

Preference of Different Terrestrial Plants as Food for *Tilapia rendalli* and *Oreochromis shiranus**

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Introduction

Tilapias are generally opportunistic, omnivorous feeders, but the species of interest to fish culturists fall approximately into two groups with respect to feeding preferences: herbivorous macrophyte and microphagous feeders (Pullin 1986). There is a wide range of terrestrial and aquatic macrophytes which could be utilized in the culture of herbivorous tilapias (*Oreochromis* spp.). Macrophytophagous tilapias could be fed terrestrial and aquatic vegetation at low cost to the farmer (Edwards 1987).

Fish have distinct preferences for plants (Edwards 1980) and there is need to identify those that will lead to good growth and production, especially in Africa where there is abundant natural and agricultural waste vegetation. Some plants may also be useful as substitutes for animal protein components in formulated fish feeds (Payne 1981; Edwards 1987).

The objective of this study was to identify terrestrial plants acceptable to *Tilapia rendalli* and *O. shiranus*, the main tilapias cultured in Malawi.

Materials and Methods

Preference testing of different plants to *T. rendalli* and *O. shiranus* was conducted in 200-m² ponds (1 m deep) at the National Aquaculture Centre (NAC), Zomba, Malawi, from 14 February to 27 April 1989. Fish were stocked at 5/m²; 1,000 *T. rendalli* were stocked in pond A and 1,000 *O. shiranus* in pond B. Overall mean body weight (MBW) of fish was 20 ± 5 g (MBW ± 1 SD).

Different terrestrial (natural and cultivated) plants were collected fresh from around the NAC and tied with string into 50-g bundles (Table 1). Each plant was given to the fish in three bundles per pond on four occasions (12 data points). Bundles of different plant species were randomly tied with wire to two 8-m long bamboo poles at 30-cm spaces. Poles were suspended horizontally in the pond, 3-5 cm below the surface by fastening them to vertical

poles staked into the pond bottom. Plant bundles were thereby fully submerged at all times. As controls, three 50-g bundles for each plant species were put into buckets with tap water to correct for any weight losses or gains due to leaching or hydration.

Plant remains were removed from ponds and buckets after 24 hours, oven dried at 90-100°C to constant weight ± 0.1 g. Per cent dry matter (DM) consumed was determined on the treatments and compared to the DM of the control, and expressed as per cent DM consumed per day:

Table 1. Plants presented to *Tilapia rendalli* and *Oreochromis shiranus* in 200-m² ponds and the amount consumed after 24 hours on a dry matter basis.

Scientific name	Common name	% Dry matter content	% Dry matter consumed by	
			<i>T. rendalli</i>	<i>O. shiranus</i>
<i>Luffa cylindrica</i>	Loofah	11	90.0	0
<i>Cucurbita maxima</i>	Pumpkin	15	83.4*	59.8*
<i>Galinsoga parviflora</i>	NA	12	81.5	0
<i>Manihot</i> spp.	Cassava	74	77.1	0
<i>Tridax procumbens</i>	NA	8	75.1*	28.7*
<i>Commelina</i> spp.	Spiderwort	10	70.6	0
<i>Ipomoea batatas</i>	Sweet potato	15	70.1*	65.6*
<i>Leucaena leucocephala</i>	Leucaena	32	69.6	0
<i>Biden pilosa</i>	Black jack	10	69.4*	25.0*
<i>Rottboellia exaltata</i>	NA	22	67.6	0
<i>Echinochloa pyramidalis</i>	NA	24	67.1	0
<i>Mucuna pruriens</i>	Buffalo beans	17	65.5*	17.9*
<i>Pennisetum purpureum</i>	Napier/Elephant grass	22	64.1	0
<i>Morus nigra</i>	Mulberry	29	60.3	0
<i>Ageratum houstonianum</i>	NA	10	52.3	0
<i>Amaranthus</i> spp.	Wild blite	19	47.2	0
<i>Emilia citrina</i>	NA	8	46.3	0
<i>Trichodesma zeylanicum</i>	NA	11	41.8	0
<i>Rhynchelytrum</i> spp.	NA	20	38.4	0
<i>Musa paradisiaca</i>	Banana	22	37.2	0
<i>Carica papaya</i>	Papaya/Pawpaw	17	32.8*	23.6*
<i>Hyparrhenia rufa</i>	Zebra/Giant grass	31	14.1	0
<i>Brachiaria arrecta</i>	NA	17	8.6	0
<i>Tephrosia vogelli</i>	Fish bean	ND	0	0
<i>Cassia obtusifolia</i>	NA	ND	0	0
<i>Ludwigia erecta</i>	NA	ND	0	0
<i>Vernonia petersii</i>	NA	ND	0	0
<i>Vernonia cinerea</i>	NA	ND	0	0
<i>Tithonia diversifolia</i>	NA	ND	0	0

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* Significantly different at P<0.01 using paired t-test.

