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NUTRITIONAL AND SENSORY PROPERTIES OF ROASTED WHEAT NOODLES SUPPLEMENTED WITH CAULIFLOWER LEAF POWDER

Towseef A. Wani, Monika Sood* and Raj Kumari Kaul
Division of Post Harvest Technology,
FOA, SK University of Agricultural Sciences and Technology-Jammu,
Jammu and Kashmir, India
E-mail: monikasoodpht@gmail.com

Abstract
Cauliflower (Brassica oleraceae var. Botrytis) is the most popular cole vegetable grown extensively in India. It belongs to family Brassicaceae. It is rich in nutrients but has highest waste index. The edible portion of cauliflower is curd (head), whereas, its leaves which are generally thrown away as waste are also rich source of iron and β-carotene and thus can be utilized in various value added products. This study therefore, considers the addition of cauliflower leaf powder in roasted wheat flour containing wide range of nutrients in enrichment of noodles. The alterations in chemical constituents (moisture, protein, fat, ash and fibre) of noodles were examined by adding cauliflower leaf powder to the noodle formulation at the level of 0, 10, 15, 20 per cent flour weight basis. The results of study indicated that samples of cauliflower leaf powder added noodles, for all addition levels, contained more protein, fibre and ash as compared to control sample. The result obtained in this study suggested that acceptable noodles in terms of physico-chemical and sensory properties could be produced by incorporating cauliflower leaf powder into roasted wheat flour upto the level of 10 per cent flour weight basis. Thus, cauliflower leaf powder could be successfully used to enrich noodles, giving alternative utilization opportunity to producers and healthy choice option to the consumers.

Keywords: cauliflower, leaves, roasted wheat, proximate composition

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1. INTRODUCTION

In this era of global industrialization and advancement of technologies, the life style of the people has changed a lot. In this changing life style, the demand for ready to eat foods like extruded foods has raised considerably. This is due to change in perception, economic consideration, westernization, urbanization, busy life, increased women employment and increased per capita income. Among ready to eat foods, noodles form an important part of Indian dietary. These products are rich in starch, fat and energy but depleted in fibre. Various epidemiological studies have shown that the diet lacking in fibre may be the cause of various gastrointestinal and cardiovascular diseases (Kumari, S., Grewal, R. B Kumari, S., Grewal, R. B., 2007).

Various studies have been carried out to develop high fibre baked and extruded products but the main emphasis has been given on incorporation of cereal and pulse husk (Brochetti, D., Penfield, M. P., 1989). But the scientists have found that the fruits and vegetables contain higher level of cellulose than cereals (Wahlqvist, M. L., 1993). Besides having good amount of dietary fibre, vegetables and fruits are also considered to be chemical power houses that produce dozens of unique, complex and biologically active organic compounds which are known to affect significantly the quality and duration of life (Fraser, G. E., 1994).

Among vegetables, cauliflower (*Brassica oleraceae* var. *Botrytis*) is the most popular cole vegetable grown extensively in India. It belongs to family Brassicaceae. It is rich in nutrients but has highest waste index. The edible portion of cauliflower is curd (head), whereas, its leaves which are generally thrown away as waste are also rich source of iron and β-carotene and thus can be utilized in various value added products (Kowsalya , S., Sangeetha, M., 1999). These are cheap and within reach of common man. The leaves contribute about 50 per cent of the total production of cauliflower. The leaves of cauliflower are available only for a short period but these can be dried or stored for use during lean season (Singh, G., Asha, K. and Sehgal,

T_1	100:00::Whole Wheat flour:Cauliflower leaves
T_2	100:00::Roasted Wheat flour:Cauliflower leaves
T_3	90:10::Roasted Wheat flour:Cauliflower leaves
T_4	85:15::Roasted Wheat flour:Cauliflower leaves
T_5	80:20::Roasted Wheat flour:Cauliflower leaves

source of β-carotene and iron which can be used in sparce season (Rao, B. S. N., 1993). Hence, incorporation of fibre rich ingredients in extruded products will improve their nutraceutical properties and help to cater to the health needs of various cross-sections of the population.

In context of this, the present study was carried out to examine the effect of cauliflower leaf powder on proximate composition of noodles during storage.

2. MATERIAL AND METHODS

Raw material: Cauliflower (*Brassica oleracea*) leaves were obtained in a single lot from local market of Jammu city, India. The leaves were separated from their stalks, washed under running tap water and were blanched for 10-15 seconds. After blanching the leaves were dried at room temperature for 1-2 hours by spreading on filter paper followed by drying in hot air oven at 40 ^{0}C for 4-6 hours. The dried leaves were ground to fine powder and packed in air tight containers for further use. Wheat was also procured from local market. Grains were cleaned manually to remove any foreign materials, washed thoroughly under running water to remove dust and dried in sun, roasted for 3 minutes, cooled and milled into flour.

