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Preliminary nutritional profile of ethnically edible wild leafy vegetable *Lactuca serriola*

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Abstract: *Lactuca serriola* is an ethnically edible wild leafy vegetable consumed by the rural population and tribals in southern India. Fresh or cooked leaves serve as a popular diet especially for lactating women owing to their nutraceutical properties. This study evaluates the proximal features and mineral composition of fresh and cooked leaves of *L. serriola*. results indicate that the proteins were about 25.2-25.7% of fresh weight. Carbohydrates were 20-20.8% and crude fiber 9.6%. Carbohydrates was higher in fresh samples compared to cooked samples ($p<0.01$). Among seven minerals assessed, all of them were higher in fresh samples than cooked samples ($p<0.05$) as expected. The iron content was highest in both samples (11-18 mg/g) followed by manganese (2.4-3.6 mg/g). Among the minerals, only manganese and iron fulfilled the NRC-NAS requirements for children and adults, while the magnesium in fresh samples satisfied the requirement of only infants. Fresh as well as cooked leaves provide nutritional benefits especially protein, fiber, carbohydrates, manganese, iron and magnesium requirements.

Key Words: *herb, minerals, proximal value, traditional knowledge, tribal nutrition, weed*

INTRODUCTION

A plethora of lesser-known wild plant species serves human as well as livestock nutrition and health worldwide [Ogle et al., 2003; Redzic, 2006; Bharucha, Pretty, 2010; Popoola et al., 2019; Singh et al., 2019]. In regional and rural vicinity, such nutritionally and medicinally valued wild plant resources cannot be underestimated owing to their food security recognized by the ethnic knowledge [Bharucha, Pretty, 2010]. One of the prominent weedy plants traditionally used as food and medicine in different regions of the world is *Lactuca* L. The genus *Lactuca* consists up to 100 species widely distributed (Asia, 40 spp.; Tropical East Africa, 33 spp.; Europe, 17 spp.; North America, 10 spp.) [Ali et al., 2016].

Lactuca serriola is popularly known as prickly lettuce, considered as one of the dominant weeds in agricultural lands, but it possesses traditionally valued culinary as well as medicinal potential. Recently, its distribution, biology, ecology, traditional uses, and management have been reviewed by several researchers [Abdul-Jalil, 2020; Ali et al., 2020; Chadha, Florentine, 2021]. The bioactive potential of *L. serriola* have also been reported such as phytochemical and pharmacological properties (against respiratory, vascular, gastrointestinal, cancer, and spasmolytic ailments) [Janbaz et al., 2013; Abdul-Jalil, 2020; Shukurlu, Goger, 2021] and inhibitory activities against microbial human pathogens [Al-Marzoqi et al., 2015; Balogun et al., 2017].

The annual or biennial C3 weedy plant *L. serriola* (Asteraceae) is common in the agricultural fields of Sorghum and pigeon pea in southern India. Leaves are alternate, oblong, lobed deeply, tips of lobes pointed backward, toothed margins, pointed base, spiny midrib, head yellow terminal clusters, produce milky sap.

The *L. serriola* grows in agricultural fields in southern India and its leaves are consumed as a salad (like to lettuce) or cooked (as a side dish with spices) as a potential nutraceutical source of the local and tribal populations. This leafy vegetable will be specifically offered to lactating women with the notion that it improves nutrition, health, and lactation. The Lambani tribe in the Gulbarga region of Karnataka State (India) uses this weed extensively in their nutrition and medicine, which has been sold in the local markets in vernacular names Hattarki Soppu and Hattarki Palya (Kannada). This study deals with a preliminary account of the proximal and mineral composition of *L. serriola* collected from the agricultural fields of southwest India.

MATERIAL AND METHODS

Vegetable and processing. Plants were uprooted and collected from three agricultural fields of Gulbarga

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District (17.4°19′ N, 76°52′ E; 470 m asl) during the rainy season (August 2020) as replicate samples. They were surface washed in the laboratory to exclude the debris and separate the leaves from the stem and roots. Each replicate sample was separated into two parts. The first part was subjected to oven-drying (50-55°C) to reduce the moisture <8% and designated as a fresh sample. Part two was cooked using a pressure cooker in distilled water (3:1), oven-dried (50-55°C), and designated as a cooked sample. Dried fresh and cooked samples were powdered and refrigerated (4°C) for analysis.

