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Development and Quality Assessment of Value Added Pasta Fortified with Cauliflower Leaf, Carrot and Mushroom Powder

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ABSTRACT

Background: Extruded products like pasta have gained popularity in today's world and these products are generally high in starch, but low in dietary fiber and micronutrient content. Emphasizing this, an attempt was made to develop nutritious pasta fortified with finger millet, legume, carrot, mushroom and cauliflower leaf powder.

Methods: Many initial trials were conducted in the laboratory to standardize that to what extent carrot, cauliflower leaves and mushroom powder could be fortified along with finger millet, and soy flour/green gram flour in semolina for formulation of value added macaronis. The sensory evaluation of developed macaronis was done by a panel of ten semi-trained judges using a 9-point hedonic scale. Developed macaronis were analyzed for proximate composition, copper, iron, zinc and β-carotene.

Result: Three types of macaronis were developed. All sensory characteristics of experimental macaronis were liked moderately. Experimental macaronis were found nutritionally superior in terms of protein, mineral, crude fiber, calcium, iron, and β-carotene content.

Key words: Carrot powder, Cauliflower leaves, Finger millet, Green gram flour, Macaronis, Mushroom, Soy flour.

INTRODUCTION

A great interest has been raised in the development of functional food products that may provide a health benefit beyond the traditional nutrients. Pasta products *viz*., macaroni, and vermicelli are becoming increasingly popular due to change in economic scenario, urbanization, increased women employment, and increased per capita income. It is a traditional cereal-based product with a relatively long shelf life, being considered a suitable matrix for the addition of functional ingredients because it is accepted worldwide due to its low cost, easy production, and sensory attributes (Chillo *et al*., 2008). Pasta products are normally high in starch but low in dietary fiber, minerals, vitamins, phenolic compounds, *etc*.

With an increasing concern by the health-conscious population, more nutritious pasta products rich in minerals, protein and dietary fiber with low glycemic index, have become the subject of research (Tripathi *et al*., 2015). While durum wheat semolina is traditionally used, recent research has focused on bioactive ingredients to improve the physical and nutritional qualities of pasta.

In India, there are many different varieties of green leafy vegetables, which are rich in micronutrients but are not fully utilized. Cauliflower is one of the most common and popular vegetable grown in India, and finds wide use as a vegetable, whereas its leaves are generally thrown away as waste. Among all the green leafy vegetables, Cauliflower greens (*Brassica oleracea*) were found to have the maximum amount of iron such as 40 mg/100 g. Besides, these leaves are also rich source of beta carotene, fiber and other nutrients and thus can be utilized in the development of value added products (Kowsalya and Sangheetha, 1999; Sadhna *et al*., 2018).

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Carrot (*Daucus carota*) is one of the important nutritious root vegetables grown throughout the world. It is a rich source of β-carotene, and contains other vitamins, like thiamine, riboflavin, vitamin B-complex, minerals and other phytonutrients (Babic *et al*., 1993; Hansen *et al*., 2003; Block, 1994). In recent times, the consumption of carrot, and its products has gained wide acceptance as a result of its natural antioxidant properties coupled with the anticancer activities of β-carotene (Speizer *et al*., 1999). The study on the use of carrot powder as an ingredient in pasta manufacturing is scanty.

Mushrooms have a great potential due to having high and good quality proteins (20 to 40% on a dry weight basis), vitamins (Vitamin B- complex), and minerals (Singh *et al*., 2000). Mushrooms can be dried, and converted into powdered form, which can be used for fortification in product development *etc*. However, little work has been undertaken regarding substitution of semolina with mushroom powders to produce pasta like products. Although the utilization of mushrooms in many types of products such as in soups, sauces, pickles, *etc*. are popular in many countries, however, information on the use of mushroom powder in pasta products is very scanty

Pulses hold an important place in human nutrition on account of their rich nutritional contribution to diets, particularly for proteins, essential minerals and vitamins and dietary fiber. Studies have shown that combining cereal flour with pulses have been recommended to improve the quality of protein, since the amino acid profiles of the two food groups are complemented by their combination (Saxena *et al*., 2010). Soybean is rich in high quality proteins, and contains essential amino acids, similar to those found in meat (Nada and Lazic, 2011). Furthermore, soybeans also contain many biological active components, including isoflavones, lecithin, saponins, oligosaccharides and phytosterols (Singh *et al.*, 1996). With the constituents of good quality protein and phytochemicals, soybean has been accepted as the functional food that have a potentially positive effect on health beyond basic nutrition.

