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Development and standardization of functional extruded food products

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Abstract
The study was designed to prepare extruded products as a functional food. Sorghum flour, defatted soy flour, maida, Tulsi(*Ocimum sanctum)* leaf powder, Methi leaf powder were the main ingredients used for the preparation of products with three formulations, *i.e.,* T1 (75:20:0:2.5:2.5), T2 (80:6.5:6.5:3.5:3.5), T3 (35:20:40:2.5:2.5). Grain sorghum contains beneficial components help in management of cholesterol in humans. Legumes such as soybean contain complex carbohydrates, minerals, phytoestrogens, soluble fibre, oligosaccharides, particularly the isoflavones genistein and daidzein that may be beneficial in the management of diabetes. *Ocimum sanctum* (holy basil) called Tulsi in India, is ubiquitous in Hindu tradition, is explored as medicinal plant and it is used for children for cold, bronchitis, fever & helps in building up stamina, reduces total cholesterol levels and blood glucose levels. The leaves are also used for sauces, soups and salads. *Menthi or Fenugreek* is a rich reservoir of medicinal properties that imparts many health benefits. Fenugreek helps to reduce cholesterol level, especially that of the low density lipoprotein (LDL). This type of functional food was designed to diabetic patients as the ingredients used are known to have functional properties. The results indicated that the sample T2 scored high for overall acceptability. The sample T2 was subjected to nutritional composition which showed a protein (2.41%), carbohydrate (63.27%), fat (0.35%) and crude fibre (1.37%). Hence it could be a beneficial functional food for controlling sugar level in diabetic patients.

Keywords: Functional Food, Diabetic patients, *Ocimum sanctum* (holy basil)

Introduction

Sorghum is a major cereal in the semi-arid regions of the world where it is an important food and feed crop. Sorghum species (*Sorghum vulgare* and *Sorghum bicolor*) are members of the grass family. Sorghum is known by a variety of names: great millet and guinea corn in West Africa; kafir corn in South Africa; dura in Sudan; mtama in eastern Africa; Jowar in India, and kaoliang in China (Kulamarva, 2009).

Sorghum is a gluten-free cereal and forms the staple diet of a majority of the populations living in the semi-arid tropics. Sorghum contains various phenolic and antioxidant compounds that could have health benefits, which make the grain suitable for developing functional foods and other applications. It is usually consumed in the form of bread made from the grain flour. Sorghum dough has poor viscoelastic properties compared to wheat dough and mechanical methods for production of sorghum roti are scarce (Nandini and Salimath, 2001) [6].

Sorghum is an important cereal crop in Africa and Asia and is consumed in different forms like tortillas, porridges, couscous and baked goods. Earlier works have reviewed the use of sorghum as human food and reported the various forms in which sorghum is being consumed. Preparation of extruded products from sorghum has also been reported. The use of sorghum in pasta processing has been evaluated. Sorghum products including expanded snacks, cookies, and ethnic foods are gaining popularity in areas like Japan (Awika and Rooney, 2004) [2].

Certain varieties of sorghum bran may affect critical biological processes that are important in diabetes and insulin resistance (Farrar *et al*., 2008) [3]. Grain sorghum contains beneficial components that could be used as food ingredients or dietary supplements to manage cholesterol levels in humans (Penchalaraju *et al*., 2014) [5].

Legumes such as soybeans contain complex carbohydrates, minerals, phytoestrogens, vegetable protein, soluble fiber, oligosaccharides, particularly the isoflavones genistein and daidzein that may be beneficial in the management of diabetes (Spandana and Penchalaraju, 2012) [8].

Soybeans are excellent sources of protein, dietary fiber and phyto-chemicals. The high content of isoflavones in soybeans and soy products have been associated with bone health, lower blood cholesterol and reduced risk of various cancers. Use of soyprotein resulted in significant decrease in blood sugar levels. Germination of soy generally improves the nutritional quality of seeds and in particular increases the vitamin content. These legumes contain complex carbohydrates, minerals, phytoestrogens, vegetable protein, soluble fiber, oligosaccharides, particularly the isoflavones Lavones genistein and daidzein, that may be beneficial in the management of diabetes (Anderson, 1998) [1]. *In vitro* studies have shown isoflavones to have antidiabetic properties such as inhibiting intestinal brush border uptake of glucose, having α- glucosidase inhibitor actions, and also demonstrating tyrosine kinase inhibitory properties (Vedavanam, 1999) [9]. Diets containing soy protein rich in isoflavones have been shown to improve insulin resistance in ovariectomized cynomolgus monkeys and to reduce insulin levels in healthy postmenopausal women (Goodman, 2001) [4].

