STANDARDIZATION AND EVALUATION OF CAULIFLOWER STALKS INCORPORATED PHULKAS

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-Pehlivan, M. and Sevindik, M. 2018. Antioxidant and antimicrobial activities of Salvia multicaulis. TURJAF. 6(5): 628-631.

-Sevindik, M., Akgul, H., Pehlivan, M. and Selamoglu, Z. 2017. Determination of therapeutic potential of Mentha longifolia ssp. longifolia. Fresen Environ Bull. 26: 4757-4763.

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 future use.

Cauliflower (*Brassica oleracea* L.) vegetable has highest waste index with highest 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 on 5 score hedonic scale for colour, flavour, texture, taste and overall acceptability. The phulkas with 10% incorporated 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 were analysed for control and cauliflower stalks incorporated phulkas with foaming properties, swelling capacity, gelatinization temperature being higher for cauliflower stalks incorporated phulkas whereas water uptake analysis, cooking time, retrogradation are lower in comparison to controlled phulkas.

Key words: Cauliflower stalks, phytoconstituents, physical parameters and value added phulkas

Introduction: For man to survive like other more complex life forms must feed himself with natural organic substances called “food” which is edible as it distinguishes man from other homo culinarians (Falk, 1994). About 1.3 billion tons per year of food is lost or wasted right from production to end consumer usage. The reduction in these wastes occurs if food produced is effectively utilised to provide food security and in addition to contribute to reduced environmental impact of agriculture (Bravo,1998). Food losses are due to decrease in edible food mass like loss occurring if food or parts of food is not suitable for processing and is thus discarded during preparation like washing, peeling or slicing or is not properly processed (Parfitt *et al*., 2010).

The vegetable processing industry produces over one million tonnes 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 (Serena and Bach-Knudsen, 2007).

Many parts of plants have significant amounts of biologically active compounds (Domínguez-Perles *et al*., 2010; Sevindik *et al.*, 2017; Mohammed *et al.,* 2018). Wastes from fruits and vegetables are rich in phenolic compounds with low molecular weight plant secondary metabolites chemically very heterogeneous. They generally comprise of polyphenols, carotenoids, alkaloids and saponins (FAO, 2011). 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 (Beecher, 1994; Podsędek, 2007; Pehlivan and Sevindik, 2018).

Brassica vegetables include some economically interesting crops such as cabbage, broccoli, cauliflower and turnip that are consumed the entire world. A high consumption of these vegetables is associated with a decreased risk of cardiovascular diseases, cancer and degenerative pathologies as they are excellent source of antioxidants (Campbell, 2012). 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 (Podsedek, 2007).

Among vegetables, cauliflower is the most popular cole vegetable grown extensively in India. The edible portion of cauliflower is curd (head), whereas its leaves which are generally thrown away as waste are also rich source of iron and β- carotene and thus can be utilized in to prepare value added products (Kowsalya and Sangeetha, 1999). Cauliflower is rich in nutrients but has the highest waste index, *i.e*. ratio of non-edible to edible parts after harvesting (Kulakarni, 2001). It contributes to about 45-60% of the total weight of the vegetable and is a crucial environmental pollution problem (Oberio *et al*., 2007 and Ferreira *et al*., 2013). 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*. (2003) reported that field of vegetable waste and its transformation into value-added products can provide future economic benefits for vegetable 'co-products'.

Cauliflower waste in developing countries like India does not find any significant commercial use although it has good amount of proteins and minerals. Hence, the aim of this study was to develop phulkas with addition of cauliflower stalks for specific nutritional and physiological benefit.

Materials and methods:

Preparation of cauliflower stalks powder: Cauliflower stalks and other ingredients were procured from local markets of Hyderabad. The stalks were washed and dried in tray drier at 60^{o} C for 6 hours and then made into fine powder. The fine powder was stored in air tight containers till use. The glassware and equipment were from Post Graduate & Research Centre, PJTSAU, Rajendranagar, Hyderabad.

Sensory analysis of cauliflower stalks powder incorporated phulkas, controlled phulkas and cauliflower stalks were carried out by fifteen semi-trained panellists using 5-point hedonic scale and were scored for colour, texture, flavour, taste and overall acceptability (Meilgaard *et al*., 1999).

Results and Discussion: Three different incorporations of cauliflower stalks at 5, 10 and 15% was done to phulkas and results shown in figure 1. Cauliflower stalks incorporated phulkas with 10% level was most accepted sample and to this phytochemical screening and analysis of physical properties was carried out.

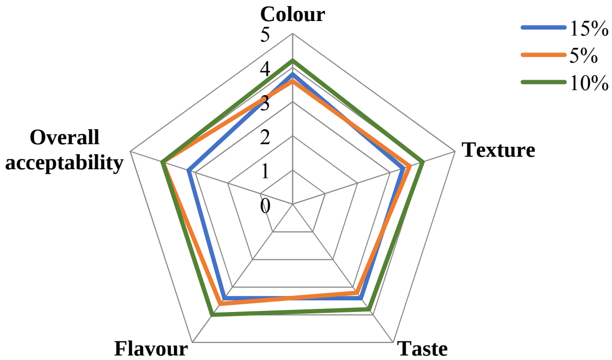

Figure 1: **Sensory scores of standardized and selected extrudates**

Preliminary phytochemical screening: The property of selective reactivity of phytochemicals present in the product was carried out by the chemical tests using standard procedures. 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, 1993. The results of the tests are shown in table 1.

