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Curry Leaves: A Promising Ingredient for the Development of β-Carotene Rich *Upma*

Sonia, Varsha Rani*, Sangeeta C. Sindhu and Josephine John

Department of Foods and Nutrition, CCS Haryana Agricultural University, Hisar, India

**Corresponding author*

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A B S T R A C T

This study was undertaken to develop and analyze β-carotene rich *upma* supplementing with curry leaves powder (5, 7.5 and 10 %). Leaves were blanched for 15 seconds and dried using freeze drier. Developed *upma* were subjected to sensory evaluation by a panel of semi-trained judges. Proximate composition, dietary fibre and β-carotene were analysed in developed *upma*. Data was statistically analysed using SPSS and OPSTAT software. Blanching of curry leaves up to 15 seconds was found suitable for proper retention of colour. Freeze drying was found suitable for the retention of β-carotene. U*pma* prepared by incorporating 7.5 per cent of CLP was more acceptable as compared to the one that containing 10 per cent CLP. Results revealed that the protein content of control *upma* was 11.10 per cent which increased significantly up to 12.07 per cent with incorporation of CLP. Crude fibre and ash content in *upma* supplemented with CLP had increased significantly as compared to control *upma*. Total dietary fibre content ranged from 20.48 to 23.70 per cent in supplemented *upma* whereas control *upma* contained 19.14 per cent. β-carotene content of T_3 *upma* (9528.28 µg/100g) was highest followed by T_2, T_1 and control *upma* which was 30 to 60 times higher than β-carotene concentration of control *upma*.

Introduction

The spice Curry Leaf (*Murraya koenigii)* is considered as a sub- tropical to tropical belonging to the family Rutaceae. Curry leaf tree, is a native to Sri Lanka, India and other Asian countries (Kumar and Reddy 2013) and available at very low cost. Among fourteen global species of genus Murraya, only *Murraya Koenigii* (Spreng.) and *Murraya Paniculata* (Linn.) are available in India (Nayak *et al.,* 2010). The curry leaf stem is dark green to brownish colour and has small spreading shrub which is about 2.5 meters in height (Jain *et al.*, 2012; Singh *et al.*, 2014). Curry plant is small and having highly aromatic and sweet smelling leaves. It possesses strong spicy and seasoning flavour with distinctive aroma. Considering the easy availability, low cost and nutritional quality of the curry leaves, various supplementary food products can be prepared with addition of leaves to utilize its potential and enhance product quality by improving its taste, aroma and increasing its energy, protein, dietary fiber, calcium, β-carotene and mineral content. Curry leaves has promising amount of β-carotene (preformed vitamin A) (Khoo *et al.,* 2011). However, it was observed that the dehydrated curry leaves contain considerable amounts of oxalates and phytate phosphorous i.e. 501.55 and 86.52 mg/100g, respectively (Lal and Kaur, 2019) that might be a constraint in its utilization in products development. The main carotenoid, β-carotene depicts antioxidant activity. (Chandrika *et al.,* 2010) and acts as free radical scavenger and singlet oxygen quencher (Jimenez-Escrig *et al.,* 2000). It was reported to exert antioxidant effects in rats fed with high fat diet (Khan *et al.,* 1997). Thus, curry leaf can prevent the formation of free radicals and maintain the tissues at normal levels (Khan *et al.,* 1997). Curry leaves are having slightly stiff texture, because of that these generally discarded from the food during eating and hence the nutritional potential remains underutilized. To confirm maximum consumption of curry leaves one way is to use as dried form and it is used from the past to preserve the leaves. So that, the incorporation of these green leaves in dried forms in the various foods especially the traditional foods, fermented foods, bakery and confectionary items can meet the demand of the generation. This paper reports the nutritional composition of β-carotene rich *upma* prepared by incorporating curry leaves powder (CLP).

Materials and Methods

Development of curry leaves powder (CLP)

Healthy leaves were separated from their stalks and to remove adhering dirt and impurities leaves were washed thoroughly for 2 times with normal tap water and one time with distilled water. The curry leaves were blanched in boiling water for 15 seconds and then immersed in chilled water immediately. The leaves were then poured in petri dishes and kept in lyophilizer (ALPHA 1-4 *LSC* plus) at -65°C under vacuum for 72 hours. It was then taken out and ground to prepare powder. The powder was then sieved to pass through 30 mesh sieve. The powder was stored in air tight food grade containers for further utilization.

Standardization and sensory evaluation of *upma*

For preparation of control *upma*, semolina (100g), bengal gram (5g), peanuts (10g), capsicum (5g), beans (5g), carrot (5g), onion (5g), coriander leaves, curry leaves and other spices were used. Semolina was replaced with 5, 7.5 and 10 per cent of CLP in experimental *upma*. It was evaluated for various sensory attributes by a semi-trained panel of 20 judges. Sensory evaluation of the prepared products was carried out to determine the most acceptable level of the curry leaves powder supplementation. The panellists were provided a proforma of 9 point hedonic scale for rating the *upma* in terms of appearance, colour, texture, aroma and taste. OAA scores were calculated on the basis of given scores to 5 sensory parameters.

