Effect of spinach puree and hydrocolloid addition on sensory and cooking characteristics of instant noodles

Shere P.D.*, Devkatte A.N., Pawar V.N.

MIT College of Food Technology, MIT Art, Design and Technology University, Pune, India.

Abstract: In present investigation efforts were made to enrich the instant noodles with spinach puree also to study the influence of hydrocolloids; carboxy methyl cellulose (CMC) and guar gum addition on sensory and cooking quality characteristics of spinach puree enriched instant noodles. Spinach puree was added at 10, 20, 30, 40 and 50g per 100g refined wheat flour. The preferred formulation was further selected to study the effect of hydrocolloid addition on cooking characteristics. Both the hydrocolloids were added at 0.25, 0.5 and 0.75% in noodle formulation containing 40g spinach puree per 100g refined wheat flour (SP_{40}) based on sensory evaluation results. The sensory evaluation results indicated that addition of CMC at 0.5% and guar gum at 0.25% was preferred compared to SP_{40} sample. The cooking time and cooking loss decreased with addition of spinach puree in noodles whereas incorporation of additives increased cooking time and decreased the cooking loss.

Keywords: spinach noodle, CMC, guar gum, quality

Introduction

Noodles are one of the staple foods of Asian countries. The increased noodle consumption is because of the convenience in cooking, palatability, less cost, long shelf life, ease of transportation. Traditional noodles are claimed to lack dietary fiber, vitamins and minerals. Consumer food demands have changed considerably over last decades giving rise to the development of functional foods which not only satisfy hunger but also prevent diseases and improve physical and mental well-being Betoret *et al.,* (2011). Noodles are the first food authorized by food and drug administration as a good vehicle for addition of bioactive compounds.

Spinach is an important vegetable in human diet providing vitamins, minerals, dietary fibres and phytonutrients. Spinach is rich source of vitamin A, C, E, K as well as minerals such as calcium, potassium, zinc, magnesium, manganese and others. Spinach extracts have several beneficial effects, such as anticancer, antiaging and protecting of central nervous system (Lomnitski *et al.,* 2003). Noodle enrichment with spinach puree is still limited Rekha *et al.,* (2013) and Deep *et al.,* (2014). Incorporation of spinach puree in noodles will increase the vegetable intake in diet of consumers of all age groups. Spinach (low energy dense) enrichment in noodles will be an effective strategy to address the issue of childhood obesity due to consumption of high energy dense fast foods.

The objective of present investigation was to develop spinach puree enriched instant noodle formulation as well as to study the effect of hydrocolloids (carboxy methyl cellulose and guar gum) addition on cooking, textural and microstructural properties of enriched noodles.

2 Materials and Methods

2.1 Raw materials

Refined wheat flour, common salt, whole egg, water

2.2 Spinach puree

Fresh spinach leaves were procured from local market. Leaves were washed, sorted, stalks were removed. Leaves were cut into pieces, steam blanched for 3 minutes and ground to fine slurry in grinder.

2.3 Noodle making

Noodles were prepared according to method described by Collado and Corke (1996) with some modifications. The noodles were prepared in an automatic laboratory Kent noodle maker. Dry ingredients were first mixed for 5 minutes, the wet ingredients like whole egg, salt solution and water were added to form crumbly dough which was then extruded through a die with 12 outlets of 0.8 mm in diameter. The noodles were cut and cooked in steam for 5 minutes and dried at 50°C for 5 hours and packed in polyethylene pouches. The noodles prepared from blends of spinach puree and refined wheat flour is presented in plate 1.

Plate 1: Spinach enriched instant noodles

2.4 Sensory evaluation of noodles

The sensory evaluation was carried out to assess the overall acceptability of carrot puree enriched noodles. The noodle samples were cooked in boiling water for 7-10 minutes and quality parameters like color, taste, flavour, texture of test noodles were evaluated against the control sample. The cooked noodles were then analysed for overall acceptability by 10 semi-trained panellists on 9 point hedonic scale.

2.5 Noodle cooking qualities

2.5.1 Optimal cooking time

To determine optimum cooking time, 250 g of noodles were dispersed in 250ml boiling water. For every 30 seconds, a piece of noodle was held between a plastic paper and pressed gently until the white color of noodle at central portion of strand disappears. Optimum cooking time was achieved when the centre of noodles become transparent.

