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# UTILIZATION OF *Limnocharis flava,* AN INVASIVE AQUATIC WEED FROM KUTTANAD WETLAND ECOSYSTEM, KERALA, INDIA AS A POTENTIAL FEEDSTOCK FOR LIVESTOCK

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**ABSTRACT:** The chemical composition, nutritive value and trace element profiles of *Limnocharis flava*, an emergent aquatic weed during its different growth stages was determined to evaluate as possible cattle feed. Samples were analyzed at three progressive morphological stages of the plant, pre-flowering, flowering and post-flowering. The moisture content, dry matter (DM), ash content, crude protein (CP), ether extract (EE), crude fiber (CF), nitrogen free extract (NFE) and mineral constituents like sodium ($Na^+$) potassium ($K^+$), calcium ($Ca^{2+}$), phosphorous (P) and trace elements like iron ($Fe^{2+}$), copper ($Cu^{2+}$), manganese ($Mn^{2+}$), zinc ($Zn^{2+}$), lead ($Pb^{2+}$), chromium ($Cr^{2+}$ ) nickel ($Ni^+$) and cadmium ($Cd^+$) contents were analyzed. The moisture content, organic matter (OM), acid detergent fiber content increased during maturation, while CP and EE were found decreased with increased growth stage. Only slight fluctuations occurred in Calcium, Potassium, Phosphorous and Sodium contents. The highest values for crude protein, fiber content, NFE and EE were observed at the flowering stage. These plant posses several characteristics which makes it a nutritious feed suitable for domestic livestock, and is recommended to use *L.flava*, particularly at the flowering stage of growth.

**Keywords:** *Limnocharis flava*, Aquatic Weed, Nutritive Value, Chemical Composition.

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## INTRODUCTION

Alien weed invasion has been identified as one of the biggest threat to biological diversity around globe. They are aggressive colonizers with flexible habitat requirement and ability to out compete native species. Recent studies reveal that the tropics are the major ecological regions, which often became the victims of biological invasions (Ramakrishnan, 1999). Attempts to eradicate such weeds with chemical, biological, mechanical or hybrid means (Abbasi and Ramasamy, 1999; Abbasi and Nipaney, 1986, Bindu and Ramasamy, 2005) have generally failed throughout the world on a long term basis. These methods succeed only in keeping weed infestations in check at enormous costs (Gajalekshmi et al., 2001). Alternatively, the initial clearance of the weed followed by regular, periodic removal of the regrown weeds, coupled with proper utilization of the harvested weeds seems to be a viable solution to the weed menace. By this means the high productivity of such weeds can be made an asset (Gupta, 1979; Abbasi and Nipaney, 1986; Ramasamy and Abbasi, 1999; Kurian and Ramasamy, 2005). The objectives of this study to determine the potential utilization of an exotic aquatic weed, *Limnocharis flava* as unconventional feed resource to livestock.

*Limnocharis flava* (L) Buchenau, an ornamental plant commonly called yellow bur-head, is a monocot weed in the *Limnocharitacea* family. This emergent weed is a native of tropical and subtropical America and now has invaded in the freshwater ponds, lakes and floodplains of Kuttanad including Vembanad lake, a Ramsar site in Kerala, India. The plant inhabits shallow swamps, ditches, pools and wet rice fields where it grows in more or less stagnant fresh water and rooted in the mud, amidst *Colocassia, Monochoria* and other emergent aquatic plants. It has been reported that this plant has became a pest in rice fields of Ceylon, Indonesia and Malaysia and paddy cultivation is often abandoned due to its serious infestation (Kammathy and Subramanyan, 1967, Bahadur and Raizada, 1968). Another important aspect is its methods of propagation. Fruiting takes place throughout the year and the seeds are produced in abundance. A single fruit produces about 1,000 seeds and a single plant may produce over 1,000,000 seeds per year (Senratna, 1940). It has both vegetative and ramets mode of propagation.

