



Nutritional Evaluation of Macrophytes of Dal Lake with Potential as Animal Fodder

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ABSTRACT

Proximate composition, fibre fraction, predictable feeding value and *in-vitro* digestibility of fourteen species of aquatic plants collected from Dal lake of Kashmir were evaluated and compared with the oats as standard maintenance fodder. The dry matter content of the major aquatic weeds was in a range of 8.53% to 10.74%, comparable with green oats fodders. Except *Nymphaea tetragona* and *Trapa natans*, the crude protein and ash content of all these aquatic weeds was significantly ($P < 0.05$) higher than Oats fodder. Whereas ether extract was found similar to oats fodder except *Trapa natans*, *Nelumbo nucifera*, *Cladophora glomerata* and *Lemna minor*. All these aquatic weeds have crude fibre (CF) percentage significantly ($P < 0.05$) lower than Oats fodder except *Typha angustata*, *Nymphaea tetragona* and *Nymphoides peltata*. Significantly ($P < 0.05$) lower percent NDF, ADF and Cellulose was reported with hemicellulose percentage significantly higher in *Nymphaea tetragona* and *Ceratophyllum demersum* than Oats fodder. All aquatic plants were having lignin ranging between 3.50% to 24.74%. The percent total carbohydrates (TC) of these aquatic plants were found significantly ($P < 0.05$) lower with higher non fibrous carbohydrates (NFC). These aquatic plants have significantly ($P < 0.05$) higher DCP, TDN and ME percent than oats fodder. The significantly ($P < 0.05$) higher percent dry matter intake (%DMI), percent digestible dry matter (%DDM) and relative feed value (RFV) with better invitro digestibility was found in these aquatic weeds than oats as standard maintenance fodder.

KEYWORDS: Aquatic plants, Dal lake, Fibre fraction, Nutrient digestibility, Proximate composition.

Article received: 15 December 2023; Article accepted: 25 March 2024

INTRODUCTION

Water ways and lakes all around Kashmir are home to a variety of aquatic plants, many of which have become weedy. In Jammu & Kashmir numerous aquatic plants like *Nymphoides*, *Ranunculus*, *Nymphaea*, *Hydrilla*, *Azolla*, *Nelumbo*, *Trapa*, etc. species are profusely found in different lakes and water bodies which deplete their water quality (Bhat, 2002). Aquatic weeds have historically been considered as a nuisance rather than a valuable resource because they obstruct canals, restrict boat traffic and spread water borne infections. In addition to providing a base to aquatic food chain, aquatic weeds have many potential uses as human

food, livestock feeds, cosmetics, ethnomedicine, paper making and fertilizer (Hasan and Rina, 2009). They can be woven into mats and baskets, and are also used for construction of dwellings and fences, as well as for purification of polluted effluents and water bodies (Naghma and Sarwat, 2005).

In past, many aquatic plants from different water bodies were used as livestock feed and many reports displayed that weeds have high protein and micronutrient content, that can even support production (Shah et al., 2010). The exploration of biochemical composition of these aquatic weeds indicated that these macrophytes can be used as a potential source of fodder for livestock (Rather and

Nazir, 2015). In recent years, many researchers have tried to investigate the possibilities of using aquatic plants as a source of feed in cattle (Kumar et al., 2022), in sheep (Ahmed et al., 2016; Mekuriaw et al., 2018), in goats (Sharma et al., 2021) in poultry (Humaira et al., 2015), in fish (Datta, 2011; Ali and Kaviraj, 2018). The outcome of recent studies suggests that these aquatic weeds can be used as a potential source of fodder for livestock. Due to severe lack of fodder in the valley, it may be possible to use these plants as animal feed after assessing their nutritional capacity in order to partially alleviate the regions' feed and fodder crisis, and also lower the environmental pollution.

MATERIALS AND METHODS

Collection of aquatic weeds

The aquatic weeds with potential as animal fodder present in Dal Lake were collected from three selected sites (Hazratbal basin, Nishat Basin and Gagribal basin) in month of July-August. A total of 14 species of these macrophytes were chosen for the present study based on their abundance (biomass) and easiness in collection. The emergent vegetation was harvested by clipping the above ground standing crop and for submerged weeds a wooden pole of about 1m was immersed in water at the places where water depth exceeded 1 meter, whereas in shallow areas the plants were taken out by hand. After sampling, the aquatic weeds were washed several times to remove adherent periphyton, detritus and marl.

