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Formulation and Shelf Life Studies of Value Added Products from *Sechium edule* – An Underutilized Vegetable from North East India

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A B S T R A C T

Sechium edule is an underutilized, rapidly perishable vegetable crop commonly grown in North East India. Attempts have been made in present investigation to formulate value added products from this vegetable. Results suggest that vegetable dumplings and tutti-frutti developed have reasonable amount of proximate principles and can be stored up to three months thereby increasing the shelf life of the vegetable. Results indicate that raw vegetable had very high moisture content (87.38%). Value addition to the vegetable led to significant increase in the protein content (21.34 %) and carbohydrate content (56.35 %) in vegetable dumplings and tutti-frutti respectively.

Introduction

Sechium edule is a vegetable crop belonging to *Cucurbitaceae* family which still remains underutilized. The crop is grown widely in the North-Eastern states of India and it is a popularly kitchen garden vegetable in this region. The crop requires minimum agronomic inputs and all the parts of the crop are used in various ways. The fruits are consumed popularly as fresh vegetable, roots are used as an alternative source of starch and even the fresh young shoots are used as vegetables (Singh *et al.*, 2002). It is known by various names in different languages viz: Chayote (in Mexico/Latin America), Chow – Chow, *Isqush* (Nepali Language), *Piskut* (Khasi language) and *Sikut* (Garolanguage), Squash (English) (Lokesh *et al.*, 2017). The plant is a native of Mexico, but the North-Eastern part of India has considerable diversity of *Sechium edule* particularly in the states of Mizoram, Meghalaya and Sikkim (Rai *et al.*, 2006).

It has been reported earlier by us that the fruits of Chayote are used as vegetable and have delicate flesh and extremely high moisture content (89.3 to 94.2 per cent) which makes it highly perishable commodity (Mishra *et al.,* 2015). Due to this the farmers growing the crop must sell the products at very cheap prices leading to economic losses. It is regarded as an important item in the daily diet among the people of North Eastern State including Meghalaya. The crop is gaining popularity among the local population as a vegetable. Further the shoots, stems, leaves and tuberous roots of the crop are edible and have been reported to have anti-diabetic (Maity *et al.,* 2013), antimicrobial (Ordonez *et al.,* 2003), anti-ulcer (Sateesh *et al.,* 2012) and antihypertensive activities (Lombardo *et al.,* 2014). Recently attempts have been made to export the organically produced fruits of Chayote to neighboring countries by the State Government of Meghalaya.

There is an increasing awareness that value addition mediated shelf life extension of perishable vegetables and fruits could result in enhanced profitability of the farmers involved in cultivation of these crops and additionally benefit the customers by providing the diversity in edible product, off-season availability of the vegetables which may further provide nutritious options. Value added products from underutilized vegetables may be a future platform for the food processing sector. Considering these facts, the present study planned to formulate few value-added products from *Sechium edule* an underutilized vegetable crop of North East India.

Materials and Methods

Fresh, healthy fruits of *Sechium edule*, used in this study were procured from the local vegetable market at Tura, West Garo Hills, Meghalaya. The fruits were cleaned, wiped and kept in refrigerator for further analysis and use. Other ingredients used were also procured from the local market and value-added products were prepared in the Food and Nutrition Lab of the Department of Food Science and Nutrition, College of Community Science, Central Agricultural University (Imphal), Tura, Meghalaya.

Proximate composition of raw vegetables

Proximate composition of the resulting maize meals, soybean flour and their blends were determined by the methods of Association of Official and Agricultural Chemists (A.O.A.C, 1990) on fresh weight basis. Ash, crude protein (N x 6.25), moisture and crude fibre content were evaluated. Total carbohydrate was evaluated using the method described by Yemm and Willis (1954).

Formulation of value-added products

Blanched vegetable dumplings and Tutti-Fruitti were two value added products prepared from raw vegetables of *Sechium edule* during the present study and further analysed.

Storage studies

The value-added products were packed and sealed in airtight “PET” containers. The packed *wadis* were stored under normal conditions (100 – 35 0C; 58-76 %RH) for 3 months. Storage stability of the product was assessed by determining the changes in moisture, water activity (aw), and any microbial spoilage up to 3 months of storage duration.

Microbial analysis

The value-added products were subjected to microbial analysis to determine the total bacterial count and total yeast/mould count.

The samples were analyzed according to the method recommended by FSSAI (1992) till 3 months of storage.

Statistical analysis

All the experiments were carried out in triplicate. Mean and standard deviation of the data related to proximate composition and microbial analysis was calculated using MS-Excel.

