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Samosa and Kachuri from Mangrove Associate Species: An Innovative Utilization of Coastal Flora

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Abstract:* Indian Sundarbans, at the apex of Bay of Bengal sustains a wide variety of mangrove associate species. Salicornia brachiata and Suaeda maritima are two such species found in the supra-littoral zone of Sundarban estuarine mudflats. These two species are used in the present research to prepare common Indian snacks namely samosa and kachuri. The proximate and elemental analyses were carried out with the final products and compared with the control. We observed significant variations in protein, carbohydrate, fat, total fibre, Ca, Na and K between the control samples (in which the mangrove associate species have not been mixed) and final products (in which the mangrove associate species are mixed separately in the ratio 1:1). The increase of Ca, Na and K in the final products clearly depicts the upgradation of samosa and kachuri in terms of essential elements needed for the benefit of human body.
Keywords: Indian Sundarbans, mangrove associate species, samosa, kachuri

I. INTRODUCTION

Development of food products from untapped natural resources plays an important role in the upliftment of rural nutrition and rural economy. Nutrition is one of the most critical issues to address the health sector of coastal population and island dwellers. The coastal zone is enriched with a wide spectrum of natural resources of which mangroves are noted for their ecosystem services. Mangroves are widely distributed in the coastal zone particularly at the land-sea interface. Lot of literatures are available on development of food products from mangroves as well as seaweeds and their microbial assay (Pramanick et al., 2015a,b; Pramanick et al., 2016a,b; Pramanick et al., 2017a,b). However, no research works have been conducted on the development of food products from mangrove associate species although they are important sources of bioactive substances and have high nutritional value.

A large number of people have the misconception that mangrove ecosystems are unproductive swamps and act as abode of harmful insects, mosquitoes, snakes and need to be cleared for the sake of public health. However, in recent years the concept has radically changed. In addition to several ecosystem benefits of mangroves like erosion control, protection against storms and tidal surges, livelihood generation, carbon sequestration etc., mangroves are also used as part of food and consumed by humans in many places of the world. Tender leaves of Acacia sp. are used as substitute for tamarind in chutneys. Bruguiera gymnorhiza fruits are edible. Fruits of Sonneratia caseolaris are edible in raw form and are also cooked. Fruit juice of S.caseolaris is also consumed by people. Fruit jelly, has been prepared from S. apetala fruit. Ice creams, cookies, bread have been prepared from mangrove associate seaweeds Enteromorpha intestinalis (Mitra et al., 2016; Pramanick, 2017). Suaeda maritima is a salt marsh plant which is considered as a mangrove associate species. It is salty in taste in raw form and hence it is cooked with other types of vegetables to reduce the salty taste (Tanaka, 1976). In many pockets of the world preferably in South Asian countries this species is used in salad, curry with crabs and various other types of chilli based preparations. In South Indian states it is pickled in vinegar and used for cooking (Patro et al., 2011). This mangrove associate species contain antioxidants and is non-toxic in nature. Polyphenolic compounds may be the major bioactive components in the species which are responsible for antioxidation and antiproliferation. Natural antioxidants have been proved to retard the process of tumour growth because of different redox status between normal cells and cancer cells (Nair et al., 2007). In addition to Suaeda sp., another species selected for the present study is Salicornia brachiata, which is widely distributed in the supra-littoral zone of the marine and estuarine systems. Salicornia has been used for decades for edible purposes. The wide application of the species in salads is well known. The species is also the source of salt that is commonly used in cooking. Salicornia is mulled to be the right candidate for reclamation of barren lands, salt flats, and sea shores. In short, they can be deemed for seawater agriculture. It is suggested that as global warming threatens to submerge more landmass, and freshwater is depleting, a shift to saline crop might be a viable option (Katschnig et al., 2013). On this background, the present research programme aims to

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develop two very popular Indian food products namely samosa and kachuri from mangrove associate species Suaeda maritima and Salicornia brachiata collected from Indian Sundarbans.