Germinated grains are better in nutritional quality on account of a higher protein, and starch digestibility, higher bioavailable minerals, B-complex vitamins, ascorbic acid and inactivation of many anti-nutritional factors (Luo and Xie, 2014). Among all legumes, green gram or Mung bean (*Vigna radiata*) is used extensively in germinated form in many countries. Present study explored the possibility of using germinated green gram as a vehicle for pulse fortification in the development of pasta.

Therefore an attempt was made to develop value added pasta products by substitution of functional ingredients like finger millet, pulse flour along with carrot, cauliflower leaf, and mushroom powder, and their sensory and nutritional evaluation were carried out.

MATERIALS AND METHODS

The experiment was conducted during 2016-18 in the Department of Community Science, Birsa Agricultural University, Ranchi. The seeds of white (JWM-1) cultivar of finger millet were procured in a single lot from the Department of Plant Breeding and Genetics, Ranchi Agriculture College, Birsa Agricultural University, Ranchi. Green gram, Soy bean, semolina, cauliflower leaves, and carrot were procured from local market in a lot. Oyster mushrooms were procured from the mushroom unit, Department of Plant Pathology, Faculty of Agriculture, Birsa Agricultural University, Ranchi-6 in a single lot.

The seeds of finger millet were cleaned of dust. Cracked and broken seeds and other foreign materials were handpicked. Ragi grains were conditioned with 5% water, tempered for about 10 mins, milled into a mini flour mill, and sieved through 40 mesh sieve (British Standard). The flour was packed in HDPE bags until used for product development.

Green gram were cleaned, soaked, and germinated for 24 hrs at 30°C ±2°C and dried in a dehydrator at 60±2°C for 6 hours. Dried germinated grains were milled to get fine flour. The flour was sieved through a 40 mesh sieve and stored in HDPE bags for further use.

The cleaned seeds of soybean were dehulled in a dehuller (CIAE model). The dehulled seeds were washed in tap water and boiled in an aluminum pot with a lid for 30 mins at 100°C. The boiling time was taken from the moment the water started to boil. The hydrated kernels were sun dried (30±2°C) for 2 days, milled using mini flour (CIAE model), and screened through a 40 mesh sieve (British standard). The flour was packed in HDPE bags until used for product formulation.

Mushrooms were cleaned, sorted, washed in tap water, and sliced into thin slices. The slices were dipped in sodium metabisulphite solution (0.5%, w/v) for 12 hrs. The slices were washed for 1 minute, drained in a basket for 15-20 minutes and oven dried (55°C±2°C, 7-8 hrs). The slices were milled and sieved through a 40- mesh sieve (British standard). The flour was packed in HDPE bags and stored until used.

The carrots were cleaned, washed in tap water, and sliced into thin slices (1 cm thick). The Slices were dipped in sodium metabisulphite solution (0.03%, w/v) for 30 mins. The slices were drained in a basket for 5 minutes and oven dried (55°C±2°C, 7-8 hrs). The slices were milled and sieved through a 40- mesh sieve (British standard). The flour was packed in HDPE bags and stored until used.

Leaves of cauliflower were cleaned, washed in tap water, and sliced into thin slices. The slices were shade dried, milled, and sieved through a 40- mesh sieve (British standard). The flour was packed in HDPE bags and stored until used.

Many initial trial were conducted in the laboratory to standardize to what extent finger millet flour, soya flour, green flour, carrot, cauliflower leaves and mushroom powder could be incorporated with semolina for the formulation of value added macaronis. After standardization, 3 types of macaronis were developed (Table 1). Macaronis prepared from semolina are only used as control.

The developed macaronis were boiled, and cooked by adding a known quantity of butter, vegetables, and sauce. The sensory quality of cooked pasta in respect of colour, appearance, aroma, texture, and taste was judged by 10 panelists using a 9- point hedonic scale (Lawless and Klein, 1991). Three identical preparation of each type of macaronis were pooled together into one sample, ground in a cyclotech grinder, and kept in an airtight container for chemical analysis. All analysis was done in triplicate.

