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Enhancement of nutritional quality of pasta by incorporating underutilized greens

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Abstract

In nature, there are many underutilized greens of promising nutritive value, which can nourish the increasing population. Therefore a study on "Enhancement of nutritional quality of pasta by incorporating underutilized greens" was carried out. The underutilized green leafy tops of Beetroot, Radish & Carrot were selected. Pasta products were developed by incorporating 10 gms of fresh leafy paste to 100gms of wheat flour. Nutritional composition of the pasta products were analyzed using AOAC (1980) and other standard procedures, expressed on dry weight basis. Results revealed that maximum moisture content was found in pasta incorporated with Radish leafy vegetable (7.8 per cent). Statistically significant difference existed for protein (16.8g/ 100g), fat (1g/100g) and crude fiber (3.7g/100g) content, which was highest in pasta incorporated with Carrot leaves, whereas carbohydrate of 76.5g/100g and energy value of 362 kcal/100g were found highest in the control pasta. Ash is an indicator of mineral composition and found highest in both pasta incorporated with Radish and Carrot leaves (1.8g/100g) and dietary fiber was found maximum for pasta incorporated with Beetroot leaves (8.2g/100g). Micronutrient composition was found to be maximum for the developed products than the control. Carrot leafy incorporated pasta contained highest calcium (390.1mg/100g), whereas beetroot leafy incorporated pasta contained highest iron (9.5 mg/100g) and β -carotene (1.5 mg/100g). Phytonutrient oxalate ranged from 21.5 and 76.0mg/100g in developed pasta and same was not detectable in control pasta. From the study it could be concluded that, incorporation of underutilized leafy vegetables in the pasta products have enhanced the macro and micronutrient value. It can be popularized among the people and entrepreneurs to add value to the diet.

Keywords: Underutilized greens, pasta, balanced food

Introduction

India's flora comprises of 6000 species of plants used for human consumption, 1/3rd of which are green leafy vegetables. Green leafy vegetables are very good source of minerals and vitamins and when consumed regularly, they can substantially improve micronutrient status of the Indian population. Several of these are used for medicinal purpose also. The health-promoting properties along with their rich nutrient profile make green leafy vegetables an important nominee for their use in the food-based approach to combat micronutrient deficiencies in India. Selected products such as biscuit, mathi, matar and sev supplemented with amaranthus leaf powder had significantly higher protein, fat, ash and fiber contents as compared to the control ^[1]. Value addition with green leafy vegetables enriches the nutritive value of traditional recipes appreciably ^[2]. Hence a study was undertaken with an objective to incorporate underutilized greens of commonly consumed root vegetables in pasta products and analyzed for their nutrient composition for nutritional enhancement.

Material and Methods

Some of the commonly consumed tuber and root vegetables like beetroot, carrot and radish greens were selected for the enrichment of pasta products and further analysis. Pasta products were developed by incorporating 10% of fresh leafy paste to the flour base and chemical composition of the pasta products were analyzed using standard procedures ^[3] and expressed on dry weight basis.

Results and Discussion

The nutrient composition of the greens and pasta products incorporated with beetroot, carrot and radish leaves are presented in the Table 1, 2 and 3.

Nutrient composition of underutilized greens

Nutrient compositions of underutilized greens are presented in Table 1. Beetroot, Carrot and Radish leaves are the excellent source of micronutrients, in which the roots and tubers are

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commonly used as vegetables but the greens are mostly discarded or used as cattle feed. These are available throughout the year at low/no cost. Green leafy vegetables are good sources of iron and β -carotenoids, providing around 5–10 mg per 100 g of iron on an average. It has been reported that available β -carotene from fruits and vegetables in India is 95%, and out of this 90% is contributed by green leafy vegetables. An increased intake of β -carotene rich food in the daily diet may be one of the strategies for improving vitamin

A status among children instead of synthetic vitamin A [4]. India, having a variety of natural climates and seasons, has a number of nutritionally and medicinally important plant species such as spinach, coriander, amaranth, curry leaf, and mint, which are relatively inexpensive and readily available throughout the year [5]. Inclusion in our daily diet about 50 g of green leafy vegetables which are rich sources of iron can meet a fair proportion of iron besides providing calcium, β -carotene and vitamin C.