Results and Discussion

Formulation of value-added products

Blanched vegetable dumplings

Vegetable dumplings were prepared by incorporating blanched mashed *Sechium edule* vegetable. The raw vegetable was cut into small pieces with the help of a stainless-steel knife. Potassium metabisulphite @ 1.5g/kg was added and allowed to rest for an hour. The vegetable was then blanched in hot water for 5minutes. The excess water was drained, and the blanched vegetable pieces were mashed and used for further use. Black gram (500g) was washed thoroughly and soaked in about 800 ml of water overnight. The drained pulses were then ground in an electric grinder (Model Phillips mixer grinder) with small amount of water to form a thick paste. Spice mix whole spices were coarsely ground in a grinder and used further.

Dumplings were formulated by incorporating the blanched mashed *Sechium edule* vegetable to replace black gram paste at levels of 20, 40 and 60%. Preliminary sensory trials indicated that substitution of up to 40% of *Sechium edule* vegetable produced significant changes in the sensory characteristics of *dumplings*. This level of vegetable substitution was used for final product development. Standardized recipe of *dumplings* had following ingredients: *Sikut*200 g, pulse paste 300 g, dried fenugreek leaves 3.5 g, coriander and cumin seeds 7.5 g cinnamon 1.5 g, black and red pepper 3.0 g, nutmeg 0.25gand asafetida 0.1 g. The thick wet pulse paste was whisked continuously to allow desired aeration and make the paste light and fluffy. To the wet pulse paste, standardized amount of *Sikut* (40 %) was added. This paste was then mixed thoroughly with flavorings. Further the preparation was taken in hand and divided into small balls weighing 30-40 g and spread on plates with oil coating, maintaining enough distances between balls. The plates were then kept in hot air cabinet drier and dried at 60 ± 5 °C for 14–16 hours.

Tutti-Frutti

TuttiFrutti which literally means "All Fruits" is a colorful sweet, chewy confectionary item made from chopped fruits, or vegetables having an artificial or natural flavour of many different fruits. *TuttiFrutti* was prepared by incorporating cubical blanched *Sechium edule* vegetable pieces. Potassium metabisulphite @ 1.5g/kg was added and allowed to rest for an hour. Sugar syrup was prepared which had 70^0 brix and used further for preparation of tutti-frutti as per the flow diagram given in Figure 1.

Proximate composition of raw vegetable and formulated products

The data for proximate composition of the raw vegetable and the formulate vegetable dumplings and tutti-frutti is presented in Table 1. It clearly indicates that raw vegetable has high moisture and crudefiber content but very low protein content (1.15%). The findings with respect to raw vegetables in the present study are in accordance with earlier reports by Lokesh *et al.,* (2017), Sanwal *et al.,* (2010).

Figure.1 Flow diagram for preparation of Tutti-Frutti from *Sechium edule* vegetable

