

## **Nutritional Evaluation and Overall Acceptability of Cauliflower Leaves Powder (*Brassica oleracea* var. *botrytis* L) in Lemon Juice.**

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### **Abstract**

Cauliflower (*Brassica oleracea*) is a cruciferous vegetable with high nutrient content and also having highest waste index. The leaves, being consider as a non-edible portion is a rich source of iron. In India, Iron deficiency anemia is highly prevalent in spite of availability of variety of low-cost green leafy vegetables. Hence in this context this study is aimed to analyze the nutrient content and sensory quality of low cost fresh and dry cauliflower leaf powder (CLP) at different variations (5g, 10g, 15g and 20g) and to study the efficacy of incorporation of 20gm of Vitamin-C in the form of lemon juice. The results of the study indicated that the fresh cauliflower leaves have greater iron (40mg) and Vitamin-C (56.5mg) when compared to dried leaves (1.2 mg) and (52mg) respectively. But there is an exponential increase in macro and micro nutrient content of dry leaves at various levels (5g, 10g, 15g and 20g) along with the incorporation of 20g of ascorbic acid. Sensory analyses shows that addition of 10g of CLP in lemon juice scored high when compared to other levels (5, 15 and 20g). Thus, low-cost cauliflower leaves can be utilized as a healthy option to eradicate iron deficiency anemia among the adolescent population.

**Key words-** Cauliflower leaves, Anemia, Iron, Vitamin-C, Lemon juice.

### **Introduction**

Iron is an essential micronutrient required for various functions like the cellular growth and differentiation, oxygen binding, transport and storage, enzymatic reactions, immune function, cognitive function, mental and physical growth in the human body(1). Iron deficiency due to either physiological or pathological reason can affect mental and physical growth leading to decreased learning capacity and work productivity. Defects in Hemoglobin synthesis causes iron deficiency anaemia (IDA) resulting in hypo chromic and microcytic red blood cells (2)

Globally Iron deficiency anaemia is a major nutritional problem having a highest prevalence rate among the developing countries due to low socioeconomic status and impecunious access to the health care services (3). WHO guidelines for control of IDA reports that, in India nutritional anaemia is a major public health problem and is predominantly due to iron deficiency (4). In WHO Comprehensive Implementation Plan on Maternal, Infant, and Young Child Nutrition, the reduction of IDA is one of the six priorities (5). These priorities have been taken as Priority Nutrition Indicators for the United Nation's post-2015 Sustainable Development Goals (6)(7).

There are many methods to augment the level of dietary iron to combat IDA like supplements in the form of capsules or drops, bio fortification involving the targeted breeding of staple food crops to enhance the iron content and food fortification by addition of micronutrients in elemental form or incorporation of iron rich food items to enhance the iron content of the food (8). Developing countries like India has indigent access to iron rich food especially the bioavailable heme iron. Thus, low-cost iron rich food in terms of underutilized green leafy vegetable (GLV) will cater the purpose.

Green leafy vegetables are micronutrient dense foods that helps to meet the micronutrient deficiencies. Due to lack of awareness and pertaining to regional specific many GLV are not explored for mass consumption by the population (9) Among the underutilized green leafy vegetables, Cauliflower (*Brassica oleraceae* var. *Botrytis*) is the popular cole vegetable cultivated in India. Though it has highest waste index, it is also rich in micro nutrients. Cauliflower has edible portion as curd (head) which is widely consumed and leaves, which are generally thrown away as waste. These leaves contribute 50% of the total production of cauliflower. The leaves are available for short period and can be dried and stored for lean season (10). The leaves are also rich source of iron and  $\beta$ -carotene and thus can be utilized in various value-added products (11).

Various studies report on nutrient profile of commonly consumed leafy vegetables, but there is very less data available on nutritive value of unconventional leafy vegetables. In this context, the present study was carried out to examine the effect of incorporation of cauliflower leaf powder in lemon juice and to assess the macro and micro nutrient composition along with the sensory attributes.

