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Physicochemical and sensory analysis of Lasagna enriched with millets

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Abstract
This study aims at the formulation and analysis of lasagne sheets enriched with millets and vegetable peel powders. Three types of sheets, namely, control (100% Refined wheat flour), variation 1 (Refined wheat flour, millet flours and vegetable peel powders) and variation 2 (Whole wheat flour, millet flours and vegetable peel powders) were made. The use of millet flours and vegetable peel powders increased the amount of fibre and protein in the variations. There was a 3% increase in the protein content in variation 2 as against the control. The fibre content was found to be 0.4% in variation 2, 0.02% in variation 1 and absolutely none in the control. Variation 1 had the highest rating in all the sensory parameters like taste, colour, flavour, etc. The addition of the millet flours and vegetable peel powders had a significant effect on the overall product.

Keywords: millet enriched Lasagna, sensory evaluation, physico-chemical analysis

Introduction

Lasagna is generally made using refined wheat flour which provides empty calories. To make this nutritious, it is substituted with millets. Millets are generally consumed less. To increase its consumption and increase the nutrient quality of lasagne, barnyard millet, kodo millet and little millet were used. To increase the fibre content, peels of few vegetables are incorporated as powders. Though peels are rich in fibre, they are not consumed. Peels of potato, carrot and beetroot were included.

Millet is a word which originated from the French word '*mille',* which means thousand; this is because a handful of the grains make a thousand. They belong to a group of forage grasses which produces small-sized grains. This group of species are said to have originated from China, Asia and Africa. Millets are the sixth biggest cereal crops after wheat, maize, rice, barely and sorghum. These are superior in nature in terms of nutritional quality; they have higher protein, aminoacids, macro and micro nutrients. Millets also have other properties which are not present in cereals (rice or wheat) like antioxidant, antimicrobial, anti-inflammatory, antiviral, anticancer, antiplatelet aggregation and catractogenesis inhibitor activities (J.A. Adebiyi, *et al.,* 2016) [8].

Millets are also known as nutria-cereals, because of their higher vitamin and amino acid content. According to Leder (2004) it contains 22-28% Albumins and Globulins, 28-32% Glutelein and Glutelein like protein and 22-35% Prolamin. They are also rich sources of phytochemicals, polyphenols, soluble and insoluble dietary fibres and minerals. They contain fatty acids which are highly polyunsaturated and also have a low glycaemic index (J.A. Adebiyi, *et al.,* 2016) [8].

Millets require only very less water and resources to grow. They can be used as a sustenance food for communities which do not have enough nutrition. Although these are rich in nutrition they are not used in food in a wide range (R. Geetha, *et al.,* 2014) [5]. As the population is growing in size, they require the nutrition, which will help them to survive; this is obtained from millets (Pu Huang, *et al.,* 2016). The millet is small in size and hence, there are high chances of small pebbles mixing in that and making it a bit difficult to eat. They undergo blanching, malting, dry heating, acid treatment, popping, etc. to reduce level of antinutrients, increase shelflife and improve digestibility (Kavitha. B. Patil, *et al.,* 2014).

Fruits and vegetables have a higher amounts of dietary fibre (Sharoba, A.M.*et al,* 2013) [3]. The waste materials such as peels from the vegetable processing units can be successfully used as a source of phytochemicals and antioxidants. The waste by-products of vegetables have higher contents of antioxidant compounds (Agricultural review, 2016) [4].

Materials and methods

Materials

The ingredients required for the formulation of lasagne, such as refined wheat flour, whole wheat flour, kodo, little and barnyard millet, were purchased from a local market in Chennai. For the preparation of the peel powders, the vegetable peels were obtained from domestic households.

Preparation of Peel Powders

Carrot peel powder

Carrot peel was washed twice with warm water (30 ºC); dried at 60 ºC for 12 hours in an electric oven drier and ground to a particle size of 500 - 600 µm. They were then packed in polyethylene bags and stored in refrigerator until use. (Sharoba.A.M.*et al.* 2013) [3]

Potato peel powder

Potato peel was washed twice with warm water (40 ºC); dried at 60 ºC for 12 hours in an electric oven drier and ground to a

particle size of 500– 600 µm. They were packed in polyethylene bags and stored in refrigerator until use. (Sharoba.A.M.*et al*. 2013) [3]

Beetroot peel powder
Beetroot peel was washed twice with warm water (70ºC); dried at 120ºC for 7 hours in an electric oven drier and ground to a particle size of 500– 600 µm packed in polyethylene bags and stored in refrigerator until use. (International journal of scientific and engineering research, 2014).

Preparation of Lasagna sheets

Table 1

S.no.	ingredients	control	variation 1	variation 2
1.	Refined wheat flour	65%	38%	38%
2.	Kodo millet flour	-NIL-	6%	6%
3.	Little millet flour	-NIL-	13%	13%
4.	Barnyard millet flour	-NIL-	6%	6%
5	Semolina	7%	6%	6%
6	Salt	1%	1%	1%
7.	Potato peel powder	-NIL-	1.2%	1.2%
8.	Carrot peel powder	-NIL-	1.2%	1.2%
9.	Beetroot peel powder	-NIL-	1.2%	1.2%
10.	Edible oil	1%	1.4%	1.4%
11.	Water	26%	25%	25%

The dough was allowed to rest for a few minutes and then divided into smaller portions. Later they were shaped into the desirable and allowed to dry. Then they are layered properly and packed.

