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NUTRITIONAL STATUS OF FOOD PRODUCTS DEVELOPED FROM *Salicornia brachiata*

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ABSTRACT

The present study systematically investigated the nutritional potential of two types of food products (samosa and kachuri) developed from Salicornia brachiata. Apart from estimating protein, carbohydrate, fat and fibre, minerals like calcium, sodium and potassium were also analysed in the food products prepared by mixing variable proportions of semi-dried Salicornia leaves. Significant variations in biochemical composition were observed between the food products ($p \leq 0.01$). This may be attributed to mixing of different proportions of potato (in case of samosa) and sattu (in case of kachuri) with Salicornia semi-dried leaves during the preparation of the food products. Development of alternative livelihood from mangrove associate halophytes is the take home message of this research programme.

KEY WORDS

Indian Sundarbans, Salicornia brachiata, Samosa, kachuri.

INTRODUCTION

Human population needs a wide range of nutrients to perform various like processes and lead a normal healthy life. A balanced diet (for human beings) refers to optimum levels of protein, carbohydrate, fat, fibre and different minerals. *Salicornia* is a common halophyte growing in the mid-littoral and supra-littoral zones of the sea coast and river mouth. This fleshy plant is found at the edges of wetlands, marshes, sea shores and mudflats, actually on most alkaline flats (Smillie, 2015). It is commonly known as pickle-weed, glasswort, sea beans, sea asparagus and crow's foot greens belonging to Amranthaceae family (Singh *et al*., 2014). This plant has spongy stems with diminutive scale-like leaves, inconspicuous flowers and fruits. The green plant turns orange, pink to reddish in autumn, before dying in winter. The species is widely available in the intertidal mudflats of mangrove dominated Indian Sundarbans (Fig.1).

Fig. 1. Morphological features of *Salicornia brachiata*

Salicornia has been used since long back for edible purposes. The species is a unique source of salt. The aerial parts of the plants are consumed in salads or processed into pickles, beverages etc. For its saltiness and crunchiness, it is used as a green salad. Even in some cultures, it is considered a delicacy. Only the green, tender parts are recommended for edibility, the reddish being too high in salinity and silica. In some communities, the shoots are processed into beverages like nuruk (a type of fermentation starter), makgeolli (a Korean rice wine), or vinegar (Song *et al*., 2013; Kim *et al*., 2013). This paper explores the present status of the genus in the food arena (preferably in the domain of snacks) and evaluates its scope ahead.

On the basis of the nutrient level and edibility factor of the species, the present programme was undertaken during July, 2018 with the aim to develop food products (samosa and kachuri) that are widely consumed throughout Indian sub-continent and are available in almost all the sweet shops of the country (Fig.2).

Fig. 2. Samosa (triangular-shaped) and Kachuri (round – shaped) prepared from semi-dried leaves of *Salicornia brachiata*

MATERIALS AND METHODS

Analysis of proximate composition

The total protein contents of the semi-dried *Salicornia* leaves and the food products were determined with Folin reagent with bovine albumin serving as standard (Lowry *et al*, 1951). The total carbohydrate content was assayed by the phenolsulphuric acid method (Dubois *et al*, 1956) after extraction with 2.5N HCl. The results were calculated from a glucose standard curve. Total lipid was determined by Soxhlet method as described by Folch *et al* (1957).

Analysis of elemental composition

Calcium (Ca) in the acid digested samples was determined by the versenate titration method as described in A Manual of Laboratory Techniques (1983). The Sodium (Na) and Potassium (K) was measured by flame photometer (ELICO-CL-360) in 10 g air dried leaf samples after digesting the samples with nitric acid and perchloric acid.

Statistical analysis

Analysis of Variance (ANOVA) was performed through SPSS 16.0 to assess whether any significant differences exist between samosa and kachuri which were prepared with different proportions of *Salicornia* semi-dried leaves. Possibilities less than 1% ($p \leq 0.01$) were considered statistically significant.

RESULTS

Salicornia brachiata leaves exhibited highest value of total carbohydrate followed by protein, fibre and fat. Among the elements, sodium exhibited highest concentration followed by potassium and calcium (Fig.3a, 3b).

