



Physical, Cooking and Sensory Characteristics of Pasta Developed with Underutilized Leafy Vegetables

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ABSTRACT

The objective of this study was to incorporate different leafy vegetables and their effect on physical, cooking and sensory parameters of pasta products. Different leafy vegetables, such as radish, carrot and beetroot were required. Incorporation of green leafy tops rendered greenish yellow color to the pasta. There was no much variation observed in the length and width between pasta products. The weight of 100 pasta was found to be highest with radish greens and on par with the control. Also similar results were obtained with respect to hydration capacity/ water absorption capacity and hydration index. Swelling capacity and swelling index was lower in developed products than the control. The highest cooked weight was observed in pasta from carrot greens (281 g/100g). The highest cooked ratio was found with respect to carrot leaf pasta (1:3.7). The sensory scores for appearance, texture, color, flavor, taste and overall acceptability of experimental pasta products was on par with the control.

Keywords: Pasta products, Sensory, Hydration index, Cooked ratio

INTRODUCTION

Green leafy vegetables play an important role in the human nutrition as they provide adequate amounts of vitamins and minerals. They are rich source of β -carotene, ascorbic acid, riboflavin, folic acid and minerals like calcium, iron and phosphorous. Green leafy vegetables are the most suitable foodstuffs for enriching dietary iron of the Indians because bioavailability of iron in green leafy vegetables is very high compared with cereals and pulses and they are easily available in any season of the year at low cost (Kavitha, 2003).

Many of the green tops of root vegetables are very rich in protein, vitamins and minerals, which are mostly discarded or used as cattle feed. These can be effectively utilised to meet the daily intake of green leafy vegetables at a lower costs. Beet leaves (*Beta vulgaris*), carrot leaves (*Beta vulgaris*) and raddish leaves (*Raphanus sativus*) are such examples which have been found nutritionally superior to their roots and tubers as well as available throughout the year. And also the use of these green leaves in their fresh form can reduce the need for water during the pasta preparation.

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Pasta products are normally high in starch but low in dietary fiber, minerals, vitamins, phenolic compounds, etc. It is necessary to make them nutrient rich in order to produce the high quality pasta to provide a balanced snack/meal. Hence the present study was conducted to evaluate the utilization of green leafy vegetables in the production of pasta products.

MATERIALS AND METHODS

Beet, radish and carrot leaves were procured from the local market in Bangalore city. Other ingredients such as rice flour, wheat flour and skim milk powder for the development of product were procured from the food bazars.

Beet, radish and carrot leaves were cleaned and unwanted parts were removed. Then they were washed in lukewarm water with the addition of limestone and turmeric for 2-3 times. Excess water is drained and made into fine paste, to be incorporated during pasta preparation, using domestic mixer.

The pasta products were prepared by incorporating beet, radish and carrot leaves paste at 100g/1000g of flour. The flour was mixed in cold extruder pasta machine for 2 -5 minutes. Further mixing was continued for 20 – 30 minutes using leafy vegetable paste and water. Water used was 370 ml per kg. The dough was extruded using a brass die with spiral shape pasta. The extruded pasta was dried till it reached 9-10 per cent moisture in tray driers at 90°C. The samples were then packed at room temperature in polythene bags and sealed.

Physical characteristics of leafy vegetable pasta

Appearance

Color of the pasta was recorded using RHS (Royal Horticultural Society) color chart.

Length

Length of the pasta was measured by the hand calipers, 25 dried pastas were taken in duplicates and measured in centimeters and average was calculated.

Width

Width of the pasta was measured by the hand calipers, 25 dried pastas were taken in

duplicates and measured in centimeters and average was calculated.

Width to length ratio

Width to length ratio of pasta was calculated using length and width and expressed in percentage.

Weight of pasta

100 pastas were counted in duplicate for each variation and weighed. Then the average is taken.

Hydration capacity (Williams et al., 1983)

Hydration capacity was measured by placing 100 pastas overnight into a beaker containing water. Next day, water was drained off and pastas were air dried and weighed. Hydration capacity was calculated as

HC = Weight after soaking – Weight before soaking

Hydration index (Williams et al., 1983)

Hydration index was calculated as

HI = $\frac{\text{Hydration capacity}}{\text{Pasta weight}}$

Pasta weight

Swelling capacity (Williams et al., 1983)

Swelling capacity was measured by adding 100 pastas of known volume into a flask and soaked in water overnight. Subsequently water was drained off and pasta was dried and displaced volume was measured in graduated jar. Swelling capacity was calculated as

SC (ml) = Volume after soaking (ml) – Volume before soaking (ml)

Swelling index (Williams et al., 1983)

Swelling index was calculated as

SI = $\frac{\text{Swelling capacity}}{\text{Pasta weight}}$

Pasta weight

Cooking quality of leafy vegetable pasta

Dried pasta (50 g) was boiled in 500 ml of water until completely cooked. Cooked samples were drained over a screen to separate the liquid portion and weighed. The cooking water was collected and transferred to a petridish and dried at 105°C to a constant weight to assess the leached out solids.