All products were analyzed for moisture, total nitrogen, crude fibre, and total ash by standard method of AOAC (1990). A factor of 6.25 was used to convert nitrogen into protein.

For determination of calcium, iron, copper and zinc about 1.0 g of sample was digested with diacid mixture (H NO_3: $HClO_4$:5: 1, v/v). After complete digestion, the sample was heated to near dryness, and volume was made to 50 ml with double distilled water. Estimation of calcium, iron, copper and zinc was done using atomic absorption spectrophotometer (Lindsey and Norwell, 1969). Phosphorus was determined calorimetrically by using acid digested sample by the method of Chen *et al*. (1956). β- Carotene was analyzed using the method suggested by AOAC (1985).

The data were subjected to statistical analysis for analysis of variance and correlation coefficient in a complete randomized design according to standard methods (Panse and Sukhatme, 1961).

RESULTS AND DISCUSSION

Sensory evaluation of macaroni

The scores for the organoleptic evaluation of value added macaronis are summarized in Table 2. Three types of value added macaronis were tried out, and macaroni made from wheat semolina alone was kept as a control. Overall acceptability was highest for control followed by Type II, III and I, respectively. All characteristics of experimental macaronis were 'liked moderately'. Though colour, appearance, texture, and overall acceptability of experimental macaroni were significantly different from its control, yet it was organoleptically acceptable. Score of aroma and taste of developed macaronis showed non significant difference and were comparable to the control. The results of this study confirmed the claim of previous workers that cauliflower leaves, carrot, and mushroom powder could be used for development of value added products (Sadhna *et al*., 2018; Phebean *et al.*, 2017; Desayi *et al.*, 2012).

Chemical composition of value added macaroni

Chemical composition of nutritious macaronis is presented in Table 3. Moisture content of four types of macaroni ranged from 4.16 to 6.4 (Table 2). Moisture content of type I, II, and III macaronis were significantly higher as compared to control, and this might be due to the higher protein content of green gram flour (type II) and Soy flour (type I, III). Significantly ($P \leq 0.05$) higher moisture content observed in experimental macaroni as compared to control might be due to its high protein content which indicated a possible relationship between water absorption, and protein content. The result obtained in this study is in agreement with earlier workers (Singh *et al*., 2006; Sinha *et al*., 2013) who also reported that moisture content increased in soy fortified products.

The protein content varied from 10.75 to 15.43 per cent. Protein content of control macaroni was significantly lower than Type I, II, and III macaroni and this might be due to incorporation of green gram and soy flour. Protein content of type I, and type III were significantly higher as compared to type II, and this might be attributed to the higher protein content of soy flour as compared to green gram flour.

Fat content in control, type I, II, and III macaronis was 0.96, 2.91, 1.13 and 2.85 per cent, respectively. The fat content of Type I and III macaroni were significantly higher compared to control, which might be due to incorporation of soy flour. The finding of this study is in conformity with previous work (Sinha *et al*., 2013).

Ash content and crude fibre content ranged from 0.60 to 1.81 and 0.21 to 1.85 percent, respectively. Significantly higher ash content in type I, II, and III may be due to incorporation of finger millet, pulse flour and dried mushroom, carrot, and cauliflower leaf. Fiber content was found maximum in type III, and type II followed by Type I. Higher fibre content observed in type III, and type II may be due to incorporation of cauliflower leaf, and carrot powder. Calcium content of different types of macaroni as ranged from 33.33 to 225.00 mg/100 g. Highest calcium content

Table 1: Composition of value added macaronis.

Ingredients	Types of value added macaronis			
	Control	Type I	Type II	Type III
Semolina (g)	100	52.5	50	52.5
Ragi (g)	-	35	35	35
Full fat soy flour (g)	-	10	-	10
Germinated green gram (g)	-	-	10	-
Oyster mushroom powder (g)	-	2.5	-	-
Carrot powder (g)	-	-	05	-
Cauliflower leaf powder (g)	-	-	-	2.5

Table 2: Sensory evaluation of value added macaronis.