Holm-Nielson (1992) in his monograph on Limnocharitaceae in the "Flora of Neotropica" has reported that *Limnocharis flava* is a neotropic weed, distributed in the northern Argentina and eastern Brazil. Ochse et al. (1931) included the *Limnocharis flava* as an aquatic leafy vegetable in the 'Vegetable of Dutch East Indies'. National Academy of Science, Washington (1976) reported that in Java, juvenile leaves and young plants of *Limnocharis*



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*flava* are a common and much esteemed vegetable. The plant is used as an aquatic ornamental plant in the United States of America. In Sumatra and other places, the plant is used as a fodder for cattle and pigs. The use of *Limnocharis flava* as a livestock feed will help in enhancing the available feed resource and control its spread. A detailed literature search has revealed that several studies have been reported on the nutritional and mineral characteristics of aquatic macrophytes (Harper et al., 1935; Bailey, 1965; Boyd, 1968; 1968a; 1969) but no study has been reported on Limnocharis. Keeping this in view, the present study was carried out to investigate the chemical composition and nutritional characteristics of *Limnocharis flava.*

## MATERIALS AND METHODS

### Collection of Plant samples

Immature *Limnocharis flava* plants (average height of 5-10 cm) were collected from five different sites, within 80 km of Kottayam district, Kerala. In order to obtain information on variation of chemical composition of natural stand, samples were collected from different environmental conditions and all sites represent a wide range of edaphic and climatic conditions. The climatic patterns of these sites are characterized by high precipitation at May, June, July and with little rainfall in summer and winter. Mean daily temperature ranges from 22-310C.

Seedlings of *Limnocharis flava* were grown in a green house in 40x165 cm pots and transplanted to the soil collected from the natural sites where the plants were collected. Sufficient replicates (5 seedlings from each site) were raised. The holes of the pots were sealed in order to provide a water impounded stage similar to the natural conditions and the plants were watered every day. Plant material was harvested for analysis at pre-flowering, flowering and post flowering from the green house plantings.

### Chemical analysis

Whole plant samples were washed and dried in an oven to constant weight at 700C to determine the dry matter (DM) content and were then air equilibrated, ground well and passed through a 1mm screen and stored for later analyses .The samples were analysed for Ash Content, Acid Soluble Ash, Crude Protein, Crude Fiber, Nitrogen Free Extract (NFE), Ether Extract (EE), Phosphorous and Calcium following standard procedures described in AOAC, 1990. A Flame photometer (Systronics make, Model-128) was used for Sodium and Potassium estimation. The trace elements like Iron, copper, manganese, zinc, cadmium, lead, chromium and nickel were determined using a Varian AA Spectra 20 Atomic Absorption Spectrophotometer at the appropriate wavelengths.

### Statistical analysis

Variability of the chemical composition, nutritive value of forage harvested at three stages of maturity were tested for statistical significance by one way analysis of variance (ANOVA) using the Statistical Package for Social Sciences (SPSS, V.II.263 Inc, Chicago, USA).

## RESULTS AND DISCUSSION

The results of the proximate analysis of *Limnocharis flava* at its three morphological stages of growth are presented in Table 1. The moisture content, ash content, acid soluble ash content increased slightly during maturation, while crude protein, nitrogen free extract (NFE) and ether extract (EE) decreased. The ash content was significantly higher at the post flowering stage than the other two stages ($P<0.05$).

**Table 1 - Chemical Composition and Nutritive value (%) of *Limnocharis flava* at three stages of growth.**

| Analyses | Pre-flowering | Flowering | Post-flowering |
|---|---|---|---|
| Moisture content | $87.00 \pm 1.61^a$ | $90.00 \pm 1.97^a$ | $92.00 \pm 3.43^a$ |
| Ash content | $7.80 \pm 0.54^a$ | $9.20 \pm 1.05^a$ | $9.68 \pm 0.36^b$ |
| Acid Soluble ash | $0.60 \pm 0.07^a$ | $0.80 \pm 0.05^a$ | $0.90 \pm 0.07^a$ |
| Crude protein | $13.90 \pm 0.4^a$ | $14.20 \pm 0.51^a$ | $11.44 \pm 0.76^a$ |
| Crude fibre | $5.30 \pm 0.58^a$ | $7.60 \pm 0.51^a$ | $7.94 \pm 0.5^a$ |
| Nitrogen free extract | $65.40 \pm 0.79^a$ | $72.84 \pm 0.44^a$ | $69.40 \pm 0.49^a$ |
| Ether Extract | $6.70 \pm 0.48^a$ | $7.53 \pm 0.44^a$ | $6.88 \pm 0.52^a$ |

Mean of 5 samples ± S.D., Within a row, the values with different letters differ significantly ($P<0.05$)

The mean values of selected inorganic nutrients (dry wt basis) in *Limnocharis flava* at its three stages of growth are presented in Table 2. The Potassium and Sodium concentrations at the pre-flowering and flowering



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stages differ, but there is no significant difference in calcium and phosphorous concentrations at the three stages of maturation (P<0.05). The trace metal composition of *Limnocharis flava* is presented in Table 3. There are significant differences in the concentrations of iron, copper, manganese, zinc, lead and nickel at the flowering and post-flowering stages (P<0.05).