Processing and analysis of aquatic weed samples

These aquatic weeds after collection were sun-dried to drain the excess water and further dried in hot air oven at 80°C till constant weight was achieved. After drying, the samples were pulverized for further analysis. Proximate composition and fibre fractions were determined as per the protocols prescribed by AOAC (2005) and Van Soest et al. (1991), respectively.

Calculation of various nutritional attributes

The calculation of total carbohydrates and non-fibrous carbohydrates was done by using formulae given by Sniffen et al. (1992), as under:

$$\text{Total carbohydrates} = 100 - (\text{CP} + \text{EE} + \text{Ash})$$

$$\text{Non fibrous carbohydrates} = 100 - (\text{NDF} + \text{CP} + \text{EE} + \text{Ash})$$

DCP (%) and TDN (%) was estimated using the following equations (Martin, 1985 and Chandler, 1990), whereas, Metabolizable energy (ME) was estimated using the equation described by Belyea et al. (1993), where ME/DM is the metabolizable energy in mega joules (MJ) per kg of DM (MJ/kgDM). The formulae used to calculate DCP (%), TDN (%) and ME, are mentioned as under:

$$\text{DCP (\%)} = (\% \text{ CP} \times 0.9115) - 3.67$$

$$\text{TDN (\%)} = (105 - 0.68 \times \% \text{ NDF})$$

$$\text{ME} = 0.17 \times (\% \text{ DMD} - 2.0)$$

The percent predictable voluntary dry matter intake (%DMI), percent digestible dry matter (%DDM) and Relative feeding value (RFV) of these aquatic plants have been calculated as per the equations given by Holland et al. (1990), as:

$$\% \text{ DMI} = \frac{120}{\% \text{ NDF}}$$

$$\% \text{ DDM} = 88.9 - (\% \text{ ADF} \times 0.779)$$

$$\text{RFV} = (\% \text{ DDM} \times \% \text{ DMI}) \times 1.29$$

In-vitro nutrient digestibility

The modified *in-vitro* procedure of Tilley and Terry (1963) was used to assess *in-vitro* dry matter degradability (IVDMD), *in-vitro* organic matter degradability (IVOMD) and *in-vitro* nutrient detergent fibre degradability (IVNDFD) at 48hr post-incubation using three adult male Corriedale sheep of same age (around 18 months) and uniform conformation as donor of rumen inoculums.

Statistical analysis

The data generated in the experiment were analyzed by applying one way ANOVA, using SPSS Software, Base 23.0, Marketing Department, SPSS Inc. Chicago, USA. The effects were considered to be significant at $p \leq 0.05$.

RESULTS AND DISCUSSION

Proximate composition and fibre fractions of aquatic weeds

The data of proximate composition of the aquatic weeds collected from different sites of Dal lake is presented in the Table 1. The dry matter content of the major aquatic weeds was in a range of 8.53% (*Nymphoides peltata*) to 10.74% (*Potamogeton lucens*), which is comparable with dry matter of green terrestrial fodders (Table 1). Shah et al. (2010) evaluated the nutritional potential of local aquatic plants, *Nymphaea alba*, *Nymphoides peltata* and *Hydrilla species* and revealed that all the three plants had dry matter below 10%. Little and Henson (1967) stated that a typical water content of a floating aquatic plants is about 92%. Similarly, Ganie et al. (2019) reported that moisture content of aquatic weeds in the range of 83-96%. Regarding crude protein, except *Nymphaea tetragona* and *Trapa natans*, the crude protein content of all these aquatic weeds was significantly ($P<0.05$) higher than Oats (standard maintenance fodder). The crude protein of these aquatic plants was found in a range of 4.11 to 20.91%, with lowest in *Trapa natans* and highest in *Cladophora glomerata*. Owing to high protein content in *Nymphoides peltata*, *Nelumbo nucifera*, *Myriophyllum spicatum* and *Cladophora glomerata* emphasizes its value as a vital source of livestock fodder for communities living adjacent to Dal Lake. The present study confirms the previous finding of Shah et al. (2010) who reported crude protein content of *Hydrilla*, *Nymphaea* and *Nymphoides* was 17.10%, 20.28% and 21.87% respectively. Similarly, Kalita et al. (2007) reported that crude protein content of *Salvinia cuculata*, *Trapa natans*, *Lemna minor* and *Ipomoea reptans*,

