

## Original Research Article

# Nutritional Evaluation and Sensory Characteristics of Products Developed From Waste Leaves of Cauliflower

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## ABSTRACT

The present study was undertaken to explore the untapped potential of otherwise considered waste cauliflower leaves. The cauliflower leaves have been reported to be a good source of iron and vitamin-C. Total six recipes namely fara, sweet biscuits, *ladoo*, salty biscuits, and rava *idli* supplemented with upto 15 per cent Cauliflower leaf powder (CLP) were tried. All products except rava *idli* were liked by the judges upto various extents. Supplementation of CLP upto 10% was most acceptable in *fara*, and *ladoo* whereas, in sweet biscuits and salty biscuits supplementation upto 5% was most liked by the panel members. On supplementation with cauliflower leaves powder the energy value of almost all the products decreased whereas, the iron content in *fara*, sweet biscuits, *ladoo* and salty biscuits containing 0% cauliflower leaf powder was 3.55, 4.0, 2.49 and 1.21mg/100gm which increased to 9.38, 25.92, 14.17 and 38.17mg/100gm, respectively on 15% supplementation. The cost of the various products was also calculated and it decreased on supplementation with cauliflower leaf powder.

### Keywords

Cauliflower leaves, Nutritional composition, Product development, Organoleptic Evaluation, Economics

## Introduction

Green leafy vegetables occupy an important place among the food crops as these provide adequate amounts of many vitamins and minerals for humans. They are rich source of carotene, ascorbic acid, riboflavin, folic acid and minerals like calcium, iron and phosphorous (Sheela *et al.*, 2004).

NNMB survey (2006) also reported mean consumption of green leafy vegetables to be only 37 per cent of Recommended Dietary Intake. Besides this, the Green leafy vegetables are highly seasonal and are available in plenty at a particular season of the year. Abundantly supply during the season results in spoilage of large quantities.

Preservations of these green leafy vegetables can prevent huge wastage as well as make them available throughout the year. There are number of household processing technique which can be utilized for improving the shelf life of green leafy vegetables.

In India, the consumption of green leafy vegetables is very low and is much below the recommended allowances. Therefore, the majority of the Indians do not get sufficient vitamins and minerals present in leafy vegetables. More than 2 billion people principally women and children have been reported to be iron deficient in developing

countries. In India, its prevalence is 60-70 per cent in pre-school children and about 70-80 per cent in lactating women (Mathew *et al.*, 1999). As per report of WHO, 828 million children have been affected by sub clinical vitamin A deficiency in more than 75 countries in the developing world (WHO, 1995).

Green leafy vegetables occupy an important place among the food crops as these provide adequate amounts of many vitamins and minerals for humans. They are rich source of carotene, ascorbic acid, riboflavin, folic acid and minerals like calcium, iron and phosphorus. In nature, there are many underutilized greens of promising nutritive value, which can nourish the ever increasing human population. Many of them are resilient, adaptive and tolerant to adverse climatic conditions. Although, they can be raised comparatively at lower management costs even on poor marginal lands, they have remained underutilized due to lack of awareness and popularization of technologies for utilization. Nowadays underutilized foods are gaining importance as a means to increase the per capita availability of foods. Since low consumption of green leafy vegetables in diet is one of the major factors, which leads to deficiency of vitamin A and iron (Joshi and Mathur, 2010).

Micronutrients are those substances which are needed only in minuscule amounts. They are known as “magic wands” that are important for proper growth and development. UNICEF(1998) defined micronutrients as nutrients that are needed by the body only in minute amounts, which play leading roles in the production of enzymes, hormones and other substances, helping to regulate growth activity, development and functioning of the immune and reproductive systems. Micronutrients of

known public health importance include iron, iodine, zinc, copper, vitamins A, E, C, D, B<sub>2</sub>, B<sub>6</sub> and folate (Ekweagwu *et al.*, 2008).

To overcome iron deficiency anaemia and a concentrated source of iron has to be supplemented in large amounts. Data on the nutrient content and availability of iron from the dehydrated green leafy vegetables are scanty. There waste green leaves include cauliflower leaves, beetroot leaves, carrot leaves, radish leaves, turnip leaves.

These leaves are available only for a short period but these can be dried and stored for use during lean season (Joshi and Mathur, 2010). Dehydrated leaves can be used for the development of various recipes. These product if incorporated in the diet, can help to reduce the incidence of iron and vitamin A deficiency. Thus the present study has been undertaken to identify some of the underutilized green leafy vegetables and to assess the nutrient content and possibilities of utilization of these waste leaves as food material.

## **Materials and Methods**

### **Sample collection and proximate analysis**

Bengal gram was procured from the Department of Agronomy, NDUAT, Kumarganj. Cauliflower leavess were arranged from the kitchen garden in the university campus. Both sample were cleaned, washed and dried in the oven. The dried samples were utilized for product development.