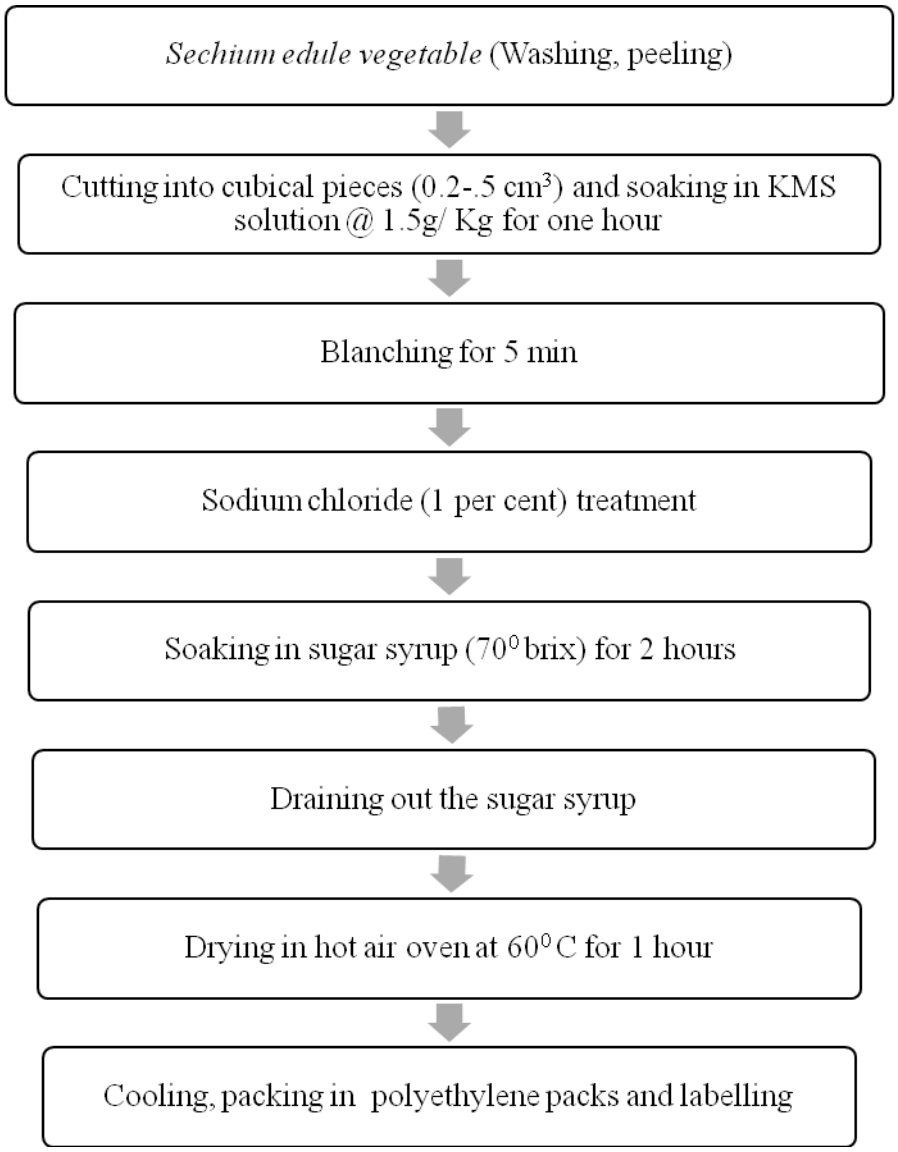

Table.1 Proximate composition of raw vegetable and value-added products from *Sechium edule* vegetable

Sample	Moisture (%)	Carbohydrate (%)	Protein (%)	Ash (%)	Crude Fibre (%)
Raw vegetable	87.38 ± 0.12	5.53 ± 0.26	1.15 ± 0.064	0.312 ± 0.025	5.47 ± 0.075
Vegetable Dumpling	5.95 ± 0.085	6.56 ± 0.21	21.24 ± 0.132	3.13 ± 0.075	6.25 ± 0.035
Vegetable tutti-fruitti	15.56 ± 0.25	56.35 ± 0.37	1.02 ± 0.015	3.56 ± 0.021	5.98 ± 0.045

Values are mean values ± SD (n=3).

Table.2 Microbial Analysis of value-added products from *Sechium edule* vegetable 3 months after storage

Sample	Water activity	Total bacterial count (CFU/mL)	Total yeast count (CFU/mL)
Vegetable Dumpling	0.667 ± 0.02	Not detected	Not detected
Vegetable tutti-fruitti	0.657 ± 0.05	Not detected	Not detected

Values are mean values ± SD (n=3).

One of the benefits of value addition of any raw product is that it increases the nutritional value of the product. Previously attempts have been made to use vegetables as substitute in formulation of legume based dumplings called *wadis* which help in value addition of the vegetable from the nutritional point of view and also aid in evolving a way to increase the shelf life of the vegetable and ensure its availability in value added form in off seasons (Kaur and Aggarwal, 2015).The same trend was observed in this study also where value-addition of *Sechium edule* vegetable with black gram paste (legume) increased the protein content markedly (21.24 %) and helped in increasing the shelf life of the vegetable up to 3 months. Increase in nutritional values of value-added products from many other raw vegetables and fruits has been similarly reported by Abong *et al.,* (2011), Kaur and Aggarwal (2015) and Lokesh *et al.,* (2017).

The tutti-frutti formulated from raw vegetables of *Sechium edule* exhibited a sharp rise in the carbohydrate content which was anticipated due to the use of sugar syrup in the preparation of the product. The findings are in accordance to the results obtained earlier by Barot *et al.,* (2018).

Microbial analysis of the formulated products indicated low water activity three months after storage and no traces of bacterial or yeast/mould contamination (Table 2). This may be due to the use of potassium metabisulphite used during the preparation stages of the products and proper packaging. The extension of shelf life is an important aspect of the study as the raw vegetable has very high moisture content leading to rapid perishability and loss to the farmers. Similar extension in shelf life of the products developed from other vegetables has been reported by Abong *et al.,* (2011) and Kaur and Aggarwal (2015).

In conclusion, *Sechium edule* is a wonderful crop belonging to *Cucurbitacea*e family. It has been underutilized till now but is gaining popularity among consumers particularly in North East India. Considering the high perishability of the vegetable suitable processing methods need to be developed to extend the shelf life of the vegetable. Value addition can be one such method which would help in inclusion of this vegetable in daily diet of the consumers thereby promoting health and providing further diversity to the food basket.

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