Table 1: Nutritional composition of beetroot, carrot and radish greens per 100 g.

Nutrients	Beetroot (<i>Beta vulgaris</i>)	Carrot (<i>Daucus carota</i>)	Radish (<i>Raphanus sativus</i>)
Moisture (%)	86.40	76.6	40.50
Protein (g)	3.40	5.10	43.07
Fibre (g)	0.70	2.80	41.64
Energy (kcal)	46.00	77.00	0.07
Iron (mg)	16.20	8.80	0.26
β -Carotene (μ g)	5,862	5,236	4,896

Table 2. The Macronutrient Composition of Products

Pasta	Moisture (g)	Protein (g)	Fat (g)	Ash (g)	Crude Fiber (g)	Carbohydrate (g)	Energy (Kcal)	Dietary fiber (g)
Control	7.0	13.4	0.6	0.7	1.8	76.5	362	4.2
RLP	7.8	15.4	0.9	1.8	2.9	71.2	354	7.8
BLP	6.5	15.2	1.0	1.6	3.1	72.6	360	8.2
CLP	5.5	16.8	1.0	1.8	3.7	71.2	361	7.4
Mean	6.7	15.2	0.8	1.4	2.8	72.8	360	6.9
F value	*	*	NS	*	*	*	NS	*
SEM	0.2062	0.3082	0.1323	0.2926	0.2121	0.8874	5.0498	0.4924
CD	0.8093	1.1900	0.5193	1.1488	0.8328	3.4837	19.8246	1.9333

*Significant at 5% level

Control –Wheat flour

RLP –Radish leafy pasta

BLP –Beetroot leafy pasta

CLP –Carrot leafy pasta

Table 3: The Micronutrient Composition of Products

Pasta	Calcium (mg)	Iron (mg)	β - carotene (mg)
Control	162.3	3.5	0.1
RLP	360.2	6.4	0.7
BLP	382.4	9.5	1.5
CLP	390.1	7.9	0.6
Mean	323.7	6.8	0.7
F value	*	*	*
SEM	0.9818	0.4416	0.0866
CD	3.8544	1.7336	0.3400

*Significant at 5% level

Control –Wheat flour

RLP –Radish leafy pasta

BLP –Beetroot leafy pasta

CLP –Carrot leafy pasta

Nutrient composition of pasta products

i) Macronutrient composition of pasta products

The moisture content of pasta incorporated with underutilized greens ranged from 5.5 to 7.8 per cent with a mean value of 6.7 per cent. Maximum moisture content was found in pasta of radish leafy vegetable (7.8 per cent) and minimum for pasta of carrot leafy vegetables (5.5 per cent). Moisture content of pasta products was dependent on the method and duration of the drying.

The protein content of pasta of green leafy vegetables ranged from 13.4 to 16.8 g/100g with a mean value of 15.2 g/100g. Significantly highest protein content was found with pasta of carrot leafy vegetable (16.8 g/100g) and minimum for control (13.4 g/100g). Carrot greens contained the highest protein

content compared to radish and beetroot greens [6]. The values observed for protein were on par with the values in nutritive value of Indian foods. Protein contents of coriander, bengal gram, spinach, cauliflower and amaranth leaves were 22.2, 26.2, 26.5, 29.9 and 26.2 percent, respectively [7].

The fat content of pasta of green leafy vegetables ranged from 0.6 to 1.0 g/100g with a mean value of 0.8 g/100g. The maximum fat content was found with pasta of carrot and beetroot leafy vegetable (1.0g/100g) and minimum for control (0.6g/100g). The lowest fat content was observed in all the products because of the use of ingredients with very less fat content and no visible fat was used during the preparation of pasta.