### **Development of value added products using bengal gram and cauliflower leaves**

Different recipes were standardized from bengal gram and cauliflower leaves namely

*fara*, sweet biscuits, *laddoo*, and *salty biscuits*.

### **Standardization of Recipes**

#### **Fara Supplemented With Cauliflower Leaf Powder (CLP)**

##### **Method**

Soak bengal gram dal overnight.  
Grind the soaked dal using only little water.

Add ginger, garlic, chilies paste and asafoetida.

Sieve whole wheat flour and make soft dough using required amount of water.

Roll the dough into medium thickness, cut into circular shapes and fill the dal mixture after adding salt in it.

Boil water in a container and steam fara's using a muslin cloth for 25-30 minutes.

Serve hot.

#### **Sweet Biscuit Supplement with Cauliflower Leaf Powder (CLP)**

##### **Method**

Sieve the white flour with baking powder.

Cream fat till light and fluffy.

Add sugar powder in the fat and mix well.

Then knead the white flour with cream.

Cut the dough into desired shapes and put into a greased tray.

Keep the tray in a preheated oven and bake for 15-20 minute at 180 °C temperature.

#### **Laddoo Supplemented with Cauliflower Leaf Powder (CLP)**

##### **Method**

Roast bengal gram flour in a thick bottom pan on a low flame till nutty flavour comes.

Take out of the flame, add powder sugar, powdered dry fruits and cardamom powder.

Pour ghee, mix properly and make small balls.

#### **Salty Biscuit Supplement with Cauliflower Leaf Powder (CLP)**

##### **Method**

Sieve the white flour with baking powder.  
Cream fat till light and fluffy.  
Add salt in the fat and mix it.

Then knead the white flour with cream and omum seeds (ajwain).

Cut the prepared dough into desired shapes and put in a greased tray.

Kept the tray in preheated oven and bake for 20-25 minute at 180 °C temperature.

#### **Nutritional evaluation of developed products**

The nutritional quality of developed products was calculated by taking in consideration the chemical composition of the selected waste leaves of vegetables and value given in the Food Composition Tables compiled by Gopalan *et al.*, (2004).

#### **Organoleptic Evaluation**

The developed products were organoleptically evaluated by the panel of

judges including school children and faculty members of College of Home Science using nine point Hedonic rating scale. The nutritional quality of the developed products was calculated by Food Composition Tables compiled by NIN.

### Cost Calculation

The cost of the product was also calculated using the cost of raw materials.

### Results and Discussion

Table 1 shows the nutrient content of fara supplemented with dry cauliflower leaf with respect to energy, protein, carbohydrate, fat, total ash and iron. Table shows significant difference between treatments with respect to energy, carbohydrate, fat and total ash and iron contents while non-significant difference between treatments with respect to protein were observed.

Supplementation of dry cauliflower leaf powder in fara increased the protein and iron contents significantly while energy, carbohydrate, fat, and ash contents were reduced.

Monika (2013) conducted a study on iron rich recipe standardization using food to food fortification and comparison of impact of supplementation of iron enriched food fortification and intermittent medicinal iron as well as sustainability. Recipes were standardized after suitable addition of iron rich ingredients along with bioavailability enhancing processing technique and analyzed for acceptability. Out of iron rich *biscuits*, *idli*, *halwa* and *soy chat*, niger seeds added *soy biscuits* had maximum acceptability and 10.8mg per cent iron. Twice weekly medicinal iron supplementation was effective ( $P < 0.05$ ) in raising Hb and building iron stores.

Result presented in table 2 revealed that supplementation with dry cauliflower leaf powder decreased the energy, protein, carbohydrate, and fat values of sweet biscuit and increased in control group the respective value per 100g were 492kcal, 15.96g, 126g, and 53.25g followed by 5, 10, and 15 per cent while total ash and iron value of sweet biscuit were maximum in 15 per cent supplementation with dry cauliflower leaf powder the value were 3.09g, 25.92mg, respectively.

Singh *et al.*, (2005) utilized that cauliflower (*Brassica oleracea*) leaves after drying for preparing *namakpara*, *kurmura*, *biscuit* and *cake* on nutritional evaluation it was found that the protein content was maximum in *kurmura* (12.25%) and minimum in *biscuit* (7.42%). Ascorbic acid and  $\beta$ -carotene contents of all the products, ranged from 2.21 to 4.29 and 2.04 to 4.98 mg/100g, respectively. Total iron content was maximum in *cake* (9.90 mg/100g) whereas, ionizable iron content was maximum in *biscuit* (2.83 mg/100g).