Mint (*Mentha*) is a genus of about 25 species of flowering plants in the family Lamiaceae (Mint Family). Mints are aromatic, annual herb. The leaves have a fresh, aromatic, sweet flavor with a cool aftertaste. Mint leaves are used in teas, beverages, jellies, syrups, candies, and ice creams.

Mint essential oil and menthol are extensively used as flavorings in breath fresheners, antiseptic mouth rinses, toothpaste, chewing gum, and candies. The substances that give the mints their characteristic aromas and flavors are *p*-menthane compounds and mainly menthol.

The major components of mint essential oil include menthol, menthone and menthofuran. Menthol essential oil is the main functional ingredient in mint (40-90%) and used as an ingredient of many cosmetics and some perfumes. Menthol and mint essential oil are also much used in medicine as a component of many drugs, and are very popular in aromatherapy.

The mint essential oil is reported to have anti-oxidant properties, and antibacterial activity and is one of the most important constituents of some over-the-counter remedies in Europe for irritable bowel syndrome. Mint oil is also used as an environmentally-friendly insecticide for its ability to kill some common pests like wasps, ants and cockroaches and to repel mosquitoes. Mint leaves are rich in some essential nutrient minerals, especially Fe and Mg which are essential for human health.

Ocimum sanctum (holy basil) called Tulsi in India, is ubiquitous in Hindu tradition. *Ocimum* is explored as medicinal plant and it occupies an enviable position in the holistic system of Indian medicine 'Ayurveda' which has its root in antiquity and has been practiced for centuries. *Ocimum* is an erect, herbaceous, much branched, soft hairy, annual with purple or crimson flowers. Leaves of *Ocimum sanctum* were found to be rich in Vitamin C, Vitamin E and phytochemicals, possessing antioxidant properties beneficial to health (Prakash and Gupta, 2005). The juice of the leaves is given to the children for cold and bronchitis. The leaves are also used for sauces, soups and salads (Sethi, *et al.*, 2004) [7].

Keeping the properties of the above functional foods in controlling diabetes, it was felt that a food product which could incorporate all three of them, if developed and accepted, would be beneficial to diabetic patients. Therefore this study was designed and developed with the following objectives.

Objectives of the study

- To standardize and develop the products
- To determine the acceptability of the product by sensory evaluation
- Analysis of physico-chemical composition of raw materials and experimental product

Materials and Methods

Procurement and Pre-Processing of Raw-Material

For the present investigation, Soybean flour and Sorghum flour were procured from a supermarket in Hyderabad as a single lot. Tulasi (*Ocimum Sanctum)* leaves were procured from the Herbal Garden, The methi and *Ocimum-Sanctum* leaves were washed under running water to remove any adhering particles of dirt. The leaves were then dried in a hot air oven at low temperatures (50-60oC), powdered, sieved and stored in airtight containers in a refrigerator till standardization of products and analysis for various parameters was carried out at a later date.

Product Development and Standardization

Table 1: Different Trials and Combinations Carried Out for Product Development

Ingredients (%)	Extruded experimental products		
	T1	T2	T3
Sorghum	75	80	35
Defatted soy Flour	20	6.5	20
Maida	0	6.0	40
Ocimum leaf powder	2.5	3.5	2.5
Methi powder	2.5	3.5	2.5

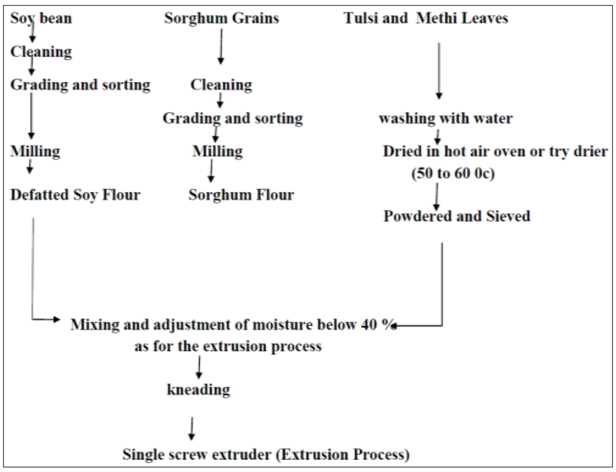

Fig 1: Flow chart for the preparation of Functional Extruded products

Plate 1: Developed extruded products.

Fig 2: Extruded product T1

Fig 3: Extruded Product T2

Fig 4: Extruded product T3

Sensory evaluation

The three products developed were subjected to Organoleptic evaluation (Colour, flavour, texture, taste and overall acceptability) by fifteen (15) trained taste panel members. A score card with nine point hedonic scale (Amerine *et al*. 1965) was used for the purpose.

Physico-chemical analysis

All the raw materials and experimental best product were subjected for physico-chemical analysis by using standard AOAC methods.