Ash content ranged from 0.7 to 1.8 g with the average value of 1.4 g. Ash content was found maximum in pasta of radish and carrot leafy vegetable (1.8g) and minimum for control (0.7g). Ash content, which is an indicator of minerals, was highest in the experimental products than the control. This may be due to the green leaves contributing to the ash content. Products namely biscuit, mathi, matar and sev incorporated with amaranth leaf powder contained more ash than the control (Sing *et al.*, 2009) [1].

Carbohydrate and energy content ranged from 71.2 to 76.5 g and 354 to 365 kcal respectively. The average carbohydrate and energy content was 72.8 g and 360 kcal respectively. The highest carbohydrate and energy content was found with control (76.5g and 365 kcal) than the experimental products. Among the experimental products the lowest carbohydrate was found in pasta incorporated with radish and carrot leafy vegetables (71.2g). In case of energy, among the experimental products lowest was found in pasta of radish leafy vegetable. This is because control pasta was made only from the wheat flour, which is rich in carbohydrate, whereas experimental pasta products showed lower carbohydrate and energy content as the green leaves are low in carbohydrate and rich in minerals.

Crude fiber was found to be lowest in control (1.8g) than the experimental products. However, among the experimental products highest crude fiber content was found in pasta of carrot leafy vegetable (3.7g). This indicates that the green leaves present in the pasta had contributed to the crude fiber content of pasta.

Dietary fiber content of pasta ranged from 4.2 to 8.2 g/100g with a mean value of 6.9 g. The maximum dietary fiber was observed in pasta with beetroot leaves (8.2 g) and lowest in pasta with control pasta (4.2 g). Leafy vegetables, which contain more dietary fiber, had contributed to the dietary fiber content of pasta. Incorporation of leafy vegetable can enhance the dietary fiber content of pasta, which are generally high in starch and low in dietary fiber. Dietary fiber has physiological properties such as hypoglycemic and hypolipidemic effects. The dietary fiber adds bulk to the diet and increases transit time of food in the diet [6].

ii) Micronutrient composition of pasta products

Calcium content ranged from 162.3 to 390.1 mg with a mean value of 323.7 mg. Calcium content was highest in experimental products than the control. The highest calcium content was found in pasta of carrot leafy vegetable (390.1mg) and lowest in control (162.3mg). Calcium is a major factor sustaining strong bones and plays a part in muscle contraction and relaxation, blood clotting, synaptic transmission and absorption of Vitamin12. The relatively high content of calcium in *Grylotalpa africana* (4.13 mg/100 g), *T. triangulare* (7.44 mg/100 g), *A. cruentus* (2.05 mg/100 g), *Celosia* sp. (2.66 mg/100 g) and *V. amygdalina* (2.25 mg/100 g) suggest that they may be of therapeutic value in hypocalcaemic state like osteoporosis and in fact potentially risky in hypercalcaemia [8].

Iron content of pasta products ranged from 3.5 to 9.5 mg/100g with a mean value of 6.8 mg. The maximum iron content was observed in pasta of beet root leafy vegetable (9.5 mg) and lowest in control (3.5 mg). Experimental products had the maximum iron content than the control. It clearly indicates that the green leaves are the rich source of calcium and iron which may be utilized in the value addition of junk foods.

The β -carotene content of pasta products ranged from 0.1 to 1.5 mg/100g with a mean value of 0.7 mg. The highest β -

carotene content was observed in the pasta of beetroot leafy vegetable (1.5 mg) and lowest was found in the control (0.1 mg). Incorporation of leafy vegetables can help to overcome the problem of night blindness. Singh *et al.*, 2007 reported that the bathua leaves are the concentrated source of β -carotene and its incorporation in paratha at different levels increased carotene content significantly i.e., from 42.6 μ g/100g to 4255.6 μ g/100g. β -Carotene content was highest in bengal gram leaves (11.8 mg/100 g) and lowest in carrots (2.2 mg/100 g) on fresh weight basis. Higher values of β -carotene in spinach (5.10 mg/100 g) have also been reported [7].