ranged between 11.0% and 32.2%. Tomar and Sharma (2002), Ganie et al. (2019) and Kumar et al. (2022) reported higher crude protein in aquatic plants than terrestrial fodders. All these aquatic weeds have CF percentage significantly ($P<0.05$) lower than oats fodder except *Typha angustata* (53.10%), *Nymphaea tetragona* (52.28%) and *Nymphoides peltata* (36.73%). The lower content of crude fibre of these aquatic plants than those of terrestrial plants is in order to maintain buoyancy. Saraf (1983) also reported that amongst the species analysed from Dal and Nigeen lake *Typha angustata* had highest CF content. Rather and Nazir (2015) reported that among *Typha angustata*, *Phragmites australis*, *Nelumbo nucifera*, *Potamogeton natans*, *Potomageiton lucens*, *Ceratophyllum demersum* the crude fibre values were observed highest in *Potamogeton crispus* (23.15%) while the lowest values were seen in *Nelumbo nucifera* (1.69%).

All these aquatic weeds have ether extract similar to oats fodder except *Trapa natans*, *Nelumbo nucifera*, *Cladophora glomerata* and *Lemna minor* where significantly ($P<0.05$) lower ether extract (EE) percent was reported than oats fodder. Similar to these findings, Dar et al. (2013) reported that lipid content in fresh water aquatic weeds obtained from Wular lake ranged between 1.0 to 7.6%. These finds also find support from previous findings of Shah et al. (2010), Rather and Nazir (2015) and Ganie et al. (2019). Kumar et al. (2022) reported significantly higher lipid in aquatic plants compared to terrestrial fodders. Except *Trapa natans* ash content of these aquatic weeds was found to be significantly ($P<0.05$) higher than oats fodder similar to previous findings of Shah et al. (2010) and Ganie et al. (2019).

Table 1. Proximate composition of major aquatic weeds from Dal lake

Aquatic weeds	Proximate composition (%)				
	DM	CP	CF	EE	Total ash
<i>Alternanthera philoxeroides</i>	9.76	13.6 ^{ef}	15.0 ^b	3.20 ^{fg}	13.04 ^c
<i>Nymphaea tetragona</i>	8.63	7.07 ^b	52.3 ^g	3.90 ^g	12.9 ^c
<i>Typha angustata</i>	10.7	10.1 ^{cd}	53.1 ^g	1.93 ^{bcg}	11.8 ^c
<i>Nymphoides peltata</i>	8.53	17.9 ^{gh}	36.7 ^f	3.20 ^{fg}	13.1 ^c
<i>Nelumbo nucifera</i>	9.80	18.9 ^h	8.53 ^a	1.37 ^{ab}	11.7 ^c
<i>Myriophyllum spicatum</i>	9.21	17.2 ^g	18.4 ^c	1.83 ^{bc}	11.6 ^c
<i>Cladophora glomerata</i>	8.92	20.9 ⁱ	18.9 ^c	1.36 ^{ab}	15.4 ^d
<i>Salvinia natans</i>	10.23	18.07 ^{gh}	20.9 ^{cd}	2.30 ^{bcde}	12.03 ^c
<i>Trapa natans</i>	9.72	4.11 ^a	12.7 ^b	0.70 ^a	4.06 ^a
<i>Potamogeton lucens</i>	10.7	17.1 ^g	23.2 ^{de}	2.10 ^{bcde}	11.7 ^c
<i>Nymphoides aquatica</i>	9.34	22.1 ⁱ	23.02 ^{de}	2.10 ^{bcde}	19.9 ^e
<i>Ceratophyllum demersum</i>	10.3	14.2 ^f	24.8 ^e	2.80 ^{def}	12.5 ^c
<i>Potamogeton crispus</i>	9.69	12.7 ^e	21.6 ^{cde}	3.04 ^{efg}	21.70 ^e
<i>Lemna minor</i>	8.64	11.3 ^d	14.05 ^b	1.60 ^{ab}	15.18 ^d
<i>Avena sativa</i>	10.2	9.13 ^c	34.5 ^f	2.68 ^{cdef}	6.75 ^b
SEM	1.19	0.76	1.97	0.14	0.64
<i>p</i> -value	0.13	<0.05	<0.05	<0.05	<0.05

Values having different superscripts between the rows show significant difference ($P \leq 0.05$).

DM- Dry matter, CP- Crude protein, CF- Crude fiber, EE- Ether extract.