Nutritional analysis of *upma*

All the control and CLP supplemented *upma* were oven dried to a constant weight at 60°C, ground to a fine powder in an electrical grinder and analysed for various nutrients. Proximate composition including moisture, protein, fat, ash and crude fibre was analysed using standard methods (AOAC, 2010). Dietary fibre constituents were determined by using the enzymatic method given by Furda (1981). The samples of β-carotene were extracted according to the method given by Garcia-Plazaola and Becerril (1999) slightly modified by Chandra-Hioe *et al.,* (2017) and were analysed in HPLC.

Results and Discussion

As per the scores given to colour, appearance, aroma, texture and taste, the overall acceptability of *upma* was calculated and it was found that *upma* prepared by supplementing 7.5 per cent of CLP was most liked followed by T_1 *upma* (Figure 1). Mean scores of OAA of control *upma* was 8.08 which fell in the category of 'liked very much'. Overall acceptability of T_1, T_2 and T_3 *upma* varied from 6.69 to 7.85 and consequently CLP supplemented *upma* were adjudged between 'liked slightly' to 'liked moderately'. It was observed that with the increased level of CLP, the scores of aroma, taste and texture of T_1 and T_2 upma were also increased whereas further increase in T_3 products turned down the scores significantly. However, the taste, aroma and texture of all the *upma* were within the acceptable range. Even the *upma* prepared with 10 per cent of CLP were found to be acceptable.

The contents of moisture, crude protein, crude fat, crude fibre, ash and total carbohydrates of T_1, T_2 and T_3 *upma* ranged from 42.62 to 44.78, 11.44 to 12.07, 5.90 to 6.25, 1.77 to 2.29, 4.41 to 4.97 and 30.63 to 32.16 per cent, respectively. Maximum contents of crude protein, crude fibre, ash and total carbohydrates were observed in T_3 *upma* however, the maximum contents of moisture and crude fat were found in T_1 *upma* (Table 1).

Soluble, insoluble and total dietary fibre content of control *upma* was found to be 4.6, 14.52 and 19.14 per cent, respectively. On the various levels of supplementation of curry leaves powder the soluble, insoluble and total dietary fibre content of *upma* was increased significantly ($P \leq 0.05$). The contents of soluble, insoluble and total dietary fibre in curry leaves powder supplemented *upma* were ranged from 4.61 to 6.10, 15.16 to 17.60 and 20.48 to 23.70 per cent, respectively (Table 2).

Results presented in Table 3 indicated that the amount of β-carotene in control *upma* prepared with 100 per cent semolina was found to be 159.18 µg/100g. Curry leaves powder supplemented T_1, T_2 and T_3 *upma* had 4843.59, 7185.89 and 9528.28 µg/100g of β-carotene, respectively, being highest in T_3 followed by T_2, T_1 and control *upma*. All three types of curry leaves supplemented *upma* had 30 to 60 times higher concentration of β-carotene than that of control *upma*.

Table.1 Proximate composition of CLP supplemented *upma* (%, on dry weight basis)

Treatments	Moisture*	Crude protein	Crude fat	Crude fibre	Ash	Total CHO's
			Upma			
Control	45.55±0.14	11.10±0.02	6.51±0.03	1.31±0.01	3.90±0.02	31.63±0.08
T_1	44.78±0.12	11.44±0.02	6.25±0.02	1.77±0.02	4.41±0.01	31.39±0.10
T_2	44.67±0.04	11.73±0.01	6.07±0.03	2.06±0.04	4.81±0.01	30.63±0.11
T_3	42.62±0.18	12.07±0.02	5.90±0.02	2.29±0.02	4.97±0.02	32.16±0.05
CD (P<0.05)	0.43	0.06	0.08	0.08	0.05	0.29

Values are mean ± SD of three independent determinations
Upma control: 100% Semolina; T_1: CLP@5%, T_2: CLP@7.5%, T_3: CLP@10%; CLP: Curry Leaves Powder
* Moisture was analysed on fresh weight basis

Table.2 Dietary fibre content of CLP supplemented *upma* (%, on dry weight basis)

Treatments	Soluble dietary fibre	Insoluble dietary fibre	Total dietary fibre
		Upma	
Control	4.61±0.07	14.52±0.09	19.14±0.07
T_1	5.26±0.07	15.16±0.04	20.48±0.04
T_2	5.31±0.05	16.84±0.08	22.15±0.03
T_3	6.10±0.05	17.60±0.07	23.70±0.11
CD (*P*<0.05)	0.21	0.24	0.23

Values are mean ± SD of three independent determinations
Upma control: 100% Semolina; T_1: CLP@5%, T_2: CLP@7.5%, T3: CLP@10%; CLP: Curry Leaves Powder