Hydrated volume was measured by using cylinder and expressed as ml/100g of dry pasta sample.

Cooking loss (CL) was expressed as percentage of the weight of dry solids leached

out in cooking water to the dry pasta weight before cooking.

Sensory quality of leafy vegetable pasta

The cooked pasta samples were evaluated by ten semi trained panel members from the Department of Food Science and Nutrition, University of agricultural Sciences, GKVK and Bangalore, for appearance, texture, flavor, taste and overall acceptability on a 9 hedonic point scale.

RESULTS AND DISCUSSION

Physical characteristics

The physical characteristics of pasta with selected leafy vegetables are shown in Table 1. Incorporation of green leafy tops rendered greenish yellow color to the pasta. There was no much variation observed in the length and width between pasta products. L/W ratio was reduced in incorporated pasta as compared to control.

The weight of 100 pasta was found to be highest in pasta with radish greens which was on par with the control. Also similar results were obtained with respect to hydration capacity and with reference to hydration index, not much variation was observed between experimental pasta products and control. Swelling capacity and swelling index was lower in experimental products than the control.

Cooking quality of pasta

The results of cooking quality of experimental pasta and control are presented in Table 2.

The cooked weight of pasta ranged from 250 to 281 g/100g with an average value of 260.5 g/100g. The highest cooked weight was observed in pasta from carrot greens (281 g/100g) and lowest was observed in control (250 g/100g). It was observed that all the experimental pasta products had highest cooked weight than the control. This may be due to the incorporation of greens.

Statistically significant difference was found at 5% level between the products and interaction with respect to cooked weight.

Cooking loss of pasta during cooking ranged from 15 to 19.5% with a mean value of 16.6%. The maximum cooking loss was

observed with the pasta prepared from beetroot leafy vegetable (19.5%) and minimum in radish leafy vegetable pasta (15%).

Statistical analysis showed significant difference at 5 per cent level between the products and interaction with respect to cooking loss.

The water uptake during cooking of pasta products ranged from 465 to 540 ml/100g. The maximum water uptake during cooking was observed with beetroot leafy vegetable pasta (540 ml/100g) and lowest in pasta from radish greens (465 ml/100g).

Statistically significant difference at 5% level was observed between the products with respect to water uptake.

The variation was observed with respect to cooked weight, cooking loss and water uptake in all the experimental pasta. This variation observed may be due to changes in optimal degree of protein polymerization during drying and/or the subsequent cooking as reported by Brunnel et al. (2010).

Yield ratio before and after cooking

Ratio of raw to cooked pasta was compared between experimental and control (Table 3). The cooked ratio of pasta products ranged from 1:2.8 to 1:3.7. The highest cooked ratio was found with respect to beetroot leaf pasta (1:3.7) and lowest in carrot leaf pasta (1:2.8). Experimental pasta products had the highest cooked ratio compared to control.

Changes in physical characteristics of pasta after cooking

Increase in length and width of the pasta after cooking are shown in the Table 4. There was an increase in length and width of the pasta products after cooking. The maximum increase in length was observed in the experimental pasta products. This may be due to the addition of green leaves, which contains the fiber, which helps in absorbing more water. The presence of solids instead of only water influenced the length and width of the pasta upon cooking by the uptake of water. Though swelling capacity and swelling index was low on soaking, cooking increased the L/W ratio due to stabilization on heating as observed by Devaraju, (2003) that finger millet flour +

refined wheat flour + whey protein concentrate had the more swelling capacity and swelling index after soaking and also retained the original structure .

Mean sensory scores of products

The mean sensory scores of pasta with leafy vegetables after cooking are presented in the Fig. 1.

The sensory scores for appearance, texture, color, flavor, taste and overall acceptability of experimental pasta products was on par with control. Statistically significant difference was not found with respect to sensory characters, which indicated all were equally accepted.