The success of any experimental approach is monitored on the basis of a comparative study between control and experimental samples in terms of few parameters (variables) that are relevant indicators of human health. In the present programme, we have used the values of protein, carbohydrate, fat, fibres, Ca, Na and K as indicators of such comparative study. These indicators (compounds/elements) are intricately related to human health.

II. MATERIALS AND METHODS

A. *Sampling*

Plant samples were collected from the supra-littoral zone of Jharkhali during November 5 to 9, 2018. The samples were thoroughly washed with double distilled water and sterilized to make them germ free. The fresh plants (except the roots) were grinded/crushed and mixed with potato (in case of samosa) and sattu (in case of kachuri) in the ratio 1:1.

B. *Analysis Of Biochemical Constituents*

1) *Estimation of Protein:* The food samples (mixed with the selected mangrove associate species) as well as the control were separately homogenized in 10% cold Tri Chloro Acetic acid TCA (10 mg: 5 ml) and were centrifuged at 5000 rpm for 10 minutes. Supernatant was discarded and pellets were saved. Pellets were again suspended in 5 ml of 10% cold TCA and re-centrifuged for 10 minutes. Supernatant was again discarded and the precipitate was dissolved in 10 ml of 0.1 N NaOH. 0.1 ml of this solution was used for protein estimation. In 1 ml of the sample, total protein content was estimated using the protocol of Lowry *et al* (1951). A stock solution (1mg/ml) of bovine serum albumin was prepared in 1 N NaOH; five concentrations (0.2, 0.4, 0.6, 0.8 and 1ml) from the working standard solution were taken in series of test tubes. In another set of test tubes 0.1 ml and 0.2 ml of the sample extracts were taken and the volume was raised up to 1 ml in all the test tubes. To each test sample, 5 ml of freshly prepared alkaline solution was added at room temperature and left undisturbed for a period of 10 min. Subsequently, to each of these mixture tubes 0.5 ml of Folin-Ciocaltcau reagent was rapidly added and incubated at room temperature for 30 minutes until the blue colour develops. The absorbance was read at 750 nm and the amount of total protein present in the samples was calculated and expressed in percentage.
2) *Estimation of Fat:* The total fat in the samples (prepared food products) was estimated by Soxhlet method using petroleum ether (80°C) as per the standard procedure (AOAC, 2000).
3) *Estimation of Carbohydrate:* The carbohydrate concentration in the food samples was measured by Anthrone method (Yemm and Willis, 1954). 100 mg of each of the samples was weighed and taken into a boiling tube, hydrolysed by keeping it in a boiling water bath for three hours with 5 ml of 2.5 N HCl and the mixture was cooled at room temperature. By using sodium carbonate it was neutralized and the volume was made up to 100 ml. Then it was centrifuged and supernatant was collected. 0.5 ml of aliquots was used for estimation. The working standards were prepared by taking 0, 0.2, 0.4, 0.6, 0.8 and 1 ml of the working standard glucose solutions and '0' served as blank. 0.1 and 0.2 ml of the test sample solutions were taken in two separate test tubes. In all the test tubes, the volume was marked up to 1 ml with water and blank was set with 1 ml of water. 4 ml of anthrone reagent was added to each tube, mixed well and kept it in water bath for 10 minutes. Cooled the contents rapidly and the absorbance was read at 630 nm and the amount of total carbohydrate present in the sample was calculated.
4) *Estimation of Fibres:* Fat free samples were digested with 1.25 N HCl for 2 hours. Then the digested mixture was filtered through a filter paper after cooling and acid free residue was further digested with 1.25 N NaOH for 2 hours. The final residue after alkali digestion was oven dried up to constant weight and calculated for the crude fibre in each sample. % Fibre = (mass of residue after alkali digestion / mass of grinded dried sample) $\times$ 100
5) *Estimation of Calcium:* The samples (samosa and kachuri) were obtained in solid form; they were digested using a mixture of concentrated nitric acid, sulphuric acid and hydrogen peroxide. An accurately weighed 5.0 g of the edible portion of each of the food stuffs was put in a heat-resistant beaker where 8 ml of concentrated sulphuric acid and 10 ml of concentrated nitric acid was added. The beaker was then placed on a hot plate and warmed cautiously until the reaction subsided. It was then heated vigorously until the solution begins to darken owing to incipient charring. To avoid such charring, a 2 cc aliquot of concentrated nitric acid was constantly added at any time the solution began to darken. This treatment was continued until the solution stopped to darken on prolonged heating. At this point, the solution was allowed to cool and diluted with 10 ml of double-distilled water and boiled to fuming. This dilution and boiling to fuming process was repeated twice again but with 5cc of double distilled water. At this point, the persistent colour(s) of the solution was cleared by the addition of about 2-4 ml of