Noodle preparation: The preparation of noodles involved the mixing of wheat flour and dried cauliflower leaf powder by adding optimum water. All these ingredients were mixed properly to get desirable consistency dough. The prepared dough was smeared with a little of refined oil and then it was extruded by the hand extruder through suitable shaped dies. The product was then dried for 6 hours at 50-55 ^{0}C. After drying they were cooled and packed in polyethylene bags and stored under ambient temperature (Bui, T. T., Small, M. D., 2007). The treatment details are given below:

Proximate analysis of Wheat-cauliflower leaf powder noodles: Moisture, ash and fibre were determined according to AOAC. Crude protein was estimated by using Micro-Kjeldahl method, AOAC, (AOAC., Official methods of analysis, 1994) using the factor 6.25 for converting nitrogen content into crude protein. For fat content of noodles, 5 g sample was placed in Soxhlet extraction apparatus and subjected to extraction for 6 hours using petroleum ether as solvent and per cent fat content of noodle samples were calculated on a weight basis. Amount of carbohydrates was calculated from the sum of moisture, crude protein, crude fat, ash and crude fibre and lastly subtracting it from 100.

The samples were evaluated for overall acceptability by semi-trained panel of 7-8 judges by using 9 point hedonic scale assigning scores 9- like extremely to 1- dislike extremely. A score of 5.5 and above was considered acceptable (Amerine, M. A. *et al.*, 1964).

Statistical analysis

The data obtained were evaluated statistically with OPSTAT package program (OPSTAT software for Windows) by variance analysis. When variance analysis showed significant difference ($p<0.05$) among the means, the least difference test was used to evaluate means.

3. RESULTS AND DISCUSSION

A) Nutrient composition of dried cauliflower leaf powder: The data pertaining to nutrient composition of dried cauliflower leaf powder in Table-1 revealed that the moisture and protein contents were 2.41 and 26.54 per cent, respectively. However, β-carotene, iron, copper, manganese and zinc contents were observed as 43.11, 60.38, 1.55, 5.86 and 5.10 mg/100g, respectively.

Table 1: Nutritional composition of dried cauliflower leaf powder

Parameter	Nutritional content
Moisture (%)	2.41
Protein (%)	26.54
β- carotene (mg/100g)	43.11
Iron (mg/100g)	60.38
Copper (mg/100g)	1.55
Manganese (mg/100g)	5.86
Zinc (mg/100g)	5.10

B) Effect of storage on prepared noodles

Moisture content: With the progression of storage period, the moisture content increased from its initial value of 9.55 to 10.92 per cent (Table 2). The maximum moisture content of 10.47 per cent was recorded in T_2 (100 : 00 :: roasted wheat flour : cauliflower leaves (powder form)) and minimum of 9.95 per cent was observed in T_5 (80 : 20 :: roasted wheat flour : cauliflower leaves (powder form)). This might be resulted from the differences in the level of water added to dough containing various levels of cauliflower leaf powder before mixing. Similar findings were reported by Eyidemir and Hayta (Eyidemir, E., Hayta, M., 2009) in noodles supplemented with apricot kernel flour.

Table 2: Effect of treatments and storage period on moisture (per cent) of roasted wheat - cauliflower leaf powder noodles

Effects C.D. (P = 0.05)
Treatment 0.08

Treatments	Storage period (days)				
	0	30	60	90	Mean
T_1	9.70	9.90	10.60	10.87	**10.27**
T_2	9.77	10.03	10.80	11.27	**10.47**
T_3	9.57	9.83	10.63	10.93	**10.24**
T_4	9.43	9.70	10.53	10.87	**10.13**
T_5	9.27	9.53	10.33	10.67	**9.95**
Mean	9.55	9.80	10.58	10.92	

Storage period 0.09
Treatment x Storage 0.05

Crude protein

A perusal of data in Table 3 indicated that treatments significantly influenced the protein content of noodles and with the incorporation of cauliflower leaf powder the protein content increased. The treatment T_5 (80: 20:: roasted wheat flour: cauliflower leaves (powder form)) recorded highest protein content of 12.40 per cent followed by T_4 (85: 15:: roasted wheat flour: cauliflower leaves (powder form)) with a protein content of 12.39 per cent. The mean crude protein content during 90 days of storage declined significantly from the initial level of 12.20 to 12.16 per cent which might be due to breakdown of amino acids (Premlatha, 2010).