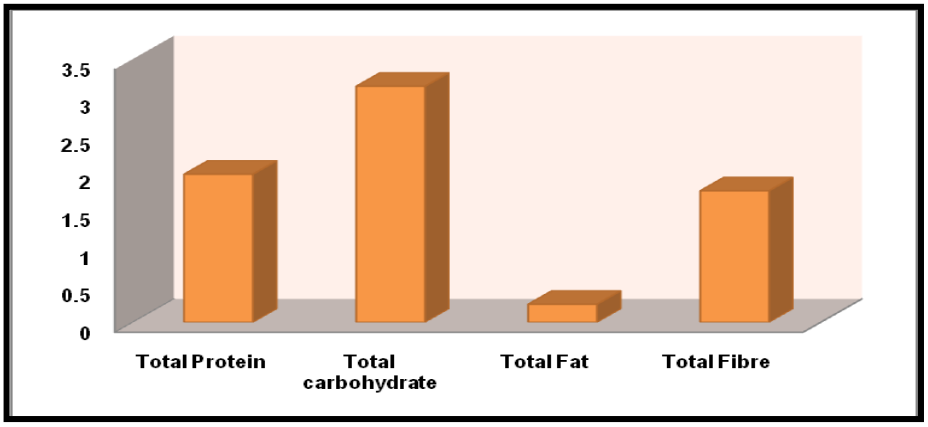

Fig. 3a. Proximate composition of air-dried *Salicornia* leaves (units are in g 100g^{-1})

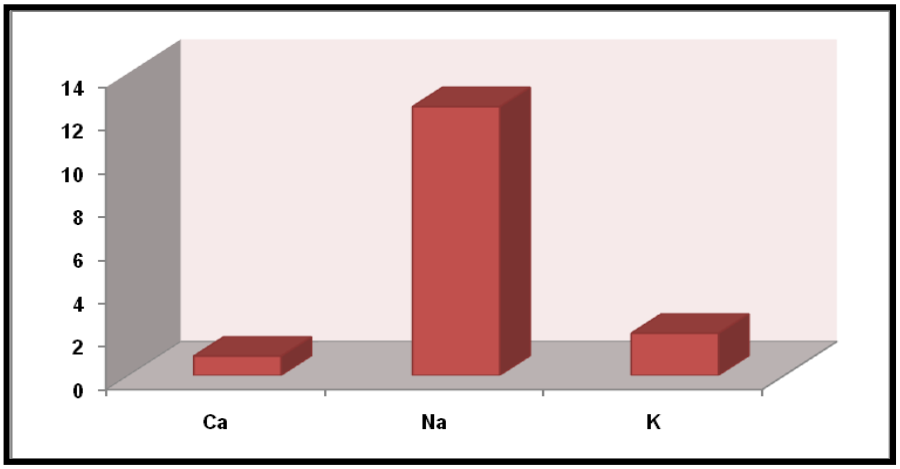

Fig. 3b. Elemental composition of air-dried *Salicornia* leaves (units are in mg g^{-1})

It is interesting to observe that the samosa prepared from *Salicornia* semi-dried leaves in the ratio 50:50 (1:1) exhibited higher protein, carbohydrate, fat, fibre, calcium and potassium compared to the samosa with proportion 70:30 (7:3). However, for Na the result was totally different. For this element, the samosa with 7:3 ratio exhibited higher value compared to the samosa with 1:1 ratio (Fig.4a, 4b). In case of kachuri, similar results were observed (Fig.5a, 5b).