## Methodology

Samples of Cauliflower leaves were collected from the market. The fresh samples were cleaned, washed and inedible part were removed and then sun dried for 5 to 7 days. The dried samples were powdered and sieved using 40 micro mesh sieve and stored in polyethene covers and sealed. The samples were stored under refrigerated condition for further use. The powdered samples were subjected to nutrient analysis in triplicates using AOAC standard procedure.

The sensory evaluation was carried out by 50 semi trained panel members, using 5 point hedonic scale for different attributes like color, taste, texture, flavor, and overall acceptability, rating 5 - Like very much, 4 - Like moderately, 3 - Neither like nor dislike, 2 - Dislike moderately, 1 - Dislike very much. The standard lemon juice recipe was prepared by using 130ml of water, 20g of lemon juice and 20g of sugar. Test recipes were prepared by incorporating CLP at various levels (5g, 10g, 15g and 20g) to the standard recipe and both the recipes were subjected to sensory evaluation to find the acceptability of the lemon juice with and without CLP. The data was compiled and statistical analysis was carried out using Complete Randomized Design (CRD) with help of SPSS at a significance level of 10%.

## Results and Discussion

### A) Nutrient composition of Fresh and Dry cauliflower leaves

**TABLE-1**

S.No	Nutrient	Cauliflower fresh leaves	Cauliflower dried leaves
1.	Calorie (kcal)	66	366.1
2.	Protein (g)	5.9	4.25
3.	Carbohydrate (g)	7.6	18.50
4.	Fat (g)	1.3	1.15
5.	Dietary fiber (g)	2.0	4.60
6.	Vitamin C (mg)	56.5	52.0
7.	Folic acid (µg)	36.5	50.0
8.	Iron (mg)	40.0	54.7
9.	Sodium (mg)	14.7	21.0
10.	Potassium (mg)	262.0	289.0
11.	Calcium (mg)	36.7	93.7
12.	β- carotene (mg)	49.52	40.3

### COMPARISON OF THE NUTRIENT COMPOSITION OF FRESH AND DRY CAULIFLOWER LEAVES (100G)

Cauliflower fresh leaves- Food composition table, ICMR, NIN (2010)

The data pertaining to nutrient composition of fresh and dry cauliflower leaves in Table-1 revealed that the Protein and vitamin-C content was higher in fresh leaves (Protein-5.9g and Vitamin-C-56.6mg) compared to dry leaves (Protein-4.25g and Vitamin-C-52.0mg), but in case of carbohydrate, fresh leaves (7.6g) has less value compared to dried leaves (18.5g). Similarly the potassium content of the fresh leaves (262mg) has lesser value compared to the dried leaves (289mg). This trend was observed in folic acid, dietary fiber and sodium where fresh leaves (folic acid-36.5µg, dietary fibre-1.2g and sodium-14.7mg) had lesser values than the dried leaves (folic acid-50 µg dietary fibre-4.6g and sodium-21mg) respectively. The estimated iron content of the fresh cauliflower leaves was found to be 40mg, whereas the dried leaves contain only 54.7mg, this finding is consistent with the result (60.38mg/100gm) of previous investigations by Towse *et al* (2011)(12).

Calcium content was found to be higher in the CDL (93.7mg) compared to fresh leaves (36.7mg). A study published by Pattan *et al* (2014) has shown the calcium content to be 175.9mg which is 2-fold higher than the value in our study. From the table it is understood that the β-carotene content of the CDL was found to be less than the fresh leaves as the dehydration process reduces 10-20% of carotenoids through autoxidation unless they were protected from air and light (13)

Study conducted by Food Research of Polish Academy of Sciences(14), reveals that parts of cauliflower plants are found to be rich in nutritive compounds both macro and micro along with amino acids. The non-edible organs such as leaf, stem being neglected parts of cauliflower, when not consumed as a main ingredient, can be used as additives and formulate varieties of functional foods.