Proximal analysis. The content of moisture, total lipids, crude fiber, and ash in leaf flours were assessed gravimetrically [AOAC, 1999].

Replicate leaf flour samples were dried (80 °C, 24 hr) and variations between initial and final weight was used to estimate moisture content on a dry mass basis.

$$\text{Moisture (\%)} = \left(\frac{\text{I} - \text{F}}{\text{W}}\right) 100$$

(where I, the weight of leaf sample prior to drying in g; F, the weight of leaf sample after drying in g; W, the weight of leaf flour taken in g).

For total lipid determination, leaf flour (-1 g) was extracted with petroleum ether for up to 6 hr using a Soxhlet apparatus. The solvent was evaporated to dryness, and the initial and final weight of the samples was recorded to estimate the total lipid content.

$$\text{Total lipids (\%)} = \left(\frac{\text{F}-\text{I}}{\text{W}}\right) 100$$

(where F, the weight of flask with lipid in g; I, the weight of empty flask in g; W, the weight of leaf flour taken in g).

To find out the crude fiber content of leaf samples, defatted leaf flour (500 mg) was treated with sulfuric acid (0.025 N, 200 ml) and boiled (30 min). On cooling the contents were filtered, and the residue was washed repeatedly in boiling distilled water to eliminate the traces of acid. The residue was boiled up to 30 min in sodium hydroxide (0.313 N). The contents were filtered and washed repeatedly in boiling water to eliminate the traces of alkali. The residue was transferred to the pre-weighed crucible, heated in a muffle furnace (550°C, 3 hr) and the final weight was recorded after cooling to room temperature.

(where F, the weight of crucible with fibre in g; I, the weight of empty crucible in g; W, the weight of leaf flour taken in g).

$$\text{Crude fibre (\%)} = \left(\frac{\text{F} - \text{I}}{\text{W}}\right) 100$$

To determine the ash content, homogenized leaf flour (~1 g) was taken in a pre-weighed porcelain crucible and dried in the oven at 100°C up to 6-8 hr. The crucible was transferred to the furnace (550°C, 8 hr) until attaining constant weight to estimate the ash content.

(where F, the weight of crucible with ash in g; I, the weight of crucible in g; W, the weight of leaf flour taken in g).

$$\text{Ash (\%)} = \left(\frac{\text{F} - \text{I}}{\text{W}}\right) 100$$

The composition of crude protein of leaf flour was determined by the micro-Kjeldahl method (N × 6.25) [Humphries, 1956]. The leaf flour (100 mg) was extracted with a pinch of the catalytic mixture (copper sulfate, selenium, potassium sulfate: 1:1:20 w/w) and conc. sulfuric acid (10 ml). The mixture was digested using Kjeldahl flasks until it becomes colorless and the volume was made up to 100 ml with distilled water. The digested sample (10 ml) was transferred to the micro-Kjeldahl unit, sodium hydroxide (40%, 10 ml) was added and distilled until the accumulation of 25 ml in receiver flask containing boric acid (2%, 10 ml) and mixed indicator (0.2 % of methyl red and methylene blue in ethanol, 2:1 v/v). After cooling to room temperature, the solution was titrated against hydrochloric acid (0.01N) till the color changed from green to pink and nitrogen content was calculated to determine crude protein content.

$$\text{Nitrogen (\%)} = \left(\frac{\text{A} \times \text{N} \times 0.0014}{\text{W}}\right) 100$$

(where A, the volume of 0.01N HCl titrated minus the volume of blank; N, normality of HCl; 0.0014 g nitrogen in 0.1N HCl; W, the weight of leaf sample in g).

$$\text{Crude protein (\%)} = \text{Nitrogen (\%)} \times 6.25$$

The carbohydrates of leaf flours were evaluated by applying the procedure outlined by Dubois et al. [1956]. Leaf samples (100 mg) were treated with hydrochloric acid (2.5 N, 5 ml) and heated in a boiling water bath (3 hr). The reaction was neutralized by the addition of sodium carbonate until the effervescence ceases and the volume was made up to 100 ml with distilled water. Sample (0.2 ml) was further diluted with distilled water (0.8 ml), phenol (5%, 1 ml) followed by sulfuric acid (96%, 5 ml) was added and kept in a water bath (30°C, 20 min). Control was prepared based on the following method without the addition of a sample. The absorbance was measured (490 nm). The D-glucose served as the standard and the mean value was expressed carbohydrate content in percent of leaf flour.