NA = Not available.

ND = Moisture and dry matter content were not determined on plants not eaten by fish.

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$$\% \text{ DM consumed} = \frac{\text{DM control} - \text{DM uneaten}}{\text{DM control}} \times 100$$

where

DM = dry matter of plants after oven drying;

DM control = plant bundles in controls soaked in a bucket of water; and

DM uneaten = plant bundles after they were given to fish for 24 hours in ponds.

Differences in plant consumption of *T. rendalli* and *O. shiranus* were determined using paired t-test at ($P < 0.05$). A multiple regression analysis was performed: the plant consumption data was the independent variable and nutritional and moisture contents of the plants were the dependent variables (Table 2).

Results

Of the 29 plants tested, 23 were eaten by *T. rendalli* and six by *O. shiranus* (Table 1). The amount of plant dry matter consumed by *T. rendalli* was significantly higher ($P < 0.01$) than that consumed by *O. shiranus*.

Among the plants eaten by *T. rendalli*, distinct preferences were noted (Table 2). Some plants were not eaten by either fish: *Tephrosia vogelli*, *Cassia obtusifolia*, *Ludwigia erecta*, *Vernonia petersii*, *V. cinerea* and *Tithonia diversifolia*.

Discussion

Junor (1969) concluded that *T. rendalli* is a voracious and largely

nonselective feeder on submerged aquatic macrophytes. In this study, *Tilapia rendalli* ate a wide range of terrestrial plants. Among the terrestrial plants eaten here, however, *T. rendalli* preferred some over others, as did *O. shiranus*. Although *O. shiranus* ate up to 65% of the dry matter of some of the plants tested, all DM consumption rates were significantly lower than those of *T. rendalli*. It is surprising that *O. shiranus*, considered a microphagous fish (Trewavas 1983), ate some of the higher terrestrial plants tested.

Nutritional values of plants eaten by *T. rendalli* and *O. shiranus* are shown in Table 2. Grasses (*Rottboellia exaltata*, *Pennisetum purpureum* and *Hyparrhenia rufa*) have low crude protein (CP) contents; while leafy plants (*Manihot* spp., *Ipomoea batatas* and *Leucaena leucocephala*) have higher CPs. A multiple regression showed that plant consumption by *T. rendalli* and *O. shiranus* was not related to the nutritional status of the plants ($r = -0.29$ to 0.14 ; $P > 0.05$).

Some of the plants eaten by *T. rendalli* and *O. shiranus* may not be suitable as fishpond inputs as they may be scarce (Boyd 1968). Others may contain toxins or antigestive factors; e.g., *Leucaena leucocephala*, which contains mimosine that can inhibit fish growth if not leached before incorporated into feeds. Cassava (*Manihot* spp.) and sweet potato leaves (*Ipomoea batatas*) are also used as human food. On the other hand, napier grass (*Pennisetum purpureum*) has a good potential as a pond input. Napier grass is commonly available in all ecological zones in Malawi all year-

round (Williamson 1975). It grows naturally near streams or in *dambos* and can also be cultivated. Yields of 80-100 t/ha/year under rainfed conditions, or up to 250-300 t/ha/year under good management, fertilization and irrigation have been recorded (Hegde 1974).

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Table 2. Plants ranked according to consumption by *Tilapia rendalli* in 200-m² ponds and their nutritional values.

Scientific name	Nutritional composition as % of dry matter					
	DM	CP	CF	Ash	EE	NFE
<i>Manihot</i> spp.	16.5	25.9	20.6	8.1	5.6	42.3
<i>Ipomoea batatas</i>	10.8	19.4	10.2	25.9	3.7	40.8
<i>Leucaena leucocephala</i>		21.0	18.1	8.4	6.5	46.0
<i>Rottboellia exaltata</i>		11.1	32.9	10.9	2.3	42.8
<i>Echinochloa pyramidalis</i>			7.0	31.4	8.6	1.1
<i>Pennisetum purpureum</i>		10.2	32.9	13.4	1.8	42.8
<i>Morus nigra</i>	38.3	17.6	7.4	20.4	11.5	43.1
<i>Amaranthus</i> spp.		19.9	21.0	17.0	1.5	40.6
<i>Musa paradisiaca</i>	94.1	9.9	24.0	8.8	11.8	45.5
<i>Carica papaya</i>	22.1	26.8	10.9	13.2	7.7	42.0
<i>Hyparrhenia rufa</i>	30.0	6.0	31.3	15.5	2.1	45.8

Nutritional values from Gohl (1975).

DM = Dry matter; CP = crude protein; CF = crude fiber; EE = ether extract; NFE = nitrogen free extract.