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

From the above study, cauliflower stalk powder contained several phytochemicals which are beneficial to human health like are carbohydrates, alkaloids, protein, flavonoids, phenols, amino acids, tannins, cardiac glycosides, steroids, saponins, tannins, compared with results of Laxmi, *et al*., (2016) and the results were found to be same. The phytochemical compounds in dried cauliflower stalks incorporated phulkas are carbohydrates, alkaloids, protein, flavonoids, phenols, amino acids, cardiac glycosides, 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 (2014) 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.

Physical characteristics of developed phulkas: The physical parameters of incorporated phulkas and controlled phulkas were analysed and shown 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 were lower in comparison to control phulkas. 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 in bound form in cauliflower stalks powder.

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**mL	Increased by 20.00 mlL
4.	Cooking time	18.0 min	16.5 min
5.	Gelatinization temperature	67.0 ^{0}C	68.0 ^{0}C
6.	Retrogradation	3.20 cm	2.00 cm

Note: Values are expressed as mean of triplicates.

Conclussion

Please add

References:

Beecher, C.W.W. 1994. Cancer prevention properties of varieties of *Brassica oleracea*: a review. *American Journal of Clinical Nutrition* 59: 1166-1170.

Bravo, L. 1998. Polyphenols: Chemistry, dietary sources, metabolism, and nutritional significance. *Nutrition Reviews*. 56(11): 317- 333.

Campbell, B., Han, D.Y., Triggs, C.M., Fraser, A.G. and Ferguson, L.R. 2012. Brassicaceae: Nutrient analysis and investigation of tolerability in people with Crohn's disease in a New Zealand study. *Functional Foods in Health and Disease*. 2: 460–486.

Dominguez-Perles, R., Carmenmartinez-Ballesta, M., Carvajal, M., Garcia-Viguera, C. and Moreno, D. A. 2010. Broccoli-derived by-products - A promising source of bioactive ingredients. *Journal of Food Science* 75: C383- C392

Falk, P. (1994). *The Consuming Body*. London: Sage Publications *Directive 2008/98/EC of the European Parliament and of the Council of 19 November 2008 on waste and repealing certain Directive* from

http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=CELEX:32008L0098:EN:NOT.

FAO, 2011 Global food losses and food waste-extent, causes and prevention. UN FAO, Rome.

Ferreira, M. S. L., Santos, M. C. P., Moro, T. M. A., Basto, G. J., Andrade, R. M. S. and Gonçalves, E. C. B. A. 2013. Formulation and characterization of functional foods based on fruit and vegetable residue flour. *Journal of Food Science and Technology*. DOI: 10.1007/s13197-013-1061-4.

Harborne, J.B. 1993. Phytochemistry. Academic press, London. 89-131.

Kowsalya, S. and Sangheetha, M. 1999. Acceptability and nutrient profile of cauliflower leaves (*Brassica oleraceae* var. *Botrytis*). *The Indian Journal of Nutrition and Dietetics*. 36:332-338.

Kulkarni M, Motey R, Lele SS. 2001 Biotechnology in agriculture, industry and environment. In: Proceedings of the International Conference of SAARC countries, organized by Microbiologists Society at Karad, India, December 28- 30. 24-31.

Lakshmi, N. B., Suneetha, W. J., Maheswari, K. U., Kumari, B. A. and Prabhakar, B. N. 2017. Antioxidant potential of rice bran and vegetable waste powders incorporated extrudates. *The Pharma Innovation Journal*. 6(4): 12-16.

Laufenberg, G., Kunz, B. and Nystroem, M. 2003. Transformation of vegetable waste into value added products: (A) the upgrading concept, (B) practical implementations. *Bioresource Technology*. 87: 167–198.

Meilgaard, M., Civille, G.V and Carr, B.T. 1999. Sensory Evaluation Techniques. 3rd Ed. CRC Press, Boca Raton.

Mohammed, F.S., Akgul, H., Sevindik, M. and Khaled, B.M.T. 2018. Phenolic Content and Biological Activities of *Rhus coriaria* var. *zebaria*. *Fresen Environ Bull*. 27(8): 5694-5702.

Oberoi, H.S., Kalra, K.L., Uppal, D.S and Tyagi, S.K. 2007. Effects of different drying methods of cauliflower waste on drying time, colour retention and glucoamylase production by *Aspergillus niger* NCIM 1054. *International Journal of Food Science and Technology*. 42: 228–234.

Parfitt, J., Barthel, M. and Macnaughton, S. 2010. Food waste within food supply chains: quantification and potential for change to 2050. *Philosophical Transactions of the Royal Society B: Biological Sciences*. 365: 3065-3081.

Pehlivan, M. and Sevindik, M. 2018. Antioxidant and antimicrobial activities of *Salvia multicaulis*. *TURJAF*. 6(5): 628-631.

Podsędek, A. 2007. Natural antioxidants and antioxidant capacity of brassica vegetables: A review. *LWT-Food Science and Technology*. *40* (1): 1 - 11.

Serena, A. and Bach Knudsen, K. E. 2007. Chemical and physicochemical characterisation of co-products from the vegetable food and agro industries. *Animal Feed Science and Technology*. 139: 109 – 124.

Sevindik, M., Akgul, H., Pehlivan, M. and Selamoglu, Z. 2017. Determination of therapeutic potential of *Mentha longifolia* ssp. *longifolia*. *Fresen Environ Bull*. 26: 4757-4763.

Shivaranjani, V. L., Poornima, H., Umamaheswari, J. and Devi, K. L. 2014. Preliminary phytochemical screening and quantification of bioactive compounds in the leaves of spinach (*Spinaceae oleraceae* L.). *Journal of Pharmacy Research*. 8(8): 1113-1119.