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hydrogen peroxide with drops of nitric acid again. The solution was heated to fuming state each time hydrogen peroxide was added until the residue was colourless or no further reduction of pale yellow colour was obtained. The solution was cooled with about 10 ml of distilled water and evaporated to fuming again. This continued until there was no more fuming; then the solution was made up to mark in 100 ml volumetric flask. A 25 ml aliquot of each digest was pipette into a beaker and 1M NaOH solution was added to adjust the pH to 12-13. Two drops of solochrome dark blue was then added and immediately titrated against a 0.01 M EDTA solution to the blue end-point. For every determination and evaluation, a standard curve of mass of calcium (mg) versus amount of EDTA (millimoles) was plotted, which finally produced the results for calcium in the unknown samples (here samosa and kachuri).

6) *Estimation of Sodium:* Sodium in the selected samples was analysed by flame photometer.
7) *Estimation of Potassium:* Flame photometric method was used to determine the potassium concentration in the food samples (samosa and kachuri).

III. RESULT

Fig. 1, 2, 3 and 4 reflect the results of proximate analysis and elemental composition of samosa and kachuri available in the market (considered as control).

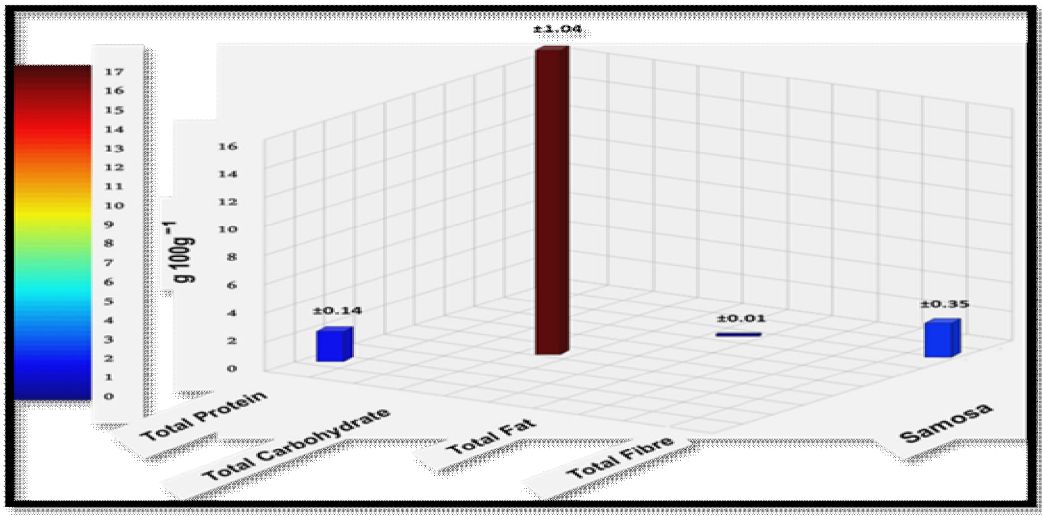

Fig 1. Proximate analysis of samosa without mixing mangrove associate species (control)