The gross energy level of leaf flours was calculated using the formula proposed by Ekanayake et al. [1999].

$$\text{Gross energy (kJ/100 g)} = (\text{Crude protein} + 16.7) \times (\text{Total lipids} + 37.7) \times (\text{Carbohydrates} \times 16.7)$$

Mineral analysis. The content of minerals of leaf samples was determined by electron microscope-energy dispersive X-ray spectrometer (SEM-EDX) [Lui et al., 2015]. Homogenized leaf flour samples (particle size, ~40 μm) devoid of moisture dusted on the brass stub with the carbon tape. The mounted flour samples were coated with gold by sputter coat (20 mA, 10 min) followed by analysis by SEM (Carl Zeiss Sigma, USA) and EDX (FESEM Carl Zeiss, Oxford Instruments, USA) at a 3.5 mm working distance. The beam energy was 15 KeV and maps (98X pixel) were obtained in specific selected area. The images of SEM and their corresponding EDS spectrum of leaf flours (e.g. shape, shell, and size) facilitate the calculation of the mineral's content.

Data analysis. The difference in proximal and mineral composition between raw and cooked leaf samples was evaluated by t-test [Statsoft Inc., 2008].

RESULTS AND DISCUSSION

A high quantity of crude protein (25.2-25.7%) and a low amount of lipid (0.3-0.4%) were found in fresh as well as cooked leaf samples (Tab. 1). Carbohydrates (20-20.8%) and crude fiber (9.6%) were the second and third major components, respectively. Foodstuff with high protein and low lipid is beneficial to combat obesity in humans [Schröder, 2007]. The presence of high fiber content in the diet prevents specific types of cancers (e.g. bowel and colon cancers) [Slavin et al., 1997]. A high quantity of fiber in foodstuffs is also known to retard the production of sugars by the starch, which helps to control diabetes [Ogbonnaya, Chinedum, 2013]. Except for carbohydrates, the other components were not affected by cooking. This feature is an added advantage to use the leaves either fresh or in a cooked state depending on the type of dish preparation. The caloric value also did not vary significantly on cooking, hence it is possible to use cooked leaves in foodstuffs without loss of calories. Further studies on the composition of amino acids and fatty acids of leaves of *L. serriola* may prove its nutritional versatility

Table 1. Proximate composition of raw and cooked leaves of *Lactuca serriola* (n=3, mean±SD; t-test: *, p<0.01; **, p<0.001)

	Raw	Cooked
Moisture (%)	2.07±0.15**	1.90±0.10
Crude protein (%)	25.67±0.73	25.19±0.37
Total lipid (%)	0.37±0.06	0.34±0.04
Crude fiber (%)	9.56±0.28	9.57±0.29
Ash (%)	16.39±0.01	16.42±0.04
Carbohydrates (%)	20.81±0.11*	20.01±0.25
Gross energy (kJ/100 g)	788.93±16.25	773.89±3.23

Table 2. Mineral composition of raw and cooked leaves of *Lactuca serriola* (mg/100 g) (n=3, mean±SD; *, p<0.05; **, p<0.01; ***, p<0.001; a, NRC-NAS, 1989 recommended pattern).

	Raw	Cooked	Children[a]	Adults[a]
Sodium	2.93±0.03**	2.26±0.09	120-400	500
Potassium	0.49±0.02***	0.37±0.02	500-1600	1600-2000
Calcium	0.18±0.02**	0.14±0.01	600-800	800
Zinc	3.11±0.10*	1.68±0.50	5-10	12-15
Manganese	3.64±0.09***	2.42±0.03	0.3-3	2-5
Iron	17.76±0.18***	10.68±0.15	10	10-15
Magnesium	170.07±0.97***	122.0±1.74	60-170	280-350

Among the seven minerals assessed, all of them were higher in fresh samples compared to cooked samples ($p<0.05$) as drained by cooking (Tab. 2). The iron content was highest in both samples (11-18 mg/g) followed by manganese (2.4-3.6 mg/g). Only manganese and iron in fresh and cooked samples fulfilled the NRC-NAS [1989] stipulated pattern for the children and adults, while the magnesium in fresh samples fulfilled the prerequisite of only children. Although minerals were significantly decreased in cooking, manganese and iron have satisfied the requirements of children and adults, while magnesium requirements for children. Another nutritional advantage of the leaves of *L. serriola* is its low sodium content, hence the foodstuffs prepared from these leaves are suitable for those suffering from hypertension [Yusuf et al., 2007].