The result of fibre fractions of major aquatic weeds of Dal Lake is presented in Table 2. Among fibre fractions all aquatic plants were having significantly ($P < 0.05$) lower percent NDF, ADF and Cellulose than Oats fodder. Highest percent NDF (49.52%) and ADF (35.23%) was reported in *Nymphaea tetragona* and highest cellulose was found in *Nymphoides peltata* (29.46%). The hemicellulose percentage was found significantly higher in *Nymphaea tetragona* and *Ceratophyllum demersum* and significantly ($P < 0.05$) lower in *Nelumbo nucifera* and *Salvinia natans* than Oats fodder. All aquatic plants were having lignin ranging between 3.50% to 24.74% significantly ($P < 0.05$) higher than lignin content of Oats fodder (4.58%) except *Nelumbo nucifera*. Except *Trapa natans* the percent total carbohydrates (TC) of these aquatic

plants was found significantly ($P < 0.05$) lower than *Avena sativa* owing to their higher crude protein and ash content. Non-fibrous highly digestible carbohydrates (NFC) were found higher almost in all these aquatic plants. Similar values in terms of NDF and ADF was reported by Huque et al. (1996) in Spirodela, Lemna and Wolffia, the most available species of duckweeds. Pandit and Qadri (1986) reported the percent mean cellulose levels, and indication of crude fibre content, of aquatic weeds of Dal lake have been reported to be as high as 32% for Hydrilla sp. and 28.9-40.3% for *Potamogeton* sp. Similarly, Kadi et al. (2018) reported sun dried *Phragmites australe* leaves have 35.60g neutral detergent fibre (NDF) and 19.70g crude protein (CP/kg).

Table 2. Fibre fraction of major aquatic weeds from Dal lake

Aquatic weeds	Fibre fraction (%)						
	NDF	ADF	Cellulose	HC	Lignin	TC	NFC
<i>Alternanthera philoxeroides</i>	22.5 ^{cd}	16.3 ^{de}	13.8 ^{bc}	6.19 ^{bcd}	11.9 ^{fgh}	74.4 ^{ab}	51.8 ^{de}
<i>Nymphaea tetragona</i>	49.5 ^h	35.2 ⁱ	14.5 ^e	14.3 ^h	12.8 ^{gh}	79.5 ^{bc}	30.01 ^{ab}
<i>Typha angustata</i>	46.1 ^g	32.9 ^h	14.8 ^e	13.2 ^h	12.32 ^{gh}	79.9 ^{bc}	33.7 ^{abc}
<i>Nymphoides peltata</i>	44.3 ^g	32.5 ^h	29.4 ^f	11.8 ^g	24.2 ⁱ	69.9 ^{ab}	25.6 ^a
<i>Nelumbo nucifera</i>	12.4 ^a	7.75 ^a	5.5 ^a	4.64 ^a	3.50 ^a	72.6 ^{ab}	60.21 ^e
<i>Myriophyllum spicatum</i>	21.3 ^c	15.4 ^{cd}	12.4 ^b	5.93 ^{abc}	9.39 ^{cde}	73.0 ^{ab}	51.6 ^{de}
<i>Cladophora glomerata</i>	23.3 ^d	17.3 ^e	15.2 ^c	6.01 ^{abc}	10.4 ^{def}	68.01 ^{ab}	44.7 ^{bcd}
<i>Salvinia natans</i>	25.6 ^e	20.3 ^f	18.3 ^d	5.26 ^{ab}	12.4 ^{gh}	71.53 ^{ab}	45.92 ^{cde}
<i>Trapa natans</i>	16.5 ^b	10.2 ^b	7.21 ^a	6.30 ^{bcd}	5.43 ^b	92.4 ^c	75.8 ^f
<i>Potamogeton lucens</i>	29.1 ^f	23.1 ^g	20.3 ^e	6.01 ^{abc}	13.4 ^h	72.7 ^{ab}	43.5 ^{bcd}
<i>Nymphoides aquatica</i>	29.33 ^f	21.2 ^f	17.8 ^d	8.14 ^{ef}	11.2 ^{cd}	62.5 ^a	33.15 ^{abc}
<i>Ceratophyllum demersum</i>	28.3 ^f	20.4 ^f	17.2 ^d	8.98 ^f	8.56 ^{cd}	74.5 ^{ab}	46.1 ^{cde}
<i>Potamogeton crispus</i>	25.2 ^e	17.6 ^e	14.3 ^c	7.63 ^{def}	8.40 ^c	69.9 ^{ab}	44.7 ^{bcd}
<i>Lemna minor</i>	21.3 ^c	14.3 ^c	12.3 ^b	7.03 ^{cde}	7.77 ^c	76.9 ^{ab}	55.6 ^{de}
<i>Avena sativa</i>	60.7 ⁱ	40.3 ^j	35.1 ^g	7.40 ^{cde}	4.44 ^{ab}	81.2 ^{bc}	20.5 ^a
SEM	1.97	1.38	1.11	0.43	0.73	1.36	2.31
<i>p</i> -value	<0.05	<0.05	<0.05	<0.05	<0.05	0.013	<0.05