Crude fat

A general decrease in crude fat content was observed during storage period and it was found that crude fat decreased from the initial mean value of 2.62 to 2.42 per cent after 90 days of storage (Table 4). The decrease in crude fat content might be due to increase in the activity of lipase enzyme (lipolytic oxidation).

Table 3: Effect of treatments and storage period on crude protein (per cent) of roasted wheat - cauliflower leaf powder noodles

Effects C.D. (P = 0.05)

Treatments	Storage period (days)				
	0	30	60	90	Mean
T_1	11.38	11.37	11.35	11.33	**11.36**
T_2	12.38	12.38	12.37	12.35	**12.37**
T_3	12.40	12.38	12.38	12.36	**12.38**
T_4	12.40	12.39	12.38	12.37	**12.39**
T_5	12.43	12.39	12.39	12.38	**12.40**
Mean	12.20	12.18	12.17	12.16	

Treatments 0.01
Storage period 0.01
Treatments x Storage 0.04

The lowest crude fat content of 2.41 per cent was reported in T_5 (80 : 20:: roasted wheat flour : cauliflower leaves (powder form)) and the highest of 2.76 was recorded in T_1 (100 : 00 :: whole wheat flour : cauliflower leaves (powder form)). Similar results have been reported by Premalatha *et al*. 2010, in the development of wheat based high fibre noodles.

Ash

A perusal of data in Table 5 revealed that the effect of treatments on ash content (per cent) of noodles was significant. The treatment T_5 (80: 20:: roasted wheat flour: cauliflower leaves (powder form)) recorded the highest value of 1.01 per cent followed by T_4 (85: 15:: roasted wheat flour: cauliflower leaves (powder form)) with a ash content of 0.98 per cent at 0 day storage.

Table 4: Effect of treatments and storage period on crude fat (per cent) of roasted wheat - cauliflower leaf powder noodles

Effects	C.D. (P = 0.05)
Treatment	0.02
Storage period	0.01

Treatments	Storage period (days)				
	0	30	60	90	Mean
T_1	2.86	2.79	2.73	2.65	**2.76**
T_2	2.61	2.54	2.47	2.41	**2.51**
T_3	2.58	2.49	2.44	2.38	**2.47**
T_4	2.55	2.46	2.40	2.35	**2.44**
T_5	2.52	2.43	2.38	2.33	**2.41**
Mean	2.62	2.54	2.48	2.42	

Treatment x Storage NS

On the other hand, at the end of storage period treatment T_1 (100: 00:: whole wheat flour: cauliflower leaves (powder form)) recorded lowest ash content of 0.63 per cent followed by 0.74 per cent in T_2 (100: 10:: roasted wheat flour: cauliflower leaves (powder form)). The highest mean ash content of 0.92 per cent was recorded of treatment T_5 (80: 20: roasted wheat flour: cauliflower leaves (powder form)) whereas, the lowest ash content of 0.74 per cent was recorded in treatment T_1 (100: 00:: whole wheat flour: cauliflower leaves (powder form)).

Data in Table 6 revealed the effect of various treatments on crude fibre content of noodles. The treatment T_5 (80: 20:: roasted wheat flour: cauliflower leaves (powder form)) recorded the highest crude fibre content of 3.45 per cent followed by T_4 (85: 15 :: roasted wheat flour: cauliflower leaves (powder form)) with a crude fibre content of 3.43 per cent at 0 day storage.

Table 5: Effect of treatments and storage period on ash (per cent) of roasted wheat - cauliflower leaf powder noodles

Effects	C.D. (P = 0.05)
Treatments	0.01
Storage period	0.01

Treatments	Storage period (days)				
	0	30	60	90	Mean
T_1	0.82	0.75	0.75	0.63	**0.74**
T_2	0.94	0.88	0.83	0.74	**0.85**
T_3	0.96	0.89	0.85	0.76	**0.86**
T_4	0.98	0.92	0.87	0.79	**0.89**
T_5	1.01	0.96	0.90	0.81	**0.92**
Mean	0.94	0.88	0.84	0.75	

Treatments x Storage 0.03

Crude fibre

However, after 90 days of storage the treatment T_1 (100: 00:: whole wheat flour: cauliflower leaves (powder form)) recorded the lowest crude fibre value of 3.25 per cent followed by T_2 (100: 00 :: roasted wheat flour: cauliflower leaves (powder form)) with crude fibre value of 3.33 per cent. Treatment T_5 (80: 20 :: roasted wheat flour: cauliflower leaves (powder form)) recorded maximum mean crude fibre content of 3.42 per cent and the minimum crude fibre content of 3.28 per cent was recorded in case of treatment T_1 (100: 00 :: whole wheat flour : cauliflower leaves (powder form)).