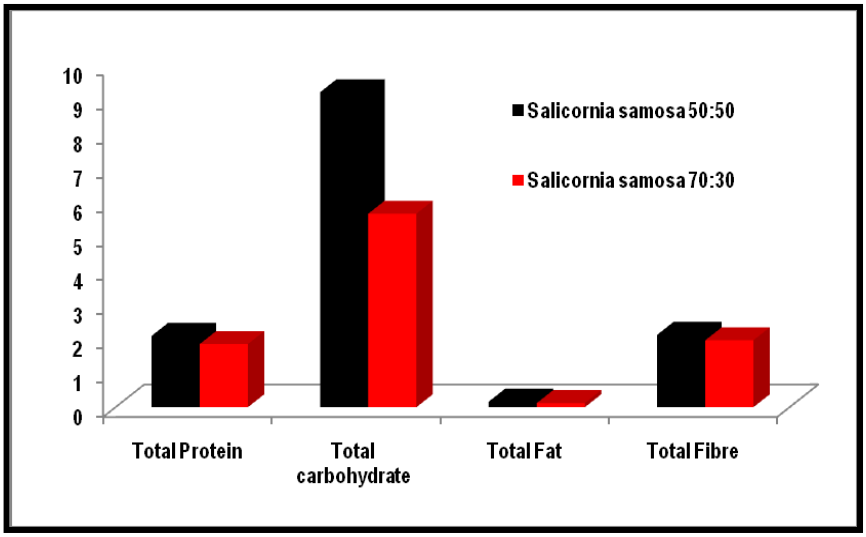

Fig. 4a. Proximate composition in *Salicornia* samosa (g 100g^{-1})

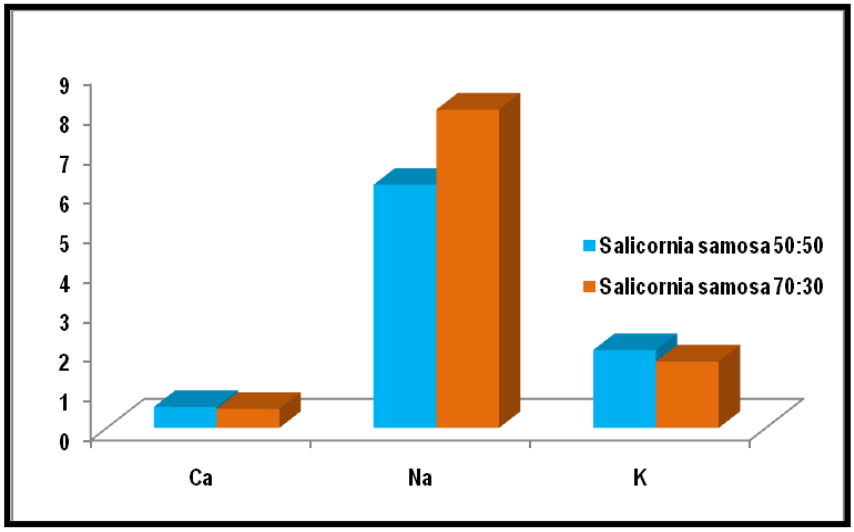

Fig. 4b. Elemental composition in *Salicornia* samosa (mg g^{-1})

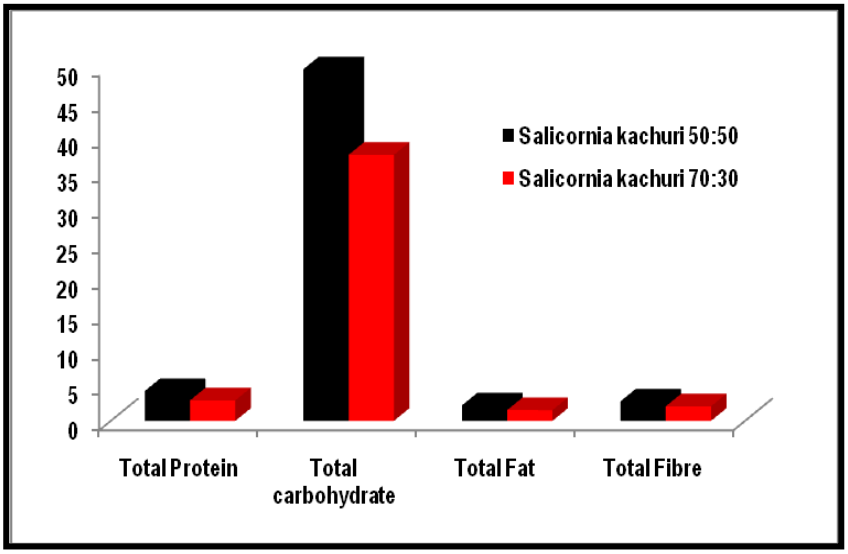

Fig. 5a. Proximate composition in *Salicornia* Kachuri (g 100g^{-1})