2.5.2 Gruel loss

Gruel loss was determined by measuring the amount of solid substance lost to cooking water. 10g noodle sample was placed into 300 ml boiling distilled water in a 500 ml beaker. Cooking water was collected in an aluminum petri dish and placed in oven at 105^0C and evaporated to dryness. The residue was weighed and reported as percentage of starting material.

$$\text{Gruel loss (\%)} = \frac{\text{Dried residue in cooking water}}{\text{Noodle weight before cooking}} \times 100$$

2.5.3 Water absorption

The water absorption was determined by the ratio of the weight of cooked noodles to the weight of noodles before cooking as described by AACC (2005).

$$\text{Water absorption (\%)} = \frac{\text{Weight of cooked noodles – weight of raw noodles}}{\text{Weight of raw noodles}} \times 100$$

2.5.4 Swelling index

The swelling index of cooked noodles was determined according to the procedure described by Cleary and Brennan (2006). The Swelling index was expressed as weight of cooked noodle.

$$\text{Swelling Index} = \frac{\text{Weight of cooked noodles – weight of noodles after drying}}{\text{Weight of noodles after drying}}$$

2.6 Statistical analysis

The data obtained from the laboratory experiment was analyzed using completely randomized design and appropriately interpreted as per the methods described in Statistical methods for agricultural workers by Panse and sukhatme (1985). Appropriate standard error (S.E) and critical differences (C.D.) at 5% level were worked out as and when necessary and used for data interpretation.

3. Result and Discussion

3.1 Sensory evaluation of spinach noodles

The colour of the product was greatly improved with addition of spinach puree. The colour is the first quality parameter that identifies the consumer in food. The maximum score was allotted to the sample SP_{30} and SP_{40} as compared to control. Flavour, texture and overall acceptability were significantly improved with addition of spinach puree in noodles. Overall acceptability was greatly improved in SP_{30} and SP_{40} samples. However, the results pertaining to test were not encouraging as the spinach imparts its vegetable taste to the product. Therefore taste parameter obtained lesser score. The similar results with respect to the colour were reported by Rekha *et al.*, (2013). Similar results of increasing sensory parameters were reported by Keyimu (2013) with addition of seaweed puree in noodles up to 3 levels. Yadav *et al.*, (2014) also reported that spinach incorporated pasta was most acceptable than rest of the pastas. SP_{40} sample was selected for further studies.

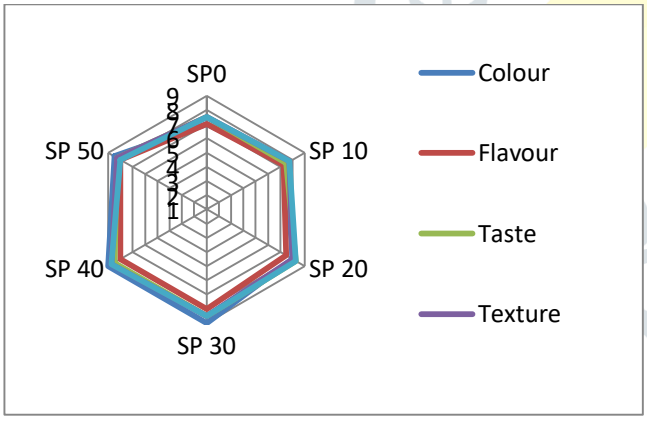

Fig. 1 Sensory evaluation of spinach puree enriched instant noodles

Table1 Sensory Evaluation of Spinach Noodles added with CMC

Concentration (%)	Colour	Flavour	Taste	Texture	Mouth feel	Overall acceptability
SP_{40}	9.00	8.00	8.25	8.25	8.00	8.00
0.25	8.75	8.00	8.25	8.25	8.50	8.00
0.5	8.75	8.00	8.00	8.50	8.50	8.25
0.75	8.00	8.25	8.25	8.00	8.00	8.00
SE ±	0.0884	0.1179	0.0884	0.0884	0.0884	0.1215
CD at 5%	0.2661	0.3548	0.2661	0.2661	0.2661	0.3657

