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Standardization and Evaluation of Cauliflower Stalks Incorporated Phulkas

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Authors' contributions

This work was carried out in collaboration among all authors. Authors MR, YS and MSP have carried out the proposed research work as part of their under graduate special project and performed the statistical analysis. Author WJS has designed the research work and wrote the draft of manuscript. Author BAK helped in compilation of data and helped in literature searches. All authors read and approved the final manuscript.

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ABSTRACT

Lot of attention is focused on the development of value-added foods that promote wellbeing and improve health due to increased awareness among consumers, rapid urbanization and globalization. Many by-products may be useful as source of nutrients and potential functional ingredients to obtain added value products for combating hidden hunger.

Cauliflower (*Brassica oleracea*) has highest waste index with maximum ratio of non-edible to edible portion after harvesting. Unfortunately, cauliflower waste in developing countries like India does not find any significant use despite containing appreciable amounts of proteins, minerals, vitamins, dietary fibre and natural antioxidants like carotenoids, phenolic compounds, glycosylates and flavonoids. Thus, it can be a novel ingredient for production of value-added foods.

The cauliflower stalks powder was incorporated to phulkas at 5, 10 and 15% respectively and evaluated by semi trained panellists using 5-point hedonic scale for colour, flavour, texture, taste

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and overall acceptability. The phulkas with 10% incorporation was most accepted one. The most accepted phulkas was screened for phytochemical constituents and analysed for physical parameters. The results showed that the cauliflower stalks incorporated phulkas contained phytochemicals like carbohydrates, alkaloids, protein, flavonoids, phenols, amino acids, cardiac glycosides, steroids, saponins and tannins. The physical parameters included foaming properties, swelling capacity, gelatinization temperature which were higher for cauliflower stalks incorporated phulkas whereas water uptake analysis, cooking time, retrogradation was lower in comparison to control phulkas.

Keywords: Cauliflower stalks; phytoconstituents; physical parameters and value added phulkas.

1. INTRODUCTION

For man to survive like other more complex life forms, he must feed himself with natural organic substances called "food" which are edible as it distinguishes man from other homo culinarians [1]. About 1.3 billion tons of food per annum was lost or wasted right from production to end consumer usage. The reduction in these wastages occur if food produced was effectively utilised to provide food security and contribute to reduced environmental impact of agriculture [2]. Food losses can be due to decreased edible food mass like loss occurring if food or parts of food were not suitable for processing and thus discarded during preparation like washing, peeling or slicing or not properly processed [3].

The vegetable processing industry produces over one million tons of vegetable trimmings as waste every year which may be used for value addition. They are inexpensively available in large quantities and are rich sources of dietary fibre with high water binding capacity and relatively low enzyme digestible organic matter [4]. The high consumption of vegetables is associated with decreased risk of cardiovascular diseases, cancers and degenerative pathologies as they are excellent source of antioxidants [5].

Many parts of plants have significant amounts of biologically active compounds [6]. Wastes from fruits and vegetables are rich in phenolic compounds with low molecular weight plant secondary metabolites comprising of polyphenols, carotenoids, alkaloids and saponins [7]. Of the many plants evaluated for their health benefits much attention has been focused on brassica vegetables as biologically active compounds from these have shown to prevent or interfere with progress of many life style diseases [8,9].

Brassica vegetables include some economically interesting crops such as cabbage, broccoli, cauliflower and turnip that are consumed worldwide [10]. Compared to other vegetables, cauliflower has higher antioxidant potential which makes them very interesting crops from the consumer's point of view with anticarcinogenic properties [9].

Among vegetables, cauliflower is the most popular cole vegetable grown extensively in India. The edible portion of cauliflower is curd (head), whereas its leaves are generally thrown away as waste are rich source of iron and β-carotene [11]. Cauliflower is rich in nutrients but has the highest waste index after harvesting [12]. It contributes to about 45-60% of the total weight of the vegetable and is a crucial environmental pollutant [13,14]. Unfortunately, cauliflower waste in developing countries like India does not find any significant commercial use, despite containing appreciable amount of proteins and minerals.

Laufenberg et al. [15] reported that field of vegetable waste and its transformation into value-added products can provide future economic benefits for vegetable 'co-products'. Hence, the aim of this study was to develop phulkas with addition of cauliflower stalks for specific nutritional and physiological benefit.