**Table 2** - Selected inorganic nutrient composition (%) in *Limnocharis flava* at three stages of growth.

| Growth stages | Pre-flowering | Flowering | Post-flowering |
|---|---|---|---|
| Calcium | 4.8±0.04[a] | 5.62±0.44[a] | 5.76±0.42[a] |
| Phosphorous | 0.66±0.03[a] | 0.76±0.04[a] | 0.79±0.05[a] |
| Potassium | 0.48±0.05[a] | 1.2±0.36[b] | 1.29±0.46[b] |
| Sodium | 0.0208±0.01[a] | 0.0292±0.004[b] | 0.0348±0.004[b] |

Mean of 5 samples ± S.D. Within a row, the values with different letters differ significantly (P<0.05)

**Table.3.** Trace metal composition of *Limnocharis flava at* the three stages of growth

| Growth stages | Pre-flowering | Flowering | Post-flowering |
|---|---|---|---|
| Iron | 1.91±0.025[a] | 1.98±0.013[a] | 2.23±0.011[b] |
| Copper | 0.020± 0.00002[a] | 0.023±0.00002[a] | 0.025±0.00008[b] |
| Manganese | 0.071±0.00001[a] | 0.076±0.00003[a] | 0.08±0.00004[b] |
| Zinc | 0.002±0.000002[a] | 0.004±0.000001[a] | 0.007±0.000001[b] |
| Lead | 0.019±0.0007[a] | 0.023±0.0013[a] | 0.028±0.0017[b] |
| Chromium | 0.007±0.000003[a] | 0.008±0.000001[a] | 0.01±0.0004[b] |
| Nickel | BDL | BDL | BDL |
| Cadmium | BDL | BDL | BDL |

All values are in ppm. Mean of 5 samples ± S.D. Within a row, the values with different letters differ significantly (P<0.05), BDL – Below Detectable Level

In the present study, the chemical composition, the nutritive value and the trace element profiles of the weed, *Limnocharis flava* at three morphological stages of growth was analyzed and determined. The crude protein, ash content, ether extract, crude fiber and Nitrogen free extract contents on its mature stage resemble that of most other common aquatic plants (Table 4). Boyd (1969) states that protein content declines rapidly with maturity. So harvesting for fodder should be at maximum protein content related to total plant material. This trend is also observed in the present study. The highest value of crude protein, crude fiber, Nitrogen free extract and ether extract were obtained at the flowering stage (Table1). Therefore, the harvesting of the plant at the flowering stage is most recommended.

**Table 4.** Results of Proximate Analysis of some common aquatic weeds.

| Plant | CP | Ash | EE | CF | NFE | References |
|---|---|---|---|---|---|---|
| *Eichhornia crassipes* | 5.70 | 0.62 | 0.40 | 2.90 | 64.2 | Muktar, 1967 |
| *Alternanthera philoxeroides* | 6.40 | 12.0 | 0.80 | 7.50 | 60.8 | Alfrod, 1952 |
| *Pistia stratiotes* | 0.78 | 2.00 | 0.30 | — | — | Boyd, 1969 |
| *Hydrilla verticellata* | 1.37 | 3.2 | 0.27 | — | — | Boyd, 1969 |
| *Lemna Minor* | 17.86 | 1.61 | 2.19 | 11.82 | 66.52 | Linn, 1975 |
| *Ceratophyllum demersum* | 17.00 | 2.18 | 1.51 | 15.2 | 64.11 | Linn, 1975 |
| *Chara vulgaris* | 7.92 | 5.62 | 0.12 | 7.65 | 77.56 | Linn, 1975 |
| *Typha aungustifolia* | 6.92 | 0.93 | 0.98 | 27.32 | 53.46 | Linn, 1975 |
| *Potamageton pectinatum* | 14.05 | 3.22 | 0.09 | 15.64 | 67.00 | Little *et* al., 1967 |
| *Limnocharis flava* | 14.22 | 9.20 | 7.60 | 7.63 | 72.84 | Present study |

All values are in percentage.