#### **b) Nutrient composition of dried leaves with addition of lemon juice**

**TABLE-2**

#### **NUTRIENT CONTENT OF *BRASSICA OLERACEA* DRY LEAVES ADDED TO LEMON JUICE AT VARIOUS LEVELS**

Nutrients	Level of cauliflower leaves powder used			
	5g	10 g	15g	20g
Energy kcal	30.7	42.6	197	211
Protein g	1.3	2.46	2.72	3.95
Carbohydrate g	12.5	27.3	32.1	37.4
Fat g	0.01	0.03	0.052	0.08
Fiber g	2.2	3.8	5.3	6.9
Sodium (mg)	52	78	92	115
Potassium (mg)	121	133	140	148
Calcium (mg)	85	92	98	106
Iron mg	0.5	1.3	2.1	3.4
Folic acid µg	67	93	113.9	131.5
Vitamin C mg	52.5	63.3	77.5	83.2
Sodium mg	12.0	21.06	36.6	45.3
Potassium mg	280	362	403.12	472.15

A perusal of data in Table 2 indicates that there was gradual increase in the nutrient value of all the nutrient, lowest by addition of 5g of CLP and highest with addition of 20g of CLP to the standard lemon juice. The lemon juice with incorporation of 5g to 20g of CLP contains energy ranging from 30.7-211 kcal, protein from 1.3-795g, carbohydrate from 12.5-37.4g, fat from 0.01-0.08g, fiber from 2.2-6.9g, sodium from 52-115mg, potassium from 121-148mg, calcium from 85-106mg, iron from 0.5-3.4mg, folic acid from 67-131.5 µg, vitamin-c from 52.5-83.2mg, sodium from 12-45.5mg and potassium from 280-472.15mg.

Addition of vitamin –c improves the absorption of iron content and all other micro nutrients.

A study conducted by Balaji et al (2021) states that addition of Cauliflower leaves to the food products like jellies enhances the nutrient content and it is a value-added, cost-effective iron supplement. (15). Shivani *et al* (2018)(16) reviewed that incorporation of CLP to the traditional food is a value-added nutrient dense food which can help to overcome the health-related problems like anemia, cancer diseases.

### c) Sensory evaluation

**TABLE-3**

## OVER ALL ACCEPTABILITY OF LEMON JUICE WITH THE INCORPORATION OF CAULIFLOWER LEAF POWDER AT VARIOUS LEVELS

From the above table, it is observed that lemon juice with the incorporation of 10% of CLP scored highest and was highly acceptable when compare to other level. Similar findings were recorded in Towseefet *al* (2013) study, where 10% incorporation of CLP, found to have high score in sensory evaluation of the noodles. A study conducted by Revathi et al (2019 (17)), 5% of the incorporation of CLP to the cookies was highly acceptable when compared to the other levels of CLP. Another study conducted by Rekha Sharma *et al* (2018) (18) stated that the incorporation of cauliflower stem powder has good organoleptic acceptability in the Indian snacks such as mathri and sev.

### Conclusion

From the present studies, it is therefore concluded that incorporation of cauliflower leaf powder at various levels in lemon juice increased the nutrient content gradually. Incorporation of 10g of the CLP improves the texture, taste and overall acceptability but also improves the nutritive value possibly in a cost-effective manner and cauliflower leaves, which are broadly thrown away can be a value-added product, thus reducing wastage. Hence it is highly recommended to consider cauliflower leaves as a natural fortification agent to enhance the nutritional quality of the food items.

### References

S.No	Level of Incorporation of CLP	Over all Acceptability
1	5 %	14.65 $\pm$ 3.03
2	10 %	17.65 $\pm$ 3.97
3	15%	13.45 $\pm$ 2.90
4	20%	13.7 $\pm$ 2.96

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