2. MATERIALS AND METHODS

2.1 Preparation of Cauliflower Stalks Powder

The cauliflower trimmings were separated from flower and leaves, washed under running water and blanched for 15 sec. After blanching, the trimmings were cut into pieces and kept at 4°C for 16 hr. Then they were dried at 80°C for 10 hr in a tray drier. The dried sample was powdered and sieved using 0.5 mm mesh screen, packed, sealed in air tight container and stored at room temperature until use [16]. The glassware and

equipment were from Post Graduate & Research Centre, PJTSAU, Rajendranagar, Hyderabad.

The preliminary tests for carbohydrates, alkaloids, proteins, amino acids, flavonoids, fixed oils, terpenoids, cardiac glycosides, steroids, tannins, phlobatins, phenols and quinones were carried out as per the procedure given by Harborne [17]. Sensory analysis of cauliflower stalks powder incorporated phulkas, control phulkas and cauliflower stalks was carried out by fifteen semi-trained panellists using 5-point hedonic scale and were scored for colour, texture, flavour, taste and overall acceptability as given by Meilgaard et al. [18].

3. RESULTS AND DISCUSSION

Three different incorporations of cauliflower stalks at 5, 10 and 15% was done to phulkas and results shown in Fig. 1. Cauliflower stalks incorporated phulkas with 10% was most accepted. It was screened for phytochemicals and analysed for physical properties.

3.1 Preliminary Phytochemical Screening of Developed Phulkas

The selective reactivity of phytochemicals present in the product was carried out by preliminary screening tests using standard procedures for carbohydrates, alkaloids, proteins, amino acids, flavonoids, fixed oils, terpenoids, cardiac glycosides, steroids, tannins, phlobatins, phenols and quinones were carried out as per the procedure given by Harborne, [17]. The results of the tests were shown in Table 1.

From the present study, it can be observed that cauliflower stalks powder contained phytochemicals beneficial for human health like carbohydrates, alkaloids, protein, flavonoids, phenols, amino acids, tannins, cardiac glycosides, steroids, saponins and tannins. The same results were reported by Laxmi, et al. [19] the phytochemical compounds in dried cauliflower stalks incorporated phulkas are carbohydrates, alkaloids, protein, flavonoids, phenols, amino acids, cardiac glycosides,