Nutritional composition of laddoo supplemented with cauliflower leaf powder presented in Table 3 shows statistically higher protein, total ash, and iron values 100g of laddoo in control group in which no cauliflower leaf was added was 8.60, 1.18g, and 2.49mg while on addition of 15 per cent cauliflower powder these values increased to 10.73, 1.93, and 14.17mg/100g.

A study was conducted on fortification of *mathri* with fresh and dehydrated vegetable and assessment of nutritional quality. Organoleptic evaluation of *mathri* was done by a panel of ten judges using 9 point hedonic scale. Levels of incorporation of powder of dry green vegetables (spinach 1.5g, mint 1.5g, carrot 1g and lotus stem 6g) was added in *mathri* at 7 per cent.

**Fara Supplemented With Cauliflower Leaf Powder (CLP) Ingredient**

Supplementation level (%)	Wheat flour (g)	Bengal gram flour (g)	Cauliflower leaf powder (g)	Green chilli (g)	Garlic (g)	Ginger (g)	Asafoetida (g)	Cumin seeds (g)	Black pepper (tsp)	Salt (g)
WF : BGF : CLP 50 : 50 : 0	50	50	0	100	5	5	a pinch	a pinch	a pinch	Acc. to taste
45 : 50 : 5	45	50	5	100	40	65	a pinch	a pinch	a pinch	Acc. to taste
40 : 50 : 10	40	50	10	100	40	65	a pinch	a pinch	a pinch	Acc. to taste
35 : 50 : 15	35	50	15	100	40	65	a pinch	a pinch	a pinch	Acc. to taste

**Sweet Biscuit Supplement with Cauliflower Leaf Powder (CLP) Ingredients**

Supplementation level (%)	Wheat flour (g)	Bengal gram flour (g)	Cauliflower leaf powder (g)	Sugar (g)	Fat (g)	Baking Powder
WF : BGF : CLP 50 : 50 : 0	50	50	0	60	60	a pinch
45 : 50 : 5	45	50	5	60	60	a pinch
40 : 50 : 10	40	50	10	60	60	a pinch
35 : 50 : 15	35	50	15	60	60	a pinch

**Laddoo Supplemented with Cauliflower Leaf Powder (CLP) Ingredients**

Supplementation level (%)	Wheat flour (g)	Bengal gram flour (g)	Cauliflower leaf powder (g)	Sugar (g)	Dry Fruits (g)	Ghee (g)	Small Cardamom
WF : BGF : CLP 50 : 50 : 0	50	50	0	60	10	50	3-4
45 : 50 : 5	45	50	5	60	10	50	3-4
40 : 50 : 10	40	50	10	60	10	50	3-4
35 : 50 : 15	35	50	15	60	10	50	3-4

**Salty Biscuit Supplement with Cauliflower Leaf Powder (CLP) Ingredients**

Supplementation level (%)	Wheat flour (g)	Bengal gram flour (g)	Cauliflower leaf powder (g)	Salt (g)	Fat (g)	Baking Powder	Omum seeds (Ajwain)
WF : BGF : CLP 50 : 50 : 0	50	50	0	60	60	a pinch	a pinch
45 : 50 : 5	45	50	5	60	60	a pinch	a pinch
40 : 50 : 10	40	50	10	60	60	a pinch	a pinch
35 : 50 : 15	35	50	15	60	60	a pinch	a pinch

**Table.1** Nutritional composition of *fara* supplemented with dry cauliflower leaf powder (DCLP) per 100g

Supplementation level (%) of DCLP	Energy (kcal)	Protein (g)	CHO (g)	Fat (g)	Total ash (g)	Iron (mg)
Control(0)	242	7.86	43	2.56	1.85	3.55
5	181	8.59	32	1.98	1.54	4.09
10	177	8.50	33	1.99	1.68	7.36
15	170	8.45	30	1.97	1.78	9.38
C.D. (0.05)	16.77	NS	3.00	0.14	0.14	0.40

**Table.2** Nutritional composition of *sweet biscuit* supplemented with dry cauliflower leaf powder (DCLP) per 100g

Supplementation level (%) of DCLP	Energy (kcal)	Protein (g)	CHO (g)	Fat (g)	Total ash (g)	Iron (mg)
Control(0)	492	15.96	126	53.25	1.71	4.00
5	422	14.07	103	44.62	2.06	11.63
10	417	14.25	98	43.05	2.60	19.06
15	412	14.42	93	41.61	3.09	25.92
C.D. (0.05)	40.18	1.10	9.77	3.53	0.19	1.03