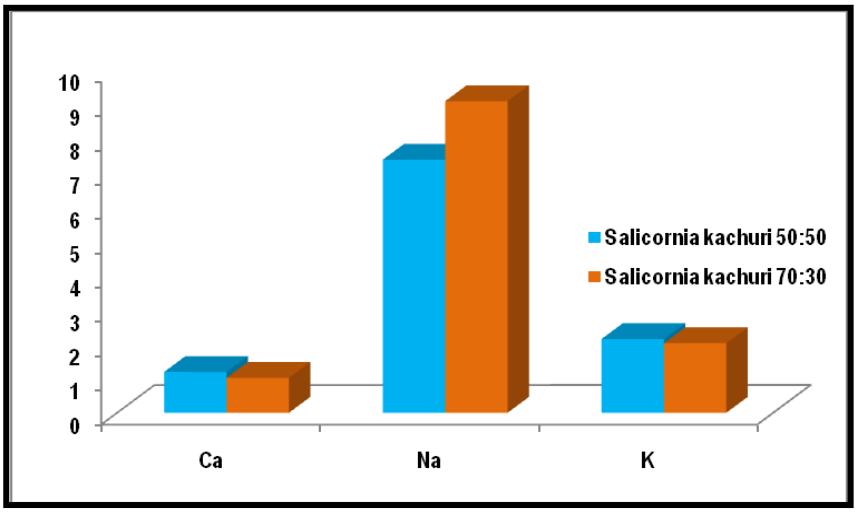

Fig. 5b. Elemental composition in *Salicornia* Kachuri (mg g^{-1})

DISCUSSION

The Indian Sundarbans at the apex of Bay of Bengal is highly vulnerable to climate change preferably sea level rise and subsequent intrusion of salt water in the islands (Mitra *et al*., 2009; Mitra *et al*., 2011; Mitra, 2013; Mitra and Zaman, 2014; Mitra and Zaman, 2015; Mitra and Zaman, 2016). The intrusion of saline water is maximum in the central Indian Sundarbans owing to blockage of fresh water due to Bidhyadhari siltation (Trivedi *et al*., 2016). This has posed an adverse impact on the traditional livelihoods (agriculture, fishery etc.) of Sundarban people. Therefore, thrust has been given to develop alternative livelihoods strategies to upgrade the local economy of the island dwellers of Sundarbans. In this context, preparation of cookies and snacks from seaweed (Pramanick *et al*., 2016) and fish feed from salt marsh grass, *Porteresia coarctata* are notable examples (Mitra, 2013).

Due to rise of salinity in different pockets of Indian Sundarbans, the community structure of vegetation has undergone a major shift. Dominance of *Suaeda*, *Salicornia* etc. are observed in majority of the areas in central Indian Sundarbans, which are salt water loving mangrove associate species and can tolerate extreme salinity.

The species are now considered as prospective natural resources from where the flowers of alternative livelihood can boom. On this background the present programme was undertaken in collaboration with commercial sweet shops after imparting proper training to the workers and stakeholders.

The relatively high values of protein, carbohydrate, fat, fibre, calcium and potassium in the samosa prepared from *Salicornia* semi-dried leaves in ratio 1:1 compared to those in the ratio 7:3 may be due to inclusion of potato in varied proportions within the samosa. In case of Na, the samosa prepared from the species showed an opposite results with higher values in samosa where the ratio *Salicornia* semi-dried leaves: potato = 7:3. This may be attributed to the fact that Na concentration is considerably high in *Salicornia* sp. The overall results point towards the development of alternative livelihood by using *Salicornia* sp. as food ingredient. The food products developed from *Salicornia* sp. are not only rich in nutrients, but also can upgrade the sweet and snack industries of Indian Sundarbans at cottage level. The present approach is expected to serve as a roadmap towards further research and popularization of this extremophile halophyte.

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