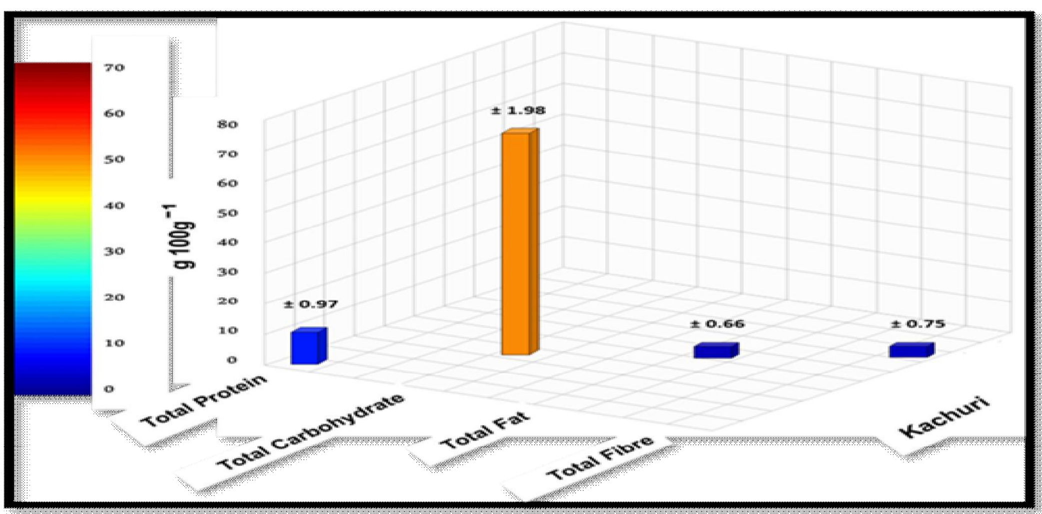

Fig 2. Elemental analysis of samosa without mixing mangrove associate species (control)

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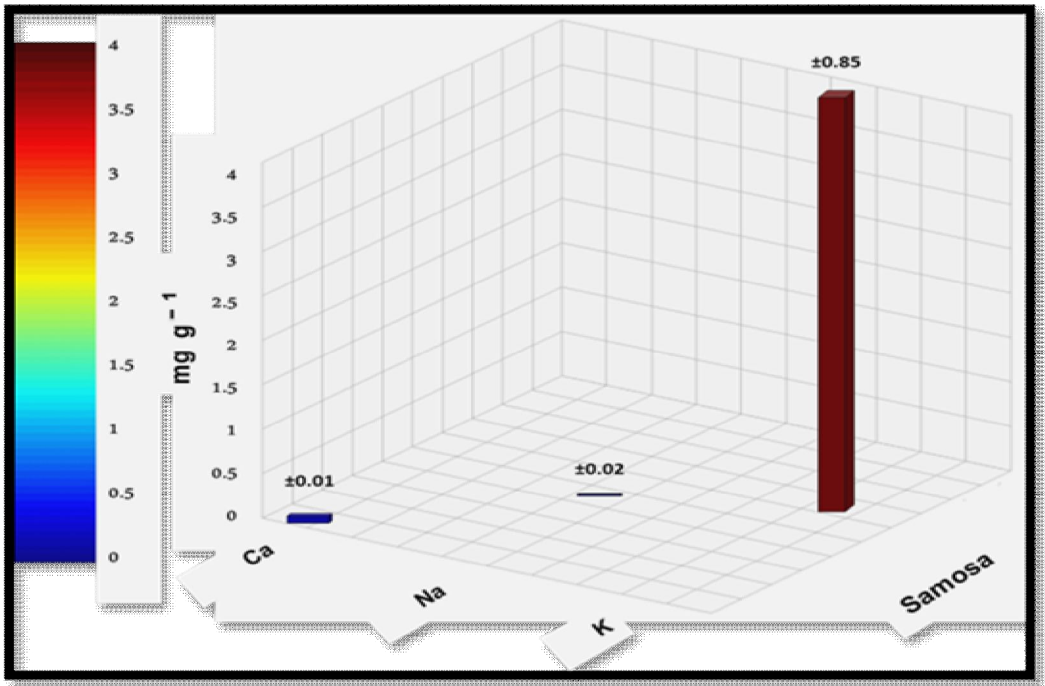

