40	18.8	2.3	19.5	54.8	4.7
F ₆	40.50	17.9	10.8	4.0	61.8	6.4

F₁ = *Echinochola colonum*F₂ = *Lursia hexandra*F₃ = *Brachiaria mutica*F₄ = *Pennisetum* sp.F₅ = *Parkia roxburghii*F₆ = *Litsaea polyantha*

TABLE 2. Growth and survival of grass carp fed on different forages.

Parameters	F o r a g e s					
	F ₁	F ₂	F ₃	F ₄	F ₅	F ₆
No. of fish	10	10	10	10	10	10
Duration (days)	40	40	40	40	40	40
Initial weight (g)*	9.2±1.4	9.5±1.2	9.6±0.9	9.2±1.0	8.8±0.7	9.1±1.1
Final weight (g)*	10.4±1.1	10.5±0.9	12.2±1.1	11.2±1.4	9.7±1.0	10.9±0.8
Weight gain (g)*	1.2±0.3	1.0±0.3	2.6±0.2	2.0±0.4	0.9±0.3	1.8±0.3
Growth (%)	13.04	10.50	27.08	21.73	10.23	19.78
Survival (%)	95	90	100	90	85.5	90

* Average wet weight/individual

F₁ = Echinochola colonum

F₂ = Lursia hexandra

F₃ = Brachiaria mutica

F₄ = Pennisetum sp.

F₅ = Parkia roxburghii

F₆ = Litsaea polyantha

TABLE 3. Growth and feed utilization parameters of grass carp fed on different forages. (g. dry weight/ individual, unless specified)

Forages	Wet weight gained*	Feed Consumed*	Fecal output	Assimi lation	Assimilation efficiency (%)*	Specific growth rate (%)*	Gross gro- wth effici- ency (%)	Net growth efficiency (%)
F ₁	1.2±0.3 ^c	4.62 ^b	2.77	1.85 ^b	40.04 ^b	0.13 ^b	25.97	64.86
F ₂	1.0±0.3 ^b	4.14 ^a	2.89	1.25 ^a	30.19 ^a	0.11 ^a	24.15	80.00
F ₃	2.6±0.2 ^f	5.37 ^c	2.32	3.05 ^c	56.79 ^c	0.26 ^e	48.42	85.25
F ₄	2.0±0.4 ^c	4.98 ^b	2.20	2.70 ^b	55.82 ^c	0.21 ^d	40.16	71.94
F ₅	0.9±0.3 ^a	4.01 ^a	2.81	1.20 ^a	29.93 ^a	0.11 ^a	22.44	75.00
F ₆	1.8±0.3 ^d	4.81 ^b	2.13	2.68 ^b	55.72 ^c	0.19 ^c	37.42	67.16

Values in each column with different superscripts (a,b,c,d,e,f) differ significantly

(*P<0.01, # P<0.05)

F₁ = Echinochola colonum

F₂ = Lursia hexandra

F₃ = Brachiaria mutica

F₄ = Pennisetum sp.

F₅ = Parkia roxburghii

F₆ = Litsaea polyantha

TABLE 4. Digestibility coefficients and nutritive value of the forages.

Parameters	Forages					
	F ₁	F ₂	F ₃	F ₄	F ₅	F ₆
Digestibility (%):						
Protein	50.36	54.54	61.31	60.10	48.41	58.23
Lipid	72.53	68.81	78.10	75.89	70.10	73.43
Carbohydrate	56.83	55.40	61.31	59.94	50.71	52.15
Nutritive value:						
Feed Conversion ratio (FCR)	3.85	4.14	2.06	2.49	4.56	2.67
Feed conversion efficiency (FCE)	0.26	0.24	0.48	0.40	0.22	0.37

F₁ = Echinochola colonum
 F₂ = Lursia hexandra
 F₃ = Brachiaria mutica

F₄ = Pennisetum sp.
 F₅ = Parkia roxburghii
 F₆ = Litsaea polyantha

P<0.01 respectively) with the type of feed; maximum being 3.05 and 56.79 respectively for F₃ (Table 3). Herbivorous fish have low assimilation efficiency and high net growth efficiency (Table 3). Gross growth efficiency and net growth efficiency are wide from each other due to the low assimilation efficiency associated with herbivorous fishes (Patterson Edward *et al.*, 1996).

Digestibility of protein, lipid and carbohydrate was highest for F₃ (60.10, 75.89 and 61.31% respectively) followed by F₄ and F₆ (Table 4). Nutritive value in terms of FCR was lowest for F₃ (2.06) followed by F₄ (2.49) and F₆ (2.67). Feed conversion efficiency also followed the same pattern (Table 4). The results indicated the efficiency of the terrestrial grass *Brachiaria mutica*, *Pennisetum* sp. and leaves of *Litsaea polyantha* as fodder for grass carp.

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