Result and Discussion

Organoleptic Evaluation

Table 2: Mean score obtained for experimental products to different variables

S. no	Variable	T1	T2	T3
1.	Colour	3.6 ± 0.63	4.0 ± 0.35	3.5 ± 0.53
2.	Flavour	3.9 ± 0.35	4.0 ± 0.53	4.1 ± 0.63
3.	Texture	4.0 ± 0.53	4.0 ± 0.59	3.7 ± 0.49
4.	Taste	4.1 ± 0.63	3.9 ± 0.53	3.5 ± 0. 46
5.	Overall acceptability	3.7 ± 0.49	4.1 ± 0.63	3.5 ± 0.35

Note: Values are expressed in mean ± SD (Five point Hedonic scale).

Three experimental products namely T1, T2 and T3 were prepared and subjected for sensory evaluation. From table 2, it is seen that for mean score for T2 product for colour was (4.0 ± 0.35) whereas T1 scored (3.6 ± 0.63) and T3 scored (3.5 ± 0.53). From table 2, it is seen that T2 product scored (4.0 ± 0.53) for flavour and T1 scored (3.9 ± 0.35) and whereas T3 got highest score (4.1 ± 0.63). The mean score for texture for T2 product was (4.0 ± 0.59) and T1 scored (4.0 ± 0.53), T3 scored very less (3.7 ± 0.49). The mean score for taste for T1 product was (4.1 ± 0.63) higher than T2 (3.9 ± 0.53) and T3 (3.5 ± 0. 46). The mean score for overall acceptability was higher for experimental product (Fig 5) T2 (3.9 + 0.35) whereas it was 3.7 ± 0.49 for T1product and 3.5 ± 0.35 for T3. Similar results were observed by (Penchalaraju *et al*., 2014) [5].

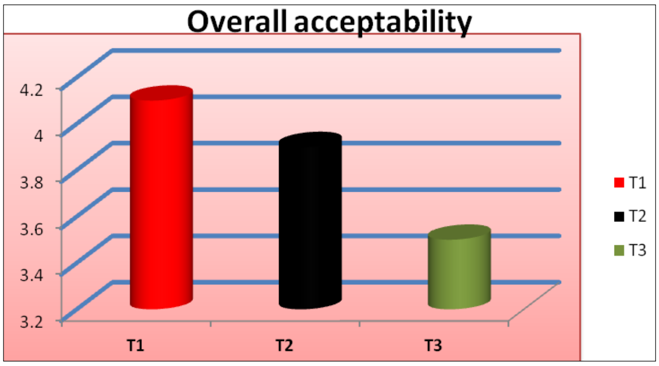

Fig 5: Mean score obtained for overall acceptability for experimental products T1, T2 and T3.

Nutritional composition dried *Ocimum* leaf powder, sorghum and defatted soy flour

Table 3: The nutrient content of dried *Ocimum* leaf powder, sorghum and defatted soy flour

S. no	Nutrient per 100g	Sorghum	Defatted soy flour	*Ocimum* leaf powder
1.	Moisture (g)	11.9	8.1	11.58
2.	Protein (g)	10.4	43.2	3.5
3.	Fat (g)	1.9	1.2	2.98
4.	Vitamin-c (mg)	-	-	81.96
5.	Total carotenes (mg)	47	426	654
6.	Iron (mg)	4.1	10.4	0.086
7.	Calcium (mg)	25	240	1.25
8.	Zinc (mg)	1.6	3.4	1.31

The nutrient content of dried *Ocimum* leaf powder is presented in table 3 and is compared to the nutritive value of sorghum and defatted soy flour. Since both sorghum and soy have been analyzed in a number of studies, the table values have been taken. *Ocimum* leaf powder was analyzed by the researcher in the laboratory. The table shows that the moisture content of sorghum was 11.9 g, *Ocimum* leaf powder was 11.5 g, whereas that of defatted soy flour was 8.1% g. Among all the three foods, the moisture content was highest in sorghum. Soy contained the highest amount of protein i.e. 43.2 g, followed by sorghum (10.4 g) and *Ocimum* leaf powder (3.5 g). *Ocimum* leaf powder contained 2.98 g of fat and it was high, whereas in sorghum it was found to be 1.9 g. There was little amount of fat in defatted soy flour (1.2 g). Vitamin C was absent in both sorghum and soy whereas it was 81.96 mg in *Ocimum* leaf powder so also the highest amount of total carotenes was present in *Ocimum* leaf powder (653.6 mg) followed by defatted soy flour (426 mg) and then sorghum (47 mg). The amount of iron which was present in defatted soy flour (10.4 mg) was high compared to sorghum (4.1 mg) and *Ocimum* leaf powder (0.0863 mg). The calcium content of defatted soy flour was found to be 240 mg where as in sorghum it was 25 mg and in *Ocimum* leaf powder it was found to be only 1.25 mg. The foods were also analyzed for zinc and it was found that at least percentage was observed in *Ocimum* leaf powder (1.34 mg), whereas it was high in defatted soy flour (3.4 mg), and in Sorghum it was 1.6 mg. Similar results were observed by (Spandana and Penchalaraju, 2012) [8].