Fig 3. Proximate analysis of kachuri without mixing mangrove associate species (control)

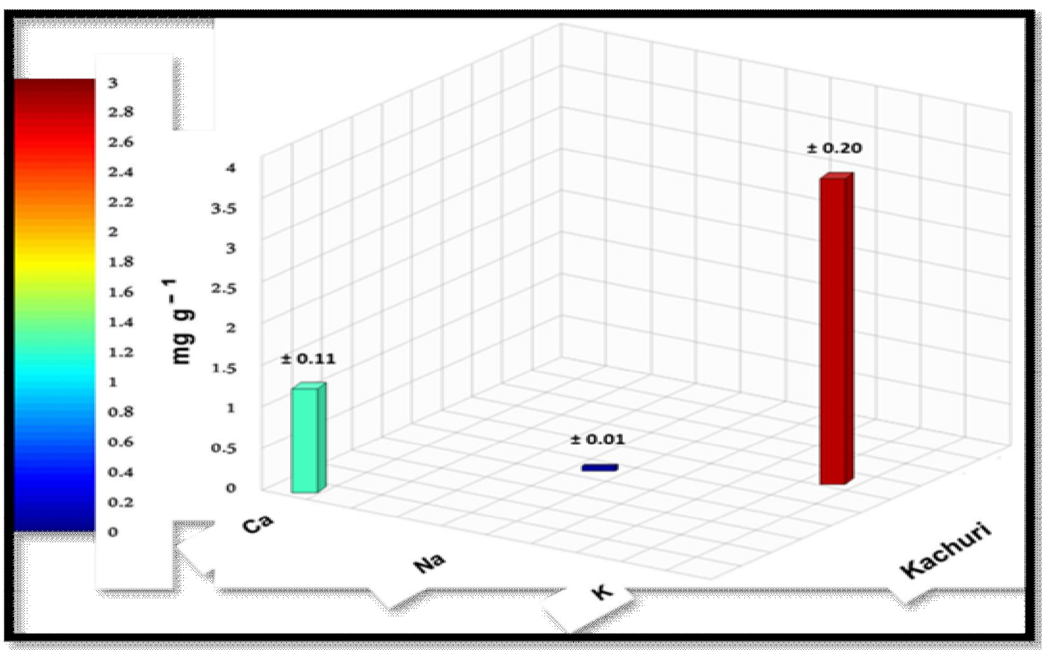

Fig 4. Elemental analysis of kachuri without mixing mangrove associate species (control)

On mixing crushed fresh *Salicornia* and *Suaeda* with kachuri and samosa in the ratio 1:1, an alteration in the values of protein, carbohydrate, fat, total fibre, Ca, Na and K was observed, which may be attributed to biochemical composition of the selected mangrove associate species.

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IV. DISCUSSION

Suaeda maritima is a salt marsh mangrove associate plant growing in mangrove forest, which can grow naturally. It is a low cost vegetable with high nutritional value. Food products prepared from this mangrove associate species can be a new source of income of the people in the community.

Salicornia is also a mangrove associate species, which is commonly known as pickleweed, glasswort, sea beans, sea asparagus, crow's foot greens, and samphire and is a halophyte, belonging to Amaranthaceae family (Singh et al., 2014). In fact, Salicornia name has originated from the Latin word meaning 'salt'. Studies report that some species, for example Salicornia europaea show tolerance towards salinity as high as 3% NaCl (Yamamoto et al., 2009). This fleshy plant is found at the edges of wetlands, marshes, sea shores, and mudflats, actually on most alkaline flats (Smillie, 2015). The aerial parts of this plant are consumed in salads or processed into pickles, beverages etc.

Both Salicornia and Suaeda are rich in Na, Ca and K, which are of vital importance for human health. Considering this, the present programme was undertaken in November, 2018 to prepare samosa and kachuri from these two halophytes collected from the Jharkhali region of Indian Sundarbans.