Table2 Sensory Evaluation of Spinach Noodles added with guar gum

Concentration (%)	Colour	Flavour	Taste	Texture	Mouth feel	Overall acceptability
SP_{40}	9.00	8.00	8.25	8.25	8.00	8.00
0.25	8.50	8.25	8.25	8.75	8.75	8.50
0.5	8.25	8.00	8.00	8.50	8.50	8.25
0.75	8.25	8.00	7.50	7.50	7.50	8.00
SE ±	0.051	0.051	0.051	-	0.1141	0.1035
CD at 5%	0.1536	0.1536	0.1536	-	0.3435	0.3155

Sensory evaluation of spinach noodles with CMC and Guar gum was performed to optimize the level of additives in noodles. A product, even if it is highly nutritious but does not taste good will not be accepted by consumer. Thus, sensory evaluation is a very important and crucial criterion in developing formulation Dhiraj and Prabhashankar (2013). Hydrocolloids were incorporated to the highly preferred spinach puree enriched noodle formulation (SP_{40}) as shown in fig. 1. Colour, flavour, taste were not significantly affected by type of hydrocolloid added however, texture, mouthfeel and overall acceptability was improved with addition of CMC up to 0.5%. The results pertaining to guar gum clearly indicated that addition of guar gum significantly improved the texture; overall acceptability and mouth feel at 0.25%. However, further increase in guar gum imparted stickiness and sliminess to the noodle strands and hence, scored less compared to control (SP_{40}).

3.2 Influence of hydrocolloid addition on cooking quality of spinach noodles

Table 3 Cooking qualities of spinach noodles with CMC

Concentration (%)	Cooking time (min)	Cooking weight (%)	Gruel loss (%)	Water absorption (%)	Swelling index ml/g
SP_{40}	5.18	260.75	7.40	160.7	1.89
0.25	7.18	279.40	6.62	165.9	1.59
0.5	7.20	285.10	6.20	168.20	1.48
0.75	7.32	300.00	6.10	171.50	1.29
SE ±	0.1161	0.7295	0.448	0.4830	1.069
CD at 5%	0.3495	2.1961	0.1348	1.9919	0.3118

Table 4 Cooking qualities of spinach noodles with guar gum

Concentration (%)	Cooking time (min)	Cooking weight (%)	Gruel loss (%)	Water absorption (%)	Swelling index (ml/g)
SP_{40}	5.18	261.85	7.40	160.70	1.89
0.25	7.40	274.50	7.30	165.30	1.79
0.5	8.10	280.10	7.10	170.58	1.49
0.75	8.50	290.50	7.00	175.30	1.36
SE ±	0.1547	0.4730	0.0232	0.1021	0.0998
CD at 5%	0.6382	1.4239	0.698	0.3072	0.3005

The cooking time significantly increased with increase in level of CMC and guar gum in the formulation. The cooking time increased from 5.18 minute to 7.32 minute in CMC and from 5.18 minute to 8.50 minute in guar gum formulation. The increase in cooking time with addition of gum has also been reported by Kaur *et al.,* (2015) and Khatkar and Kaur (2018). The increase in cooking time may be attributed to restriction of water availability to the starch granules in noodle strands causing delay in swelling and gelatinization. Noodles prepared with CMC and guar gum showed significantly lower gruel loss (cooking loss). The percent gruel loss in spinach noodles added with CMC decreased from 7.40% to 6.10% and from 7.40% to 7.00% with addition of guar gum. The lower gruel loss may be attributed to formation of complex between amylose and hydrocolloids added in formulation. Singh *et al.,* (2002) and Liu *et al.,* (2003) also reported that addition of hydrocolloids decreased solubility of starch polymer molecules within the swollen granules causing reduction of leaching loss in cooking water.

CMC and guar gum added noodles exhibited significant higher cooking weight and water absorption with increase in percentage of additives in formulation. Both guar gum and CMC have hydrophilic nature, they have affinity to absorb the water molecules through hydrogen bonding and thus addition of CMC and guar gum exhibited increased cooking weight and water absorption in both spinach noodles. Similar observations of increased water absorption and cooking yield by incorporation of hydrophilic guar gum were also recorded by Chandra *et al.*, (2015). Increase in cooked weight was also recorded by Kaur *et al.*, (2015). This may be due to higher swelling of cooked strands. Further it can also be observed from these tables that there was continuous decrease in swelling index of noodles with increase in percentage of hydrocolloids in formulation.