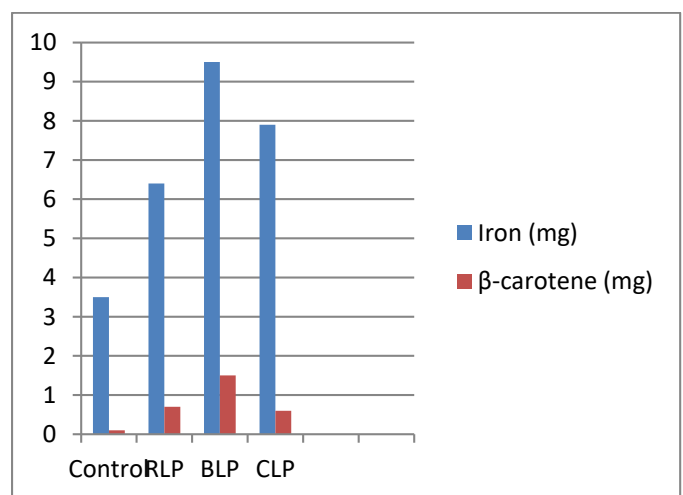
A highly significant increase in the nutrient composition of pasta products incorporated with leafy vegetables was observed. The maximum content of protein, crude fiber and calcium (16.8g, 3.7g and 390.1mg respectively) was found for carrot leafy pasta. Dietary fiber, iron and β -carotene (8.2g, 9.5mg and 1.5mg respectively) were found maximum for beetroot leafy pasta. As in [9] leafy vegetable paratha being good source of proteins, minerals and energy clearly shows that GLVs may be incorporated in the daily diets of vulnerable sections of population.

Comparison of iron and β -carotene content of pasta incorporated with green leaves with control

Iron and β -carotene content of pasta incorporated with greens were compared with the control (Fig 1). The iron content ranged from 3.5 to 9.5 mg/100g with an average value of 6.8 mg. It was observed that the pasta incorporated with green leaves contained highest iron content than the control.

The β -carotene content was found between 0.1 to 1.5 mg with a mean value of 0.7 mg. The β -carotene content was found highest in the pasta incorporated with the greens than the control.

The iron and β -carotene content was more in the products incorporated with the green leaves. As already discussed this is due to the leafy vegetables being the rich source of iron and β -carotene. In India, anemia and night blindness are the most common problems encountered caused due to the deficiency of iron and β -carotene respectively. This is because the daily intake of green leafy vegetables is less than the recommended allowance. Enrichment of the traditional pasta with the underutilized green leafy vegetables may help in combating these problems through the efficient use of underutilized greens economically.



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

Fig 1: Comparison of Iron and B-Carotene Between Pasta Products

Oxalate composition of product

Oxalate is an antinutrient compound that binds with the calcium and hinders its absorption. The oxalate was only present in the pasta products prepared with the incorporation of leafy tops and there was no oxalate found in the control. This is because leafy vegetables contain more of oxalic acid. Presence of oxalates hinders the absorption of calcium present in the food.

Table 4: Antinutrient Component of Pasta Products

Pasta	Oxalates (mg)
Control	Nil
RLVP	32.2
BVLP	76.0
CVLP	21.5
Mean	36.9

Control –Wheat flour

RLP –Radish leafy pasta

BLP –Beetroot leafy pasta

CLP –Carrot leafy pasta

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. From the study it could be concluded that, incorporation of underutilized leafy vegetables in the pasta products have enhanced the macro and micronutrient value. It can be popularized among the people and entrepreneurs to add value to the diet.

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