It is observed that Salicornia based samosa showed a decrease of protein, carbohydrate, fibre and K by 36.51%, 6.21%, 4.31%, 28.39% respectively. However, fat, Ca and Na increased abruptly by 40%, 400% and 150% respectively (Fig. 5).

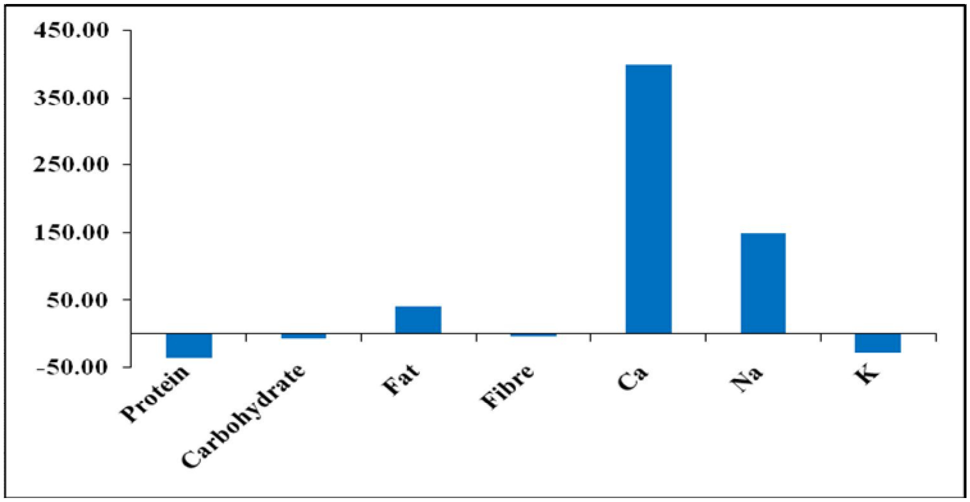

Fig 5. Percent alteration of biochemical composition in final product (samosa prepared from *Salicornia brachiata*) compare to control

In case of Salicornia based kachuri, the protein, carbohydrate, fat and fibre decreased by 59.80%, 2.25%, 8.20% and 2.66% respectively. Ca, Na and K increased by 3.91%, 116.67%, 1.72% respectively (Fig.6).

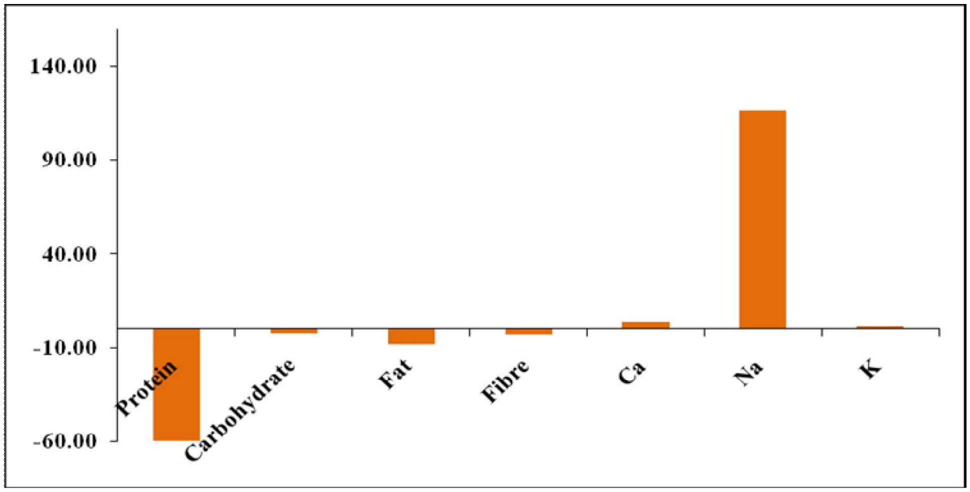

Fig 6. Percent alteration of biochemical composition in final product (kachuri prepared from *Salicornia brachiata*) compare to control

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Suaeda based samosa clearly showed an increase of protein, fat, fibre, Ca and Na by 4.23%, 140%, 37.80%, 525% and 200% respectively. However, carbohydrate and K decreased by 35.50% and 22.11% respectively (Fig. 7).