**Table.3** Nutritional composition of *laddoo* supplemented with dry cauliflower leaf powder (DCLP) per 100g

Supplementation level (%) of DCLP	Energy (kcal)	Protein (g)	CHO (g)	Fat (g)	Total ash (g)	Iron (mg)
Control(0)	209	8.60	84	24.78	1.18	2.49
5	208	8.80	71	24.76	1.45	5.24
10	206	9.15	70	24.74	1.71	10.28
15	205	10.73	48	24.73	1.98	14.17
C.D. (0.05)	NS	0.55	5.80	NS	0.12	0.55

**Table.4** Nutritional composition of *salty biscuit* supplemented with dry cauliflower leaf powder (DCLP) per 100g

Supplementation level (%) of DCLP	Energy (kcal)	Protein (g)	CHO (g)	Fat (g)	Total ash (g)	Iron (mg)
Control(0)	337	21.23	89.13	31	2.20	1.21
5	343	21.58	83.41	68.64	3.10	17.78
10	321	20.17	71.89	61.15	3.63	26.97
15	338	21.23	69.85	61.47	4.50	38.17
C.D. (0.05)	NS	0.77	5.23	NS	0.12	1.39

**Table.5** Mean Sensory Scores of Developed Products

Products	0%	5%	10%	15%
Fara	6 (liked slightly)	7 (liked moderately)	9 (liked extremely)	8 (liked very much)
Sweet biscuits	8 (liked very much)	8.3 (liked very much)	7 (liked moderately)	6.8 (liked moderately)
Laddoo	6.17 (liked slightly)	7.02 (liked moderately)	8 (liked very much)	7.05 (liked moderately)
Salty biscuits	7.92 (liked very much)	7 (liked moderately)	6.67 (liked moderately)	6.58 (liked moderately)

**Table.6** Cost of developed products (Rs. /100g)

Products	0%	5%	10%	15%
Fara	3	2	2	2
Sweet biscuits	14	12	11	11
Laddoo	10	10	9	9
Salty biscuits	9	8	7	7

Iron content was found to be higher in dried vegetable *mathri* (5.37mg) in comparison to control *mathri* (1.3mg). The ash content of *mathri* varied significantly and values were 2.1 per cent and 1.4 per cent for dried and control groups, respectively. Thus, it can be concluded that dry vegetable powder *mathri* being good sources of micronutrient may be incorporated in the daily diets of vulnerable sections of population (Verma and Jain, 2012).

Effect of addition of cauliflower leaf powder on the nutritional composition of salty biscuit given in the table 4 shows that protein, total ash, and iron contents significantly increased as the level of supplementation increased. The protein, total ash and contents of control group were 10.47g, 0.57g, and 2.5mg which increased to 12.51g, 2.64g, and 29.35mg/100g on 15 per cent addition of cauliflower leaf powder.

Verma *et al.*, (2001) reported the cauliflower green and bengal gram green were utilized for preparation of nutritious snacks. They reported the protein, iron and  $\beta$ -carotene contents of *biscuits*, *chikki*, *chiwda mix*, *khatta mitha chiwda* prepared from cauliflower greens, bengal gram etc and found that the protein content of *biscuits*, *chikki*, *chiwda mix* and *khatta mitha chiwda* were 8.49, 8.14, 6.74 and 11.06g/100g, whereas iron values were 7.16, 11.57, 13.71 and 14.88mg/100g.

The table 5 shows the sensory scores of fara, sweet biscuit, salty biscuit and laddoo supplemented with 5, 10 and 15 per cent with dry cauliflower leaves. There was significant difference between treatments. The sensory score of all products (fara, sweet biscuit, salty biscuit and laddoo) were in the range of like moderately to like extremely and all type of products were acceptable.

Motey and Lele (2003) also reported that cauliflower leaves powder to be a good source of calcium. Incorporation of cauliflower leaf powder at 3 per cent and 5 per cent level was found to be acceptable in cutlets and patties, while the acceptability scores decreased at 7 per cent level. Cauliflower leaf powders incorporated at 10 per cent level in *masala biscuits*, *masala buns*, *gingelly chikki*, *wheat soy halwa*, had mean acceptability scores of 3.4, 3.6, 3.4 and 3.9 respectively on a five point scale. Products were found to be rich in iron, beta carotene and calcium (Begum *et al.*, 2000).

Table 6 shows the economics of dry cauliflower based value added products per 100g. Among all the products the cost of the control was most expensive as compare to the other products because the supplementation of dry cauliflower leaves reduced the cost as it was available free of cost and was sun dried.

Research studies revealed that cauliflower green leaves and Bengal gram are excellent source of a variety of nutrients and phytochemicals, which have positive health effects. Since iron supplementation programmes have had a little reported success in reducing anaemia, interest is turning to food based approaches that have higher potential for achieving longer lasting benefits for the control of iron deficiency. The utilization of cauliflower greens and Bengal gram and cauliflower greens can be an easy and cheap method.

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