Nutritional composition of experimental product T2

Table 4: Nutritional composition of extruded product T2.

S. no	Variables	Extruded product T2
1.	Protein	2.41 %
2.	Carbohydrate	63.27 %
3.	Fat	0.35 %
4.	Crude fiber	1.37 %

The sample T2 was subjected to nutritional composition which showed a protein (2.41%), carbohydrate (63.27%), fat (0.35%) and crude fibre (1.37%). Hence it could be a beneficial functional food for controlling sugar level in diabetic patients. Similar results were observed by (Spandana and Penchalaraju, 2012) [8].

Conclusion

The main objective of the study was to develop a palatable and well-accepted food product with ingredients having not only good nutritional value but also functional properties. Therefore a combination of millet, a legume and medicinal green leaf were selected. These were sorghum, defatted soy flour, *Ocimum* leaf powder (OLP) and methi powder.

Three extrude products namely T1, T2 and T3 were prepared and subjected for sensory evaluation and the results indicated that the sample T2 scored high for overall acceptability.

Three experimental products namely T1, T2 and T3 were prepared and subjected for sensory evaluation. From table 1, it is seen that for mean score for T2 product for colour was (4.0 ± 0.35) whereas T1 scored (3.6 ± 0.63) and T3 scored (3.5 ± 0.53). From table 1, it is seen that T2 product scored (4.0 ± 0.53) for flavour and T1 scored (3.9 ± 0.35) and whereas T3 got highest score (4.1 ± 0.63). The mean score for texture for T2 product was (4.0 ± 0.59) and T1 scored (4.0 ± 0.53), T3 scored very less (3.7 ± 0.49). The mean score for taste for T1 product was (4.1 ± 0.63) higher than T2 (3.9 ± 0.53) and T3 (3.5 ± 0. 46). The mean score for overall acceptability was higher for experimental product T2 (3.9 + 0.35) whereas it was 3.7 ± 0.49 for T1product and 3.5 ± 0.35 for T3.

The sample T2 was subjected to nutritional composition which showed a protein (2.41%), carbohydrate (63.27%), fat (0.35%) and crude fiber (1.37%). Because of the functional properties of the ingredients, product could be a beneficial functional food for controlling sugar level in diabetic patients.

Further comprehensive chemical and pharmacological investigations are needed to elucidate the exact mechanism of the hypoglycemic effect of *Ocimum sanctum* leaves and methi leaves so a long-term study is needed to study these effects more clearly.

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References

1. Anderson JW, Blake-JE, Turner – J, Smith BM, Messina M, Erdman – JW. Effect of Soy protein on renal function and proteinuria in patients with type 2 diabetes Am. J. Clin. Nutr. 1998; 68(6):1347S-1353S.
2. Awika JM, Rooney LW. Sorghum phytochemicals and their potential impact on human health. Phytochemistry. 2004; 65(9):1199-1221.
3. Farrar JL, Hartle DK, Hargrove JL, Greenspan P. A novel nutraceutical property of select sorghum (Sorghum bicolor) brans: inhibition of protein glycation. NRL. 2008; 22(8):1052-6.
4. Goodman-Gruen D, Kritz-Silverstein D. Usual dietary isoflavour intake in association with cardio vascular disease risk factors in postmenopausal women. J. Nutr. 2001; 131:1202-1206.
5. Penchalaraju1 M, Sailaja PSS, Murali naik k, Poshadri A. Study on hypoglycemic activity of functional food. International Journal of Food Science & Technology (IJFST). 2014; 4(2):1-12.
6. Nandini CD, Salimath PV. Structural features of arabinoxylans from sorghum having good roti-making quality. Food Chemistry. 2001; 74(4):417-422.
7. Sethi, Jyoti, Sood, Sushma, Seth, Shashi. Evaluation of hypoglycemic and antioxidant effect of *Ocimum* sanctum. Indian Journal of Clinical Biochemistry. 2004; 19(2):152-155.
8. Spandana S, Penchalaraju M. Development of a functional food for diabetes. J. Res. Angrau. 2012; 40(3):45-47.
9. Vedavanam K, Srijayanta O’ Reilly, Raman A, Wiseman H. Antioxidant action and potential antidiabetic properties of an isoflavonoid containing soybean phytochemical extract (Spe). Phytother. Res. 1999; 13:601-608.