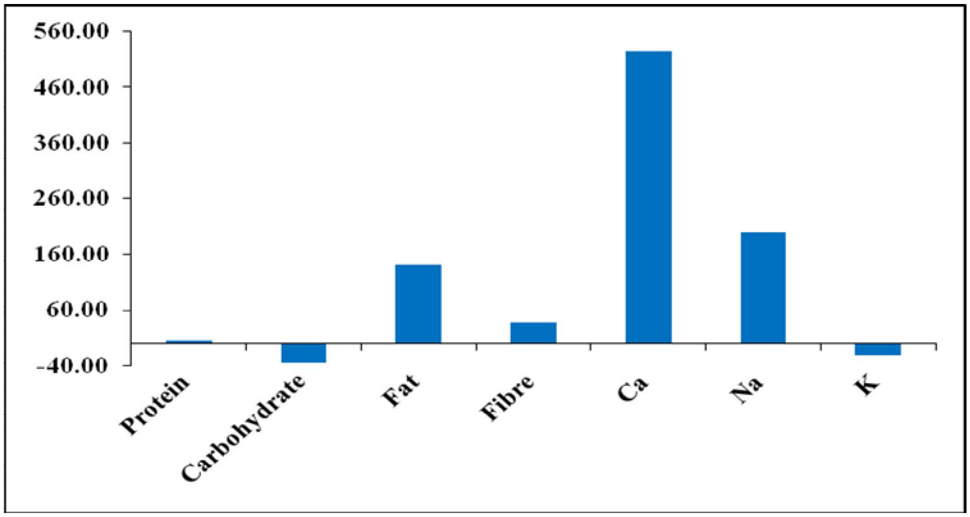

Fig 7. Percent alteration of biochemical composition in final product (samosa prepared from *Suaeda maritima*) compare to control

In case of Salicornia based kachuri the carbohydrate, fibre, Ca, Na, K increased by 2.19%, 2.66%, 10.16%, 183.33% and 5.84% respectively. 53.81% and 5.99% was the decrease in protein and fat respectively (Fig. 8).

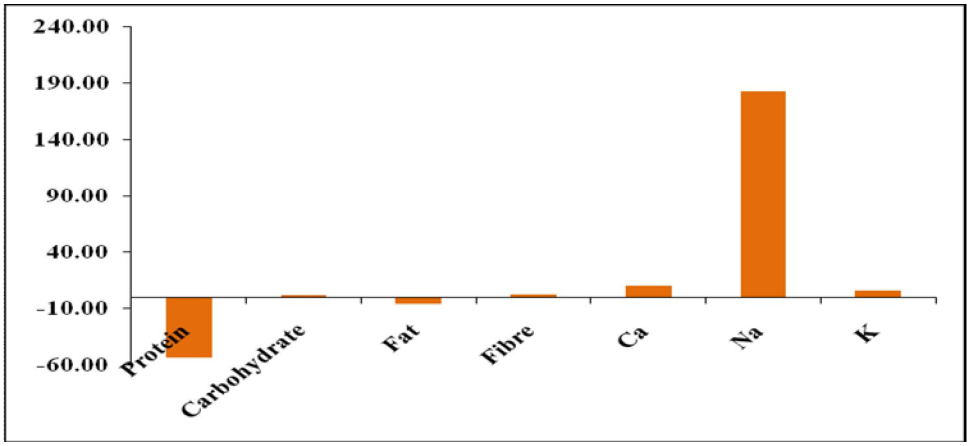

Fig 8. Percent alteration of biochemical composition in final product (kachuri prepared from Salicornia brachiata) compare to control

The findings in the present research programme show a promising market for mangrove associate based food products, not only because of their rich mineral value, but also for establishing future cottage industries for the island dwellers and coastal population of the country.