Product	Colour	Appearance	Aroma	Texture	Taste	Overall acceptability
Control	8.5±0.16	8.4±0.16	8.00±0.00	8.2±0.13	8.2±0.13	8.2±0.13
Type I	7.5±0.16	7.6±0.16	7.6±0.16	7.5±0.16	7.5±0.27	7.5±0.16
Type II	7.8±0.20	7.8±0.24	7.7±0.15	7.9±0.23	7.9±0.18	7.8±0.24
Type III	7.6±0.16	7.7±0.15	7.5±0.16	7.6±0.16	7.9±0.23	7.5±0.16
CD	0.50	0.53	NS	0.51	NS	0.53

Values are Mean±SE of ten replications; Type I= Ragi+Mushroom powder; Type II= Ragi+Carrot powder; Type III= Ragi+Cauliflower leaf powder.

Table 3: Chemical composition of value added macaronis (on dry weight basis).

Name of the nutrient	Control	Type-I	Type-II	Type-III	C.D P≤0.05
Moisture (%)	4.16±0.28	6.4±0.20	5.52±0.15	6.23±0.15	0.65
Protein (%)	10.75±0.13	15.43±0.11	12.23±0.09	15.32±0.05	0.337
Fat (%)	0.96±0.023	2.91±0.04	1.13±2.85	2.85±0.02	0.13
Ash (%)	0.60±0.00	1.80±0.01	1.42±0.01	1.81±0.02	0.04
Fibre (%)	0.21±0.00	1.82±0.01	1.75±0.02	1.85±0.02	0.07
Calcium (mg/100 g)	33.33±2.20	142.82±3.60	139.16±3.00	225.00±2.88	9.83
Iron (mg/100 g)	2.70±0.05	3.44±0.07	3.69±0.015	8.33±0.08	0.21
Phosphorus (mg/100 g)	99.00±0.51	195±2.88	186.66±1.6	205.00±2.88	7.36
β-Carotene (μg/100 g)	ND	55.00 ±0.57	122.33±1.45	57.66±0.88	2.97
Cu (mg/100 g)	-	0.21±0.02	0.15±0.04	0.22±0.03	0.07
Zn (mg/100 g)	-	1.06±0.03	1.24±0.05	1.06±0.04	0.09

Values are Mean±SE of three replications; Type I= Ragi+Mushroom powder+Soy flour; Type II= Ragi+Carrot powder+green gram; Type III= Ragi+Cauliflower leaf powder+Soy flour.

was found in type III macaroni followed by type I (142.82 mg/100 g) on a dry weight basis. High calcium content of type III is attributed to the incorporation of cauliflower leaf powder. Iron content of different types of macaronis varied significantly with each other. Maximum iron content was observed in type III followed by type I and type II. Similarly, significantly higher ash, and iron content of *laddoo* supplemented with cauliflower leaf powder has been reported by earlier worker (Sadhana *et al*., 2018).

β-Carotene was found maximum in type II which might be due to incorporation of carrot powder followed by type III and type I. In an earlier study also, addition of carrot powder increased the carotenoids content of biscuit significantly (Phebean *et al*., 2017). Phosphorus content of control macaronis was 99 mg/100 g, where as phosphorus content of value added macaronis ranged from 186.66 to 205 mg/100 g. Significantly higher phosphorus was observed in experimental macaronis could be due to incorporation of soy flour, green gram along with mushroom, cauliflower, and carrot powder, respectively. Similarly, significantly, higher copper and zinc content were observed in experimental macaronis.

CONCLUSION

It can be concluded that value added macaronis with better nutritional properties could be developed by incorporating finger millet, pulse, carrot, cauliflower, and mushroom powder. The inclusion of green gram or soy flour in the macaronis improved the protein content, while on the other hand inclusion of carrot, mushroom and cauliflower leaf powder improved the carotenoids, calcium, and iron content significantly. These macaronis can be exploited for commercial venture because of their high nutritional quality.

Conflict of interest: None.

REFERENCES

AOAC (1985). Official Methods of Analysis, Association of Official Analytical Chemists 14th Edition, Washington DC.

AOAC (1990). Official Methods of Analysis, Association of Official Analytical Chemists 16th Edition, Washington, DC.

Babic I., Amiot, M.J., Ngugen-The, C. and Aubert, S. (1993). Changes in phenolic content in fresh, ready-to-use and shredded carrots during storage. Journal of Food Science 58: 351.