Values having different superscripts between the rows show significant difference ($P \leq 0.05$).

NDF- Neutral detergent fiber, ADF- Acid detergent fiber, HC- Hemicellulose, TC- Total carbohydrates, NFC- Non-fibrous carbohydrates

Predictable feed intake of aquatic weeds

Among the major aquatic plants collected from Dal lake, the percent DCP were highest for *Nymphoides aquatica* (16.50%) and lowest in *Trapa natans* (0.07%) (Table 3). Except *Nymphaea tetragona* and *Trapa natans* all these aquatic plants significantly ($P < 0.05$) higher DCP percent than Oats fodder. The highest DCP in *Nymphoides aquatica* is due to higher CP value as reported in findings of Kalita et al. (2007). The percent TDN and ME were all these aquatic plants were found significantly ($P < 0.05$) higher than oats fodder (Table 3), possibly because of higher crude protein, non-fibrous carbohydrates & digestibility as reported by Mir and

Ahmed (2017) that grasses with higher proximate constituents and digestibility had better DCP and ME percent.

The percent dry matter intake (%DMI), percent digestible dry matter (%DDM) and relative feed value (RFV) was also found significantly ($P < 0.05$) higher in these aquatic weeds than oats fodder (Table 3), possible due to lower neutral detergent fibre as NDF has been shown to be negatively correlated with DMI. Holland et al. (1990) reported that the % DDM of aquatic weeds is almost similar to terrestrial fodders like alfa alfa, Brome-grass, Bermuda grass, corn silage, corn stalks, Fescue, orchard grass, sorghum-sudan grass and wheat straw.

Table 3. Predictable nutrient intake and relative feeding value of major aquatic weeds from Dal Lake

Aquatic weeds	DCP (%)	TDN (%)	ME (MJ/kg DM)	DMI (%)	DDM (%)	RFV
<i>Alternanthera philoxeroides</i>	8.78 ^{ef}	89.7 ^{fg}	10.9 ^{fg}	5.34 ^{fg}	76.1 ^{fg}	525.06 ^{fg}
<i>Nymphaea tetragona</i>	2.77 ^b	71.3 ^b	8.45 ^b	2.42 ^{ab}	61.4 ^b	192.16 ^{ab}
<i>Typha angustata</i>	5.51 ^{cd}	73.6 ^c	8.75 ^c	2.60 ^b	63.2 ^c	212.27 ^{ab}
<i>Nymphoides peltata</i>	12.7 ^{gh}	74.8 ^c	8.81 ^c	2.71 ^b	63.5 ^c	221.88 ^b
<i>Nelumbo nucifera</i>	13.59 ^h	96.6 ⁱ	12.09 ⁱ	9.75 ⁱ	82.8 ⁱ	1043.05 ⁱ
<i>Myriophyllum spicatum</i>	12.0 ^g	90.5 ^g	11.07 ^{gh}	5.63 ^g	76.9 ^{gh}	558.72 ^g
<i>Cladophora glomerata</i>	15.4 ⁱ	89.1 ^f	10.8 ^f	5.15 ^{efg}	75.4 ^f	501.09 ^{fg}
<i>Salvinia natans</i>	12.8 ^{gh}	87.6 ^c	10.4 ^c	4.70 ^{cde}	73.05 ^c	442.98 ^{cde}
<i>Trapa natans</i>	0.07 ^a	93.7 ^h	11.7 ⁱ	7.30 ^h	80.94	762.15 ^h
<i>Potamogeton natans</i>	11.9 ^g	85.1 ^d	10.05 ^d	4.12 ^c	70.8 ^d	376.39 ^c
<i>Nymphoides aquatica</i>	16.5 ⁱ	85.0 ^d	10.3 ^c	4.10 ^c	72.4 ^c	382.57 ^c
<i>Ceratophyllum demersum</i>	9.33 ^f	85.7 ^d	10.41 ^c	4.24 ^{cd}	72.9 ^c	398.93 ^{cd}
<i>Potamogeton crispus</i>	7.91 ^e	87.8 ^c	10.7 ^f	4.76 ^{def}	75.2 ^f	462.06 ^{def}
<i>Lemna minor</i>	6.65 ^d	90.5 ^g	11.2 ^h	5.64 ^g	77.7 ^h	566.30 ^g
<i>Avena sativa</i>	4.62 ^c	63.7 ^a	7.77 ^a	1.95 ^a	57.5 ^a	146.72 ^a
SEM	0.70	1.34	0.18	0.29	1.08	34.35
<i>p</i> -value	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05