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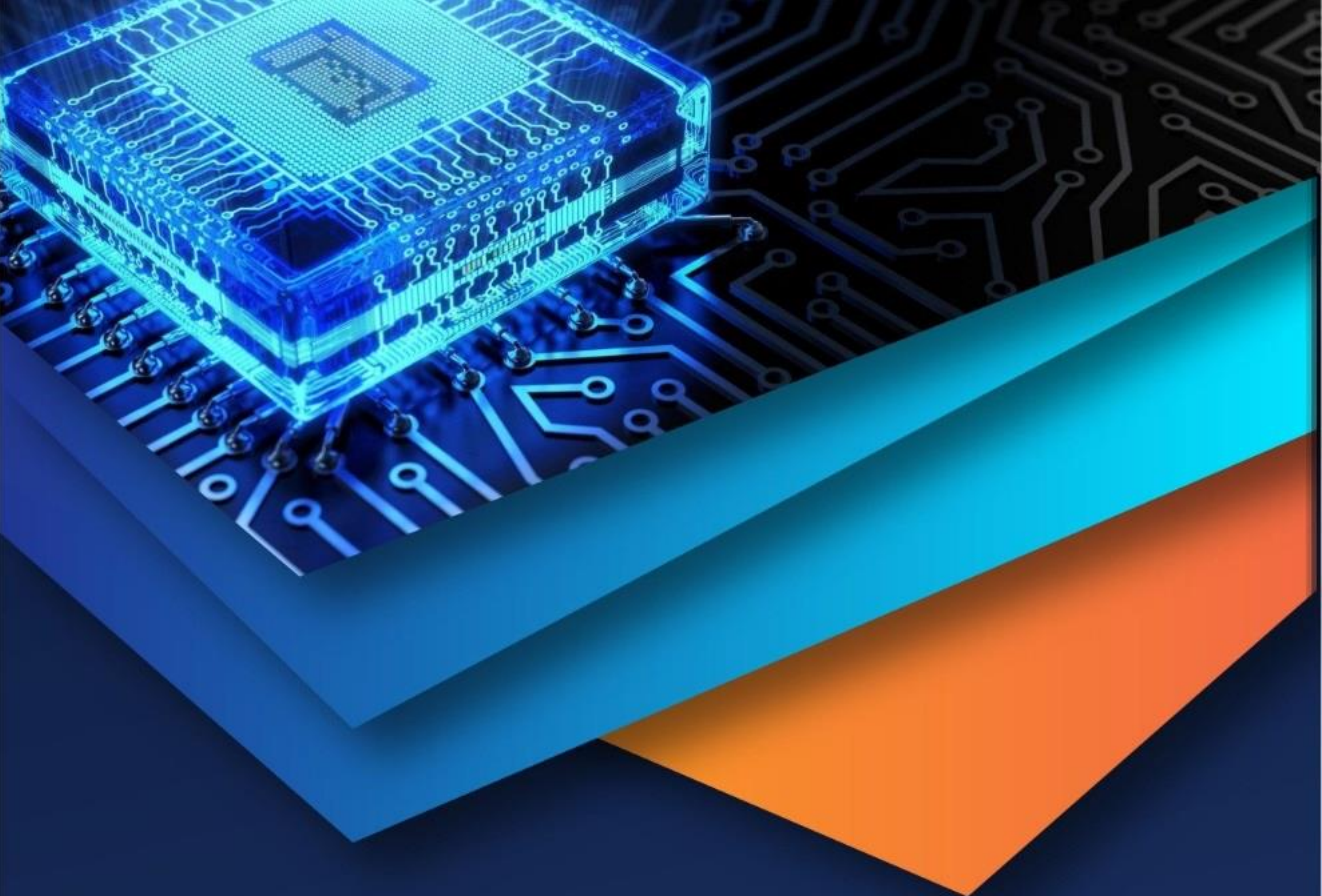

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