Block, G. (1994) Nutrient source of pro-vitamin a carotenoids in American diet. America Journal of Epidemiology. 139: 290-293.

Chillo, S., Laverse, J., Falcone, P.M., Protopapa, A. and Delnobile, M.A. (2008). Influence of addition of buckwheat flour and durum wheat bran on spaghetti quality. J. Cereal Sci, 47(2): 144-152.

Chen, P.S., Tosikbara, T.Y and Warner, H. (1956). Micro determination of phosphorous. Anal Chem. 28: 1756-1759.

Desayi, D.B., Kukanoor, L.H., Patil, C.P., Shirur, M. and Shivakumar, B.B. (2012). Utilization of dried mushroom powder for development of mushroom fortified biscuits. Mushroom Research. 21(1): 67-71

Hansen, S.L., Purup, S., Christensen, L.P. (2003) Bioactivity of falcarinol and the influence of processing and storage on its content in carrots (*Daucus carota* L). Journal of the Science of Food and Agriculture. 83: 1010-1017.

Kowsalya, S. and Sangheetha, M. (1999). Acceptability and nutrient profile of cauliflower leaves (*Brassica oleraceae* var. Botrytis). India J. Nutr. Dietetics. 36: 332-338.

Lawless, H.T. and Kelin, B.P. (1991). Sensory science theory and application in foods. Marcel Dekker Inc, New York.

Lindsay, W.L. and Norwell, M.A. (1969). A new DPTA-TEA soil test for zinc and iron, Agron Abstract. 61: 84-85.

Luo, Y., Xie, W. (2014). Effect of soaking and sprouting on iron and zinc availability in green and white faba bean. J. Food Sci. Technol. 51(12): 3970-3976.

Nada, N. and Lazic, M. (2011). The main components contents, Rheology properties and Lipid profile of wheat-soyabean flour. Journal of Recent Trends for Enhancing the Diversity and Quality of Soyabean Products. 4(96): 307-533.

Panse, V.G. and Sukhatme, P.V. (1961). Statistical Methods for Agricultural Workers. 2nd edn. Indian Council of Agricultural Research, New Delhi.

Phebean, I.O., Akinyele, O., Toyin, A., Folasade, O., Olabisi, A. and Nnenna, E. (2017). Development and quality evaluation of carrot powder and cowpea flour enriched biscuits. International Journal of Food Science and Biotechnology. 2(3): 67-72.

Revathi, D., Sashidevi, G., Hemalatha, G. and Kanchana, S. (2019). Formulation of cookies from cauliflower leaves. Acta Hortic. 1241: 659-662.

Sadhna, S., Anjali, Y. and Sony, A. (2018). Nutritional evaluation and sensory characteristics of products developed from waste leaves of cauliflower. Int. J. Curr. Microbiol. App. Sci Special Issue. 7: 4782-4790.

Speizer, F.E., Colditz, G.A., Hunter, D.J., Rosner, B., Hennekens, C. (1999). Prospective study of smoking, antioxidant intake and lung cancer in middle aged women. Cancer Causes Control. 10: 475-482.

Singh, S., Kumar, C.G. and Chauhan, G.S. (2000). Production, processing and consumption patterns of mushrooms. Indian Food Industry. 14: 8-47.

Singh, R., Singh, G., Chauhan, G.S. (1996). Effect of incorporation of defatted soy flour on the quality of biscuits. J. Food Sci. Technol. 33: 355-357.

Saxena, K.B., Kumar, R.V. and Sultana, R. (2010). Quality nutrition through pigeon pea- A review. Health. 2: 1335-1344.

Singh, G., Sehgal, S. and Kawatra, A. (2006). Sensory and Nutritional evaluation of cake developed from blanched and malted pearl millet. J. Food Sci. Technol. 43(5): 505-508.

Sinha, R., Sharma, B. and Haider, Z.A. (2013). Quality assessment of pasta prepared from finngermillet, Aloe vera ad legume. Asian J. Dairy and Food Res. 32(1): 50-55.

Tripathi, S., Prasad, R., Gupta, A. and Puranik, V., (2015). Development of value added pasta with incorporation of malted finger millet flour. Journal of Applied and Matural Science. 7(2): 598-601.