Proximate Composition Analysis
Moisture
The moisture for the Lasagna sheets was analysed by the AOAC method. 5 g of the sample was transferred to the dried and weighed dishes. It was placed in the drying oven and dried for 3 hours at 105 °C, and then cooled in desiccators to room temperature and reweighed (Heshe *et al.*, 2015) [30].

Fat
Fat was determined by Soxhlet extractor using diethyl ether (boiling point, 55°C) to extract the fat from a 5g sample. The ether was evaporated from the extraction flask. It was calculated from the difference in weight of the flask before and after extraction and was expressed in percentage (Heshe *et al.*, 2015) [30].

Protein
The protein was estimated by Khjeldahl method using concentrated sulphuric acid, copper sulphate and potassium sulphate. These convert the nitrogen to ammonia. The ammonia which is released after alkalization (using Sodium Hydroxide) is steam distilled into boric acid and titrated with hydrochloric acid (Heshe *et al.*, 2015) [30].

Fibre
5g of the sample was taken and boiled along with 0.255N sulphuric acid for 30 minutes, and is later filtered in a muslin cloth, and the residue is washed till it is free from acid and the contents are boiled again in 0.313N sodium hydroxide, again the contents are filtered and wash the residue with alcohol and ether, the contents are dried overnight at 80-100°c and heat the crucible in 600°c for 2-3 hours, the loss in weight represents the fibre content.

Carbohydrate
The carbohydrate content was found using the formula:
100-(Ash+ Moisture+ Fat+ Fibre+ Protein)

Total Ash
Total ash was determined according to AOAC. The porcelain dishes used for the analysis were placed into a muffle furnace for 30 min at 550°C. The dishes were removed and cooled in desiccators for about 30 minutes to room temperature; each dish was weighed. 2.5 g of the samples were added into each dish. The dishes were placed on a hotplate under a fume hood and the temperature was slowly increased until smoking stopped and the samples become thoroughly charred. The dishes were placed inside the muffle furnace at 550°C for 5 hours, removed, cooled in the desiccator and weighed. Weight of total ash was calculated and expressed as percentage of sample (Heshe.*et al*. 2015) [30].

Physical Characteristics
Diameter and Thickness: The diameter, breadth and length of the Lasagna were measured using a Vernier calliper.

Sensory Evaluation
The Lasagnas made were tested by a 15 semi trained panellists. They were given the samples simultaneously to distinguish between each other. They were asked to rate the sample on a 9 point hedonic scale on the taste, flavour, colour, etc.

Results and discussion
Proximate Composition

Table 2

Attributes	Control	Variation 1	Variation 2
Moisture	8.7%	8.84%	6.76%
Fat	2.68%	2.64%	10.54%
Ash	0.51%	2.83%	3.26%
Protein	6.005%	7.579%	9.153%
Crude fibre	0%	0.02%	0.4%
Carbohydrate	78.957%	78.091%	73.035%

Physical Parameters

Table 3

Attributes	Control	Variation 1	Variation 2
Thickness	0.12cm	0.15cm	0.2cm
Length	11.9cm	11.9cm	11.9cm
Breadth	6.16cm	6.16cm	6.16cm

Sensory analysis

Table 4

Attributes	Control		Variation 1		Variation 2	
Taste	Mean	Standard deviation	Mean	Standard deviation	mean	Standard deviation
	7.8	**0.560612**	**8.6**	**0.507093**	**7.14**	**0.833809**
Flavour	7.4	0.632456	8.4	0.632456	7.14	0.833809
Aroma	7.93	0.703732	8.14	0.99043	7.2	0.560612
Colour	8.2	0.774597	8.27	0.798809	7.27	0.703732
Texture	7.8	0.560612	8.27	0.798809	7.14	0.915475
After taste	7.74	0.593617	8.2	0.774597	7.14	0.833809
Overall acceptability	7.87	0.516398	8.4	0.632456	7.07	0.798809

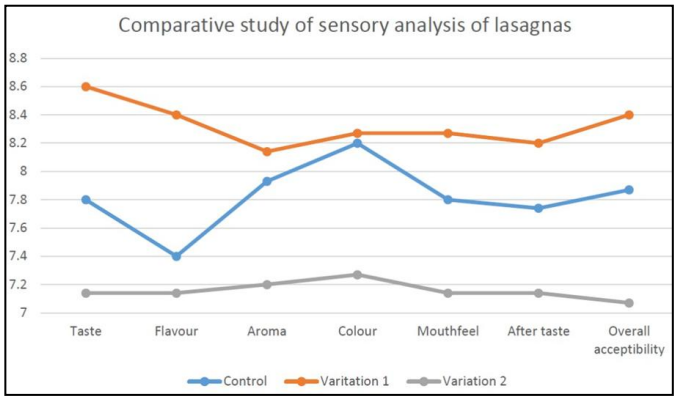

Fig 1

Conclusion

The effect of addition of millet flours and vegetable peel powders were studied in detail. A significant difference in all parameters was observed. The variation formulated with refined wheat flour, millets and peel powder was found more acceptable. The amount of fibre, protein increased in variation 1. The most important attribute for the consideration of a product is its sensory characteristics. In terms of sensory analysis, and nutritional analysis, variation 1 showed better results. The sheets after drying can be shrink wrapped in polypropylene films. Polypropylene is generally preferred as it has good moisture barrier properties and also has a high melting point. From the results obtained, it can be concluded that the addition of the millets and vegetable peel powders have a positive effect on the sensory and physicochemical properties of the Lasagna.

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