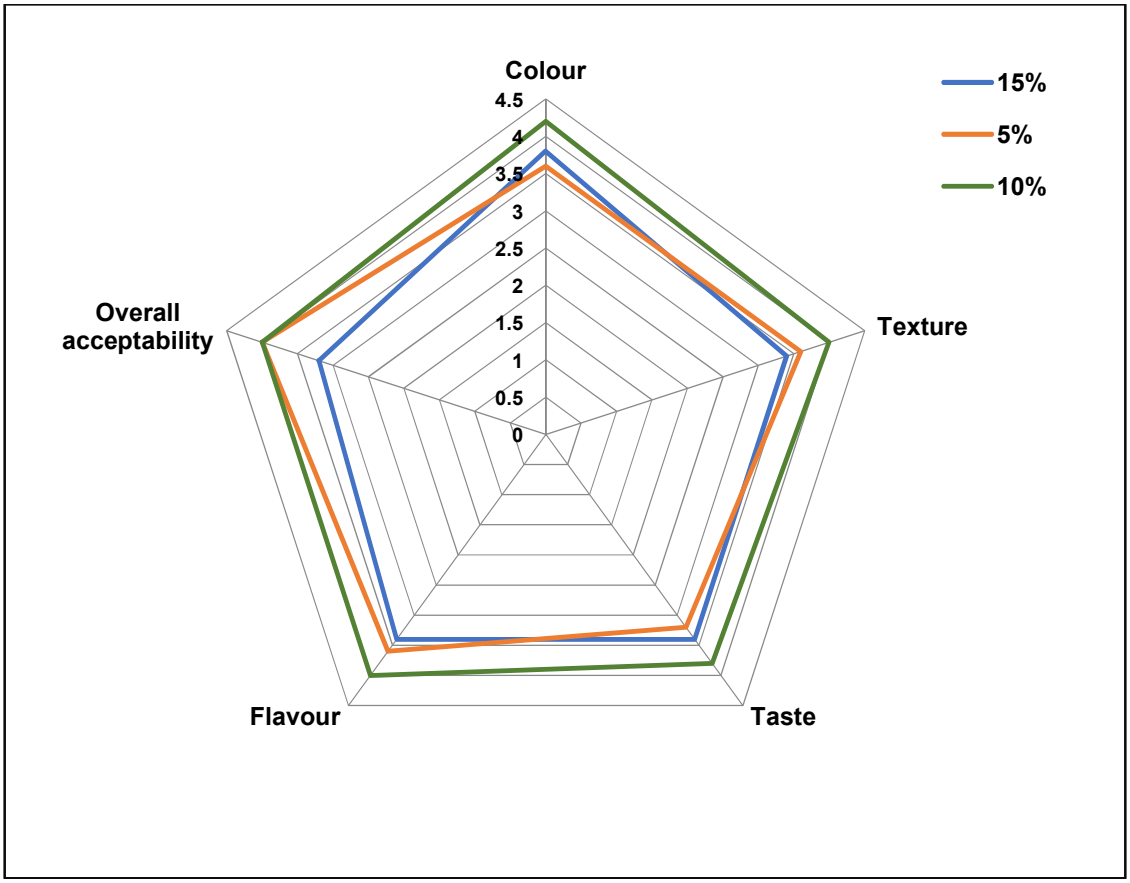

Fig. 1. Sensory scores of standardized and selected extrudates

Table 1. Screening of phulkas for phytochemical constituents

S. No.	Phytochemicals	Test	Cauliflower stalks powder	Control phulkas	Cauliflower stalks Incorporated phulkas
1	Carbohydrates	Molisch test	-	+	+
2	Alkaloids	Wagner's test	+	-	+
		Hager's test	+	+	+
3	Protein	Kjeldahl method	+	+	+
4	Flavonoids	With NH_3 solution	+	+	+
5	Terpenoids	-	-	-	-
6	Cardiac glycosides	-	+	-	+
7	Steroids	Liebermann-Burchard test	+	-	+
8	Saponins	Foam test	+	+	+
9	Phenols	Liebermann's test	+	+	+
10	Fixed oils and fats	Foam test	-	-	-
11	Amino acids	Ninhydrin test	+	+	+
12	Quinones	With HCl	-	-	-
13	Phlobatinins	With HCl	-	-	-
14	Tannins	$FeCl_3$	+	+	+

Note: All screening tests were carried out in triplicates

Table 2. Analysis of physical parameters in phulkas

S. No.	Physical parameters	Control phulkas	Cauliflower stalks incorporated phulkas
1.	Foaming properties	20.00%	62.50%
2.	Water uptake analysis	66.00%	55.00%
3.	Swelling capacity	Increased by 8.00 mL	Increased by 20.00 mL
4.	Cooking time	18.0 min	16.5 min
5.	Gelatinization temperature	67.0°C	68.0°C
6.	Retrogradation	3.20 cm	2.00 cm

Note: Values are expressed as mean of triplicates

steroids, saponins and tannins. Alkaloids and steroids were absent in control phulkas but present in value added phulkas as it was incorporated with cauliflower stalk powder.

The results obtained were compared with Shivaranjani [20] results for qualitative analysis of *S. oleraceae* leaves extract showed the presence phenolic compounds, tannins, flavonoids, saponins, alkaloids, cardiac glycosides and absence of phlobatinins. The absence of quinones indicates that all the extracts have not undergone any oxidation before usage.

3.2 Physical Characteristics of Developed Phulkas

The physical parameters of incorporated and control phulkas were analysed and presented in Table 2. The foaming properties, swelling capacity and gelatinization temperature was higher for cauliflower stalks incorporated phulkas whereas water uptake, cooking time and retrogradation was lower in comparison to control. The incorporation of cauliflower stalk powder to phulkas resulted in swelling of particles leading to lowered cooking. The retrogradation too decreased as more water was present in bound form in cauliflower stalks powder.

4. CONCLUSION

The results showed that the cauliflower stalks incorporated phulkas contained phytochemicals like carbohydrates, alkaloids, protein, flavonoids, phenols, amino acids, cardiac glycosides, steroids, saponins and tannins which are beneficial to fight free radicals. The foaming properties, swelling capacity, gelatinization temperature were higher for cauliflower stalks incorporated phulkas whereas water uptake analysis, cooking time, retrogradation was lower in comparison with control.

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COMPETING INTERESTS

Authors have declared that no competing interests exist.

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