Table 6: Effect of treatments and storage period on crude fibre (per cent) of roasted wheat - cauliflower leaf powder noodles

Effects	C.D. (P = 0.05)
Treatments	0.02
Storage period	0.01
Treatments x Storage	0.02

Treatments	Storage period (days)				
	0	30	60	90	Mean
T_1	3.30	3.30	3.28	3.25	**3.28**
T_2	3.38	3.36	3.34	3.33	**3.35**
T_3	3.40	3.38	3.36	3.35	**3.37**
T_4	3.43	3.39	3.38	3.37	**3.39**
T_5	3.45	3.43	3.41	3.38	**3.42**
	3.39	3.37	3.35	3.34	

Similar results have been reported by Stojceska *et al*. 2008 in cauliflower supplemented cereal based ready-to-eat expanded snacks.

Carbohydrates

Table 7 illustrates the effect of various treatments and storage on carbohydrate content of noodles. The data revealed that the treatments had a significant effect on carbohydrate content. Treatment T_1 (100: 00:: whole wheat flour: cauliflower leaves (powder form)) recorded the highest carbohydrate content of 71.94 per cent followed by T_2 (100: 00:: roasted wheat flour: cauliflower leaves (powder form)) at 0 day storage. However, at 90 days storage the treatment T_2 (100: 00:: roasted wheat flour: cauliflower leaves (powder form)) recorded the lowest carbohydrate content of 69.90 per cent followed by 70.22 per cent in T_3 (90: 10 :: roasted wheat flour: cauliflower leaves (powder form)). There was a significant decrease in the carbohydrate content of noodles with the advancement in storage period. Highest mean carbohydrate content of 71.30 per cent was recorded at 0 day storage whereas, lowest mean carbohydrate content of 70.41 per cent was recorded at 90 days storage.

Table 7: Effect of treatments and storage period on carbohydrates (per cent) of roasted wheat - cauliflower leaf powder noodles

Effects	C.D. (P = 0.05)
Treatment	0.10
Storage period	0.08
Treatment x Storage	0.20

Treatments	Storage period (days)				
	0	30	60	90	Mean
T_1	7.98	7.51	7.27	7.16	**7.48**
T_2	7.37	7.29	7.04	6.93	**7.16**
T_3	7.95	7.89	7.83	7.81	**7.87**
T_4	6.90	6.76	6.65	6.59	**6.73**
T_5	5.66	5.46	5.29	5.13	**5.39**
Mean	7.17	6.98	6.82	6.72	

Overall acceptability

A decrease in overall acceptability score was observed in all the treatments with the advancement of storage period (Table 8). It decreased from 7.17 at 0 day storage to 6.72 at 90 days storage. Non-significant differences have been observed in treatment storage interaction. The treatment T_3 (90: 10: roasted wheat flour:: cauliflower leaves (powder form)) recorded highest score of 7.87 followed by treatment T_1 (100: 00: whole wheat flour :: cauliflower leaves (powder form)) having score of 7.48. Similar results have been reported by Stojceska *et al*. [13]. In cereal based ready to eat expanded snacks using cauliflower by products.

Table 8 : Effect of treatments and storage period on overall acceptability of roasted wheat - cauliflower leaf powder noodles

Effects	C.D. (P = 0.05)
Treatments	0.06
Storage period	0.04
Treatments x Storage	N.S.

4. CONCLUSION

Treatments	Storage period (days)				
	0	30	60	90	Mean
T_1	71.94	71.89	71.29	71.27	**71.59**
T_2	70.92	70.81	70.19	69.90	**70.45**
T_3	71.09	71.03	70.34	70.22	**70.68**
T_4	71.21	71.14	70.44	70.25	**70.76**
T_5	71.32	71.26	70.59	70.43	**70.90**
Mean	71.30	71.23	70.57	70.41	

From the present studies, it is therefore concluded that incorporation of cauliflower leaf powder in noodles upto 10 per cent along with roasted wheat flour not only improves the texture, taste and overall acceptability but also improves the nutritive value of these products without adding much to the cost of the product and cauliflower leaves, which are generally thrown away can be utilized in a better way thus reducing wastage.

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