CONCLUSION

The wild plant resources constitute a significant portion of the ethnic food and medicine in the rural population. Such awareness comes from the traditional knowledge or local ecological knowledge from generation to generation. Although *L. serriola* has been considered a weed in agricultural fields, it has several value-added properties like protein, fiber, carbohydrate, energy, and selected minerals. Nutritional point of view, the leaves of *L. serriola* could be used either fresh or cooked depending on the type of dish preparation. Besides, it has several active metabolites of health concern. Thus, instead of attempts to eliminate *L. serriola* by weedicides, it is worth accommodating as a nutraceutical source in the future.

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Yeməli yabanı yarpaqlı tərəvəz olan *Lactuca serriola*-nın ilkin qida profili

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Lactuca serriola, Hindistanın cənubundakı kənd əhalisi və qəbilələri tərəfindən istehlak edilən etnik cəhətdən yeməli yabanı yarpaqlı tərəvəzdir. Təzə və ya bişmiş yarpaqlar qida xüsusiyyətlərinə görə xüsusilə laktasiya dövründə olan qadınlar üçün məşhur pəhriz kimi istifadə edilir. Bu tədqiqatda *L. serriola*-nın təzə və bişmiş yarpaqlarının proksimal xüsusiyyətlərini və mineral tərkibini qiymətləndirilir. Nəticələr göstərir ki, zülallar təzə çəkinin təxminən 25.2-25.7%-ni təşkil edir. Karbohidratlar 20-20.8%, xam lif isə 9.6% olub. Karbohidratlar təzə nümunələrdə bişmiş nümunələrlə müqayisədə daha yüksək olmuşdur ($p<0.01$). Qiymətləndirilən yeddi mineral görə aparılıb və onların hamısı gözlənildiyi kimi təzə nümunələrdə bişmiş nümunələrdən daha yüksək olub ($p<0.05$). Hər iki nümunədə ən yüksək dəmirin (11-18 mq/q), sonra isə manqanın miqdarı (2.4-3.6 mq/q) olub. Minerallar arasında yalnız manqan və dəmir uşaqlar və böyüklər üçün NRC-NAS tələblərinə cavab verir, təzə nümunələrdəki maqnezium isə yalnız körpələrin tələbatını ödəyir. Təzə və bişmiş yarpaqlar qida faydaları, xüsusilə protein, lif, karbohidratlar, manqan, dəmir və maqnezium ehtiyaclarını ödəyir.

Açar sözlər: *ot, minerallar, proksimal dəyər, ənənəvi bilik, qəbilə qidası, alaq otu*

Предварительный питательный профиль съедобных диких листовых овощей *Lactuca serriola*

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Lactuca serriola - этнически съедобный дикий листовой овощ, потребляемый сельским населением и племенами на юге Индии. Благодаря их нутрицевтическим свойствам, свежие и/или приготовленные листья служат популярной диетой, особенно для кормящих женщин. В этом исследовании оцениваются проксимальные свойства и минеральный состав свежих и приготовленных листьев *L. serriola*. Результаты исследования показывают, что белки составляют около 25.2-25.7% сырого веса растения, содержение углеводов 20-20.8%, сырой клечатки - 9.6%. Углеводы были выше в свежих образцах по сравнению с приготовленными образцами ($p<0.01$). Количественное содержание оцененных семи минералов выше в свежих образцах, чем в приготовленных ($p<0.05$). Содержание железа было наиболее высоким в обоих образцах (11-18 мг/г), за ним следовал марганец (2.4-3.6 мг/г). Среди минералов только марганец и железо соответствовали требованиям NRC-NAS для детей и взрослых, в то время как магний в свежих образцах удовлетворял требованиям только младенцев. Свежие, а также приготовленные листья обеспечивают потребность в белках, клетчатке, углеводах, марганце, железе и магнии.

Ключевые слова: *трава, минералы, проксимальная ценность, традиционные знания, племенное питание, сорняк*