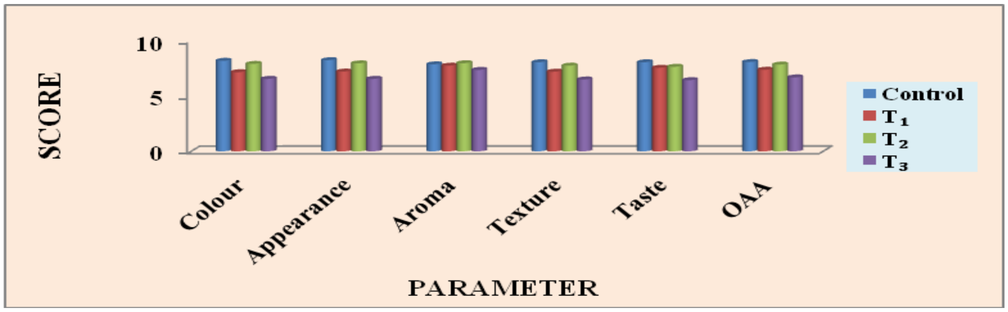
Table.3 Beta-carotene content of CLP supplemented *upma* (on dry weight basis)

Treatments	β-carotene (µg/100g)
Upma	
Control	159.18±0.05
T_1	4,843.59±0.89
T_2	7,185.89±0.01
T_3	9,528.28±0.01
CD (*P*<0.05)	0.19

Values are mean ± SD of three independent determinations
Upma control: 100% Semolina; T_1: CLP@5%, T_2: CLP@7.5%, T_3: CLP@10%; CLP: Curry Leaves Powder

Plate.1 CLP supplemented *Upma*

Figure.1 Mean sensory scores of CLP supplemented *upma*



Exhaustive screening of literature on curry leaves indicated the fact that it is a popular remedy among the various ethnic groups, Vaidyas, Hakims and ayurvedic practitioners for cure of variety of ailments. Following the traditional and folk claims, very little efforts have been made by the researchers to explore the therapeutic potential of this plant. Results of sensory evaluation of *upma* observed in present study are in close agreement with those of earlier workers who also incorporated curry leaves powder at various levels i.e. 3, 4, 5 and 10 per cent in the development of *chapatti*, cooked rice and seasoned potatoes (Shanthala and Prakash 2005), *mathri, uttapam, idli* and lemon rice (Khatoon *et al.,* 2011), buns (Sudha *et al.,* 2014), biscuits (Drisya *et al.,* 2015) *idli* (Chelliah *et al.,* 2016), *naan, vadiyan, bhatura, vada* (Lal and Kaur 2017) and *shrikhand* (Jerish *et al.,* 2020). It was observed that level beyond 8 per cent of curry leaves powder supplementation adversely affected the sensory acceptability of developed products.

Further, the results of proximate composition of CLP supplemented products of present study are supported by the findings of earlier investigators (Shanthala and Prakash 2005; Khatoon *et al.,* 2011; Sudha *et al.,* 2014; Drisya *et al.,* 2015; Chelliah *et al.,* 2016; Lal and Kaur, 2017; Jerish *et al.,* 2020). The increased amounts of crude protein, ash and crude fiber in CLP supplemented products have been attributed due to higher contents of those in dried leaves powder. The addition of fresh and dehydrated curry leaves had significantly increased the dietary fibre content of the refined flour and whole wheat flour based buns i.e.10.8 to 14.4 per cent and 9.8 to 11.3 per cent, respectively (Sudha *et al.,* 2014). Chelliah *et al.,* (2016) revealed that incorporation of 5 per cent of curry leaves powder in to *idli* increased the dietary fibre content by 18.6 per cent as compared to control. Shanthala and Prakash (2005) found that the *chapatti* and seasoned potatoes with 5 per cent incorporation of curry leaves powder had increased the β-carotene by 37 per cent and 43 per cent, respectively than the control products. Other workers also found an increased β-carotene contentof products (*mathri, uttapam, idli,* lemon rice, buns and biscuits) prepared using CLP (Khatoon *et al.,* 2011; Sudha *et al.,* 2014; Wani and Sood 2014). Nandita and Prabhasanker (2009) stated that the natural antioxidants by some means enhanced the shelf-life of bakery products.

From the present study, it may be concluded that curry leaves powder are very good source of protein, dietary fibre and β-carotene. Curry leaves powder can be successfully incorporated up to 10 per cent to develop β-carotene rich *upma* without affecting the sensory acceptability except colour. Overall sensory acceptability of *upma* prepared using 7.5 per cent level of incorporation of CLP was found maximum, though all the *upma* were found acceptable. Beta carotene rich *upma* can be successfully developed by incorporating curry leaves powder. Besides β-carotene *upma* had significantly higher contents of ash, crude fibre and crude protein than the control products. Consumption of curry leaves powder supplemented products may improve the sub clinical deficiency of vitamin A in vulnerable group.

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