Conclusion

It can be concluded that enrichment of instant noodles with spinach puree is preferred up to a level of 40g per 100g refined wheat flour (SP_{40}). The cooking time and gruel loss or cooking loss decreased in spinach noodles compared to control noodles (100% refined wheat flour) which is attributed to dilution of gluten protein with spinach puree as well as better binding of vegetable fibres with starch-protein matrix. SP_{40} sample was studied for incorporation of hydrocolloids such as CMC and guar gum. The sensory evaluation concluded 0.5% level of CMC and 0.25% guar gum addition. The guar gum imparted stickiness in noodle strands above the specified limits and scored less in mouthfeel characteristics. The cooking and mouthfeel characteristics of hydrocolloid added noodles were improved compared to SP_{40} sample.

References

AACC (2005) Approved methods of the American Association of cereal chemists.St paul Minnesota.

Betoret, E., Betoret N., Vidol D. and Fito P. (2011). Functional foods development. Trends in Food Science and Technology. 22(9): 498-508.

Cleary L. and Brennan C. (2006). The influence of (1→3)(1→4) β glucan rich fraction from barley on the physicochemical properties and in vitro reducing sugars release of duram wheat pasta. International Journal of Food Science and Technology. 41: 910-918.

Collado, L.S and Corke, H. (1996). Use of wheat-sweet potato composite in yellow alkaline and white salted noodles. Cereal chemistry 73(4): 439-444.

Deep, N.Y.,Yadav M,Sharma N Chilkara T,Anand S.B. (2014) Quality characteristics of vegetable blended wheat-pearl millet composit pasta. *Agri Res*, 3:263-270.

Dhiraj,B. and prabhashankar,P. (2013).Influence of wheat milled products and their additive blends on pasta dough rheological, microstructure and product quality characteristics.InternationalJournal of Food Science: 1-11.

Kaur, A., Singh,N., Katyl, M.,Virdi, A.S., Kaur,D.,Ahlawal,A.K. and Singh, A.M. (2015).Relationship of various flour properties with noodle making characteristics among durum wheat varieties. Food Chemistry 188: 157-526.

Keyimu xiren guli (2013). The effects of using seaweed on the quality of asian noodles. Journal of Food Process Technology 4(3): 1000216-1000219.

Khatkar,A.B. and Kaur,A. (2018). Effect of different methods of instantisation, drying and gum addition on quality characteristics of instant noodles. Food Nutrition OA 1(1): 103.

Liu, H., eskin, NAM, Cui, S.W. (2003) Interaction of wheat and rice starches with yellow mustard mucilage. Food Hydrocolloids 17:863:869.

Lomnitski L., Bergman M., Nyska A., Ben-Shaul V., Grossman S. (2003) Composition, efficiency and safety of spinach extracts. Nutrition and cancer, Vol. 46 (2), pg. 222–231.

Panse, V.S. and sukhatme, V.S. (1967) Statistical methods for agricultureal workers. ICAR., New Delhi

Rekha M. N.,Chauhan A.S.,Prabhashankar,P,Ramteke,R S and Venkateswara Rao G. (2012). Influence of vegetable paste on quality attributes of pastas made from bread wheat (*T.Aestivum*) Cyta Journal of Food. 11:142-149

Singh, N., Singh N. Singh, J. Sodhi, N.S. (2002) Morphological, Thermal, rheological and noodle making properties. Journal of Science Food and Agriculture 82: 1376-1383.

Yadav Suman, Gupta Rajinder, K. (2015). Formulation of noodles using apple pomace and evaluation of its phytochemicals and antioxidant activity. Journal of Pharmacognosy and Phytochemistry, 4(1): 99-106.

Yadav, D.N., Chikkara,N., Anand,T., and Singh, A.K. (2014) Co-extrusion of pearl millet-whey protein concentrate for expanded snacks. International Journal of Food Science and Technology 49 (3): 840-846.