Boyd (1969) found that the crude protein levels in *Pistia stratiotes* and *Hydrilla verticellata* was 0.78% and 1.37% respectively. The crude Protein content of *Limnocharis flava* is appreciably higher than that most of the other common aquatic weeds of Kerala. The Crude fibre content of *Limnocharis flava* was comparable to the studies by Alfrod, 1952 and Linn, 1975a on Alteranthera philoxeroides and Chara vulgaris. The mean crude protein levels were as high as values reported for many high quality forages (Morrison, 1961). On comparing the chemical composition of *Limnocharis flava* with other common tropical feedstuffs, it has been observed that the plant has rather similar or high values than the other common feeds (Table 6).



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**Table 5** - The Chemical Composition (% of dry matter) in some common tropical feeds.

| Items | DM | CP | Ash | Crude fibre | References |
|---|---|---|---|---|---|
| Chopped whole Sugarcane | 23.7 | 2.5 | 2.3 | 41.1 | Van et al., 2001 |
| Rice straw | 89.4 | 3.88 | 4.9 | — | Keir et al., 1997 |
| *Fleminga macrophylla* | 28.5 | 18.3 | 5.4 | 52 | Van et al., 2005 |
| Jackfruit foliages | 32.8 | 14.8 | 10.6 | 50.6 | Van et al., 2001 |
| *Acacia mangium* | 31.6 | 16.2 | 4.6 | 49.8 | Van et al., 2004 |
| Cassava hay | 28.5 | 15.6 | 9.8 | — | Keir et al., 1997 |
| Rubber seed cake | 12.5 | 14.8 | 5.9 | 34.7 | Hao and Ledin, 1999 |
| Ground nut cake | 88.1 | 3.02 | 1.3 | 26.2 | Hao and Ledin, 1999 |
| *Limnocharis flava* | 9.0 | 9.68 | 9.68 | 7.94 | Present study |

**Table 6** - Recommended Mineral requirements for lactating cattle

| Mineral Constituent | Percent in dry matter* | Present study |
|---|---|---|
| Calcium | 0.43-0.77% | 5.76% |
| Phosphorous | 0.28-0.49% | 0.79% |
| Potassium | 0.90-1.00% | 1.29% |
| Sodium | 0.18% | 0.035% |
| Iron | 50ppm | 2.23ppm |
| Copper | 0.10ppm | 0.025ppm |
| Manganese | 40ppm | 0.08ppm |
| Zinc | 40-60ppm | 0.007ppm |

* As recommended in Sharma and Mahajan, 2002.

The calcium, phosphorous and potassium content during its mature stage is 5.6%, 0.76% and 1.19% respectively are equal to or above the nutritional requirement for finishing cattle (National Academy of Sciences, 1976). On comparing the mineral requirements of lactating dairy cattle (Table 5) with that of the present study it has been observed that the calcium, phosphorous and potassium concentrations are exceeding the prescribed values for lactating cattle. Moreover, compared to other alien aquatic weeds like *Eichhornia crassipes, Alternanthera philoxeroides, Pistia stratiotes, Hydrilla verticellata, Chara vulgaris, Typha aungustifolia* and *Potamageton pectinatum* this emergent aquatic weed has higher value of Crude protein, Ash and Crude fibre.

## CONCLUSION

In this study, the possibility of utilizing this plant as a food was considered. Based on the proximate and chemical analysis done, the plant species appears to be a potential feed for domestic livestock. These species produce mono specific stands, which cover large areas. Therefore, methods of utilization would develop an important resource in many areas.

Analyses of the dehydrated samples indicate that the plant contain rather large amounts of crude protein, crude fibre and ether extract and had satisfactory level of micro-minerals like Iron, Copper, Manganese and Zinc. More over the concentrations of macro-minerals like Calcium, Potassium and Phosphorous is very high and rather higher than the requirements for lactating cattle.

In summary, *Limnocharis flava* seem to possess several characteristics, which make it as a suitable candidate for consideration as a cattle feed. The utilization of this weed as a source of livestock feed also serves as an effective means of weed control.

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