Values having different superscripts between the rows show significant difference ($P \leq 0.05$).

DCP- Digestible crude protein, TDN- Total digestible nutrients, ME- Metabolic energy, DMI- Dry matter intake, DDM- Digestible dry matter, RFV- Relative feed value

***In-vitro* digestibility of aquatic weeds**

Among the major aquatic plants collected from Dal lake, the percent *in vitro* digestibility of dry matter (Table 4), was found significantly ($P < 0.05$) lower in *Typha angustata*, *Nymphoides peltata*, *Myriophyllum spicatum*, *Cladophora glomerata*, *Salvinia natans*, *Potamogeton lucens*, *Nymphoides aquatica* and *Ceratophyllum*

demersum than oats fodder. However, *in-vitro* organic matter and *in-vitro* neutral detergent fiber digestibility all these aquatic plants were found significantly ($P < 0.05$) higher than oats as standard maintenance fodder. Similarly, *in-vitro* digestibility values were reported by Khan et al. (2002) for *Lemna trisulaca*, *Lemna perpusila*, *Azolla pinnata* and *Eichhornia crassipes*.

Table 4. Percent *in-vitro* digestibility of major aquatic weeds from Dal Lake

Aquatic weeds	IVDMD	IVOMD	IVNDFD
<i>Alternanthera philoxeroides</i>	55.3 ^{ef}	70.3 ^g	60.3 ^g
<i>Nymphaea tetragona</i>	54.2 ^{def}	69.3 ^{fg}	59.4 ^{fg}
<i>Typha angustata</i>	53.3 ^{cde}	68.3 ^{efg}	58.3 ^{ef}
<i>Nymphoides peltata</i>	46.5 ^a	61.5 ^b	51.5 ^b
<i>Nelumbo nucifera</i>	64.3 ^h	79.2 ^j	69.2 ⁱ
<i>Myriophyllum spicatum</i>	51.2 ^{bc}	66.4 ^{cde}	56.4 ^{cde}
<i>Cladophora glomerata</i>	50.3 ^b	65.2 ^c	55.3 ^c
<i>Salvinia natans</i>	52.2 ^{bcd}	67.4 ^{def}	57.2 ^{cde}
<i>Trapa natans</i>	63.4 ^h	78.4 ⁱ	68.2 ⁱ
<i>Potamogeton lucens</i>	50.3 ^b	65.4 ^{cd}	55.4 ^{cd}
<i>Nymphoides aquatica</i>	52.3 ^{bcd}	67.4 ^{def}	57.5 ^{def}
<i>Ceratophyllum demersum</i>	50.7 ^b	65.5 ^{cd}	55.9 ^{cd}
<i>Potamogeton crispus</i>	58.3 ^g	73.4 ^h	63.5 ^h
<i>Lemna minor</i>	60.2 ^g	75.4 ⁱ	65.4 ^h
<i>Avena sativa</i>	55.7 ^f	56.2 ^a	45.3 ^a
SEM	0.75	0.90	0.91
<i>p</i> -value	<0.05	<0.05	<0.05

Values having different superscripts between the rows show significant difference ($P \leq 0.05$).

IVDMD- *In-vitro* dry matter digestibility, IVOMD- *In-vitro* organic matter digestibility, IVNDFD- *In-vitro* neutral detergent fiber digestibility.

CONCLUSIONS

Owing to the proximate composition (high crude protein and low crude fibre), and fibre fraction with better digestibility, these aquatic plants have a huge potential as animal feed. Further research on live animals by conducting feeding trial is recommended to ascertain the physiological, productive and reproductive performance of the animals under study and develop a general feeding regime for inclusion of aquatic weeds in the ration of animals.

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