Table 1: Physical characteristics of products

Pasta	Length (cm)	Width (cm)	L/W ratio	Weight of 100 pasta (g)	Hydration Capacity (g)	Hydration Index	Swelling Capacity (ml)	Swelling Index
Control	3.24	1.10	2.94	88.00	6.50	0.07	-41.00	-0.46
RLP	3.04	1.10	2.76	88.25	6.75	0.07	-34.00	-0.38
BLP	3.02	1.10	2.74	85.00	5.50	0.06	-38.00	-0.44
CLP	3.15	1.10	2.86	74.50	5.50	0.07	-40.00	-0.46
Mean	3.11	1.10	2.85	83.93	6.06	0.06	-37.00	-0.43
F value	NS	NS	NS	*	*	*	*	*

Note: * significance level at 5%

Control –Wheat flour

RLP –Radish leafy pasta

BLP –Beetroot leafy pasta

CLP –Carrot leafy pasta



Control



Radish leaf pasta



Carrot leafy pasta



Beetroot leaf pasta

Table 2: Cooking quality of pasta

Pasta	Cooked weight (g/100g)	Cooking loss (%)	Water uptake (ml/100g)
Control	250.00	16.3	520.00
RLP	255.00	15.0	465.00
BLP	256.00	19.5	540.00
CLP	281.00	15.6	515.00
Mean	260.50	16.6	510.00
F-value	*	*	*
CD	42.19	3.17	10.00

Note: * significance level at 5%

Control –Wheat flour

RLP –Radish leafy pasta

BLP –Beetroot leafy pasta

CLP –Carrot leafy pasta

Table 3: Yield ratio before and after cooking

Pasta	Raw weight(g)	Cooked weight(g)	Ratio
Control	88.25	255	1:2.9
RLP	85.00	256	1:3.0
BLP	74.50	281	1:3.7
CLP	88.00	250	1:2.8
F value	*	*	*

Note: * significance level at 5%

Control –Wheat flour
 RLP –Radish leafy pasta
 BLP –Beetroot leafy pasta
 CLP –Carrot leafy pasta

Table 4: Changes in physical characteristics of pasta after cooking

Pasta	Before cooking		After cooking		Increase in length(cm)	Increase in width(cm)
	Length(cm)	Width(cm)	Length(cm)	Width(cm)		
Control	3.24	1.10	3.55	1.30	0.31	0.20
RLP	3.04	1.10	3.58	1.33	0.54	0.23
BLP	3.02	1.10	3.53	1.20	0.51	0.10
CLP	3.15	1.10	3.64	1.28	0.49	0.18
Mean	3.11	1.10	3.57	1.27	0.46	0.17
F value	NS	NS	NS	NS	*	*

Note: * significance level at 5%

Control –Wheat flour
 RLP –Radish leafy pasta
 BLP –Beetroot leafy pasta
 CLP –Carrot leafy pasta

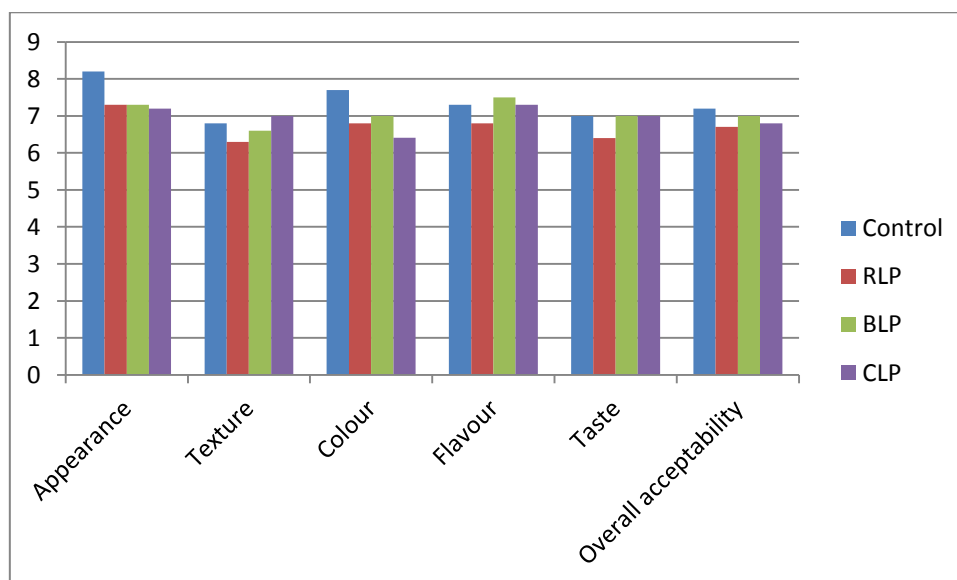


Fig. 1: Sensory parameters of pasta products

CONCLUSION

Pasta products are the most popular food next to bread and it is consumed worldwide. Pasta is generally a cereal based product which is becoming popular worldwide because of its convenience, low cost, ease of preparation and

palatability. Incorporation of leafy vegetables can increase the physical, cooking quality and acceptability of the pasta products. The results showed that the incorporation of green leafy tops rendered greenish yellow color to the pasta. Cooking quality of experimental pasta

products were good compared to control with respect to cooked weight, cooking loss and water absorption. Furthermore, experimental pasta products were found to be better than control in terms of increase in length and width after cooking. Also, experimental pasta products had good acceptability rate which was on par with the control.

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