Estimation of Macro-Nutrients in Domestically Processed Cauliflower Leaf Powder

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Abstract: *In India, under-nutrition is widely prevalent in spite of availability of various types of highly nutritious, less familial, low-cost, nutritious green leafy vegetables (GLVs). Cauliflower (Brassica oleraceae) leaf is a widely grown, neglected, nutritious GLV which is wasted due to ignorance of the common people. It can be explored to improve nutritional scenario of our country. Quantitative estimation of macro-nutrients in domestically processed dry cauliflower leaf powder (CLP) showed that 100g CLP contains 319.88 Kcal energy, 40.14g carbohydrate, 27.77g protein, 5.36g fat, 8.55g fibre, 13.98g total ash and 4.2g moisture. It can be used to enrich many common recipes like roti, puri, paratha, soup, besan, dal etc. Cauliflower leaves, which are generally thrown away, can be utilized to improve the nutritional status of the population.*

Keywords: Cauliflower leaves, drying, macronutrients, cauliflower leaf powder (CLP)

1. Introduction

In our country both poverty and malnutrition are widespread which hinders national development in spite of availability of various types of nutritious, cheap green leafy vegetables (GLVs). For instance, cauliflower leaf is a neglected, seasonal leafy vegetable which can be explored to improve the nutritional scenario of our country.

Cauliflower (Brassica oleraceae var. Botrytis, family Brassicaceae) is a popular cole vegetable, grown extensively in different parts of India. But the leaves of cauliflowers are usually thrown away in garbage as a non-edible waste material. However, these leaves can easily be dried by home-based methods and can be included in the daily diets of common people as a source of protein, energy and micronutrients [10].

Cauliflower leaves are cheap and within reach of common man but they are available only for a short period of time. They are highly perishable due to their high moisture content (80g %). According to the Food Composition Table provided by the National institution of Nutrition, Hyderabad, India, 100g fresh Cauliflower leaves contain 5.9g protein, 1.3g fat, 7.6g carbohydrate, 2g crude fiber and 66Kcal energy [7].

Cauliflower leaves can be dried by various methods but the nutritive value of cauliflower leaf powder depends on the drying method used.

- Nutrient analysis of shade-dried (27-37^{0}C) Brassica oleracea leaves showed that dry cauliflower leaf is a good source of protein (28.98 g/100g), containing only little moisture (2.52%) (Buvaneswari, K.M.et.al: 2014) [3].
- Mogra, R.et.al (2012) dried cauliflower leaves using mechanical drier (40°C for 22hours).100g CLP contained 12.55g moisture, 17.67g protein, 1.76g fat, 8.20g fiber, 15.32g ash and 256 Kcal energy [4].

- Wani, T.A.et.al. (2011) dried blanched cauliflower leaves using hot air oven (40^{0}C for 4-6 hours) and then powdered. Leaf powder contained 2.41g% moisture and 26.54 g% protein [5].
- Khan, A.D.et al.(2004) prepared leaf protein concentrates (LPC) from cauliflower leaves by pulping, pressing and protein coagulation by heating at 80+2^{0}C followed by drying. LPC contained 48.11-61.68% protein [6].
- In another study, Khanna, K.et.al. (2002) prepared LPC of cauliflower leaves using sun, shades and cabinet drying methods. 100g of blanched cabinet dried LPC contained 23.9 g protein [9].
- Cauliflower leaf protein concentrate contained nutritionally adequate amounts of lysine and tryptophan but it is deficient in cystine and methionine (Goel, U. et. al.; 1997) [11].

2. Materials & Methods

In the present study, cauliflower leaves are domestically processed and converted into dry cauliflower leaf powder and then quantitatively analyzed for macronutrients [2].

Sample Preparation:

Fresh cauliflower leaves were collected, dried and powdered. The detail procedure is as follows:

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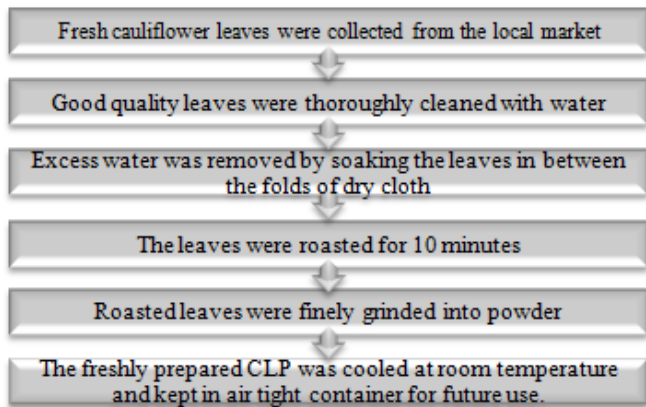
Macronutrient estimation of Cauliflower Leaf Powder

A. Estimation of moisture [8],[1]:Moisture content was determined by drying 10g sample in an oven at 105^0C and cooling in desiccator in a repetitive manner until a constant weight was achieved.

$$Moisture\ (\%) = \frac{(w_i - w_f) * 100}{w_i} \qquad (1),$$

where w_i is the initial weight and w_f is the final weight.

B. Estimation of fat [8]: Crude ether extract of the moisture-free sample was used to estimate fat content. 5g dry sample was weighed accurately into a thimble which was placed in a Soxhlet apparatus and extracted with anhydrous ether for 16 hours. The ether extract was filtered into a weighed conical flask. Now the ether was evaporated, cooled in a desiccator and weighed.

C.

$$Fat\ content(g/\ 100g\ sample) = \frac{w_e * 100}{w_s} \qquad (2),$$

Where w_e is the weight of ether extract and w_s is the weight of the sample.

D. Estimation of fiber [8]:

2g moisture and fat free sample (w_s) was taken in a 500ml beaker, 200ml boiling 0.255 N (1.25% W/V) sulphuric acid was added, boiled for 30 minutes keeping the volume constant by frequently adding water and the mixture was then filtered through a muslin cloth and the residue washed with hot water till free from acid. The material was then transferred to the same beaker, 200ml boiling 0.313N (1.25%) NaOH added, boiled again for 30 minutes, the mixture was again filtered through muslin cloth and the residue was washed with hot water till free from alkali, followed by washing with some alcohol and ether. It was then transferred to a crucible, dried overnight at 80-100^{0}C and weighed (w_e). The crucible was heated in a muffle furnace at 600^{0}C for 2-3 hours, cooled and weighed again (w_a). The difference in the weights (w_e-w_a) represents the weight of the crude fiber.

$Crude\ fibre\ (g/100\ g\ sample)$

$$= \frac{[100 - (moisture* + fat*)](w_e - w_a)}{w_s} \qquad (3)$$

Where, w_s is the weight of the sample.

*g/100g sample.

E. Estimation of total protein by macro Kjeldahl method [8]:

2g sample was taken into a dry Kjeldahl flask and digested with 5g digestion mixture (98 parts K_2SO_4 + 2 parts $CuSO_4$) and 20ml conc. H_2SO_4 for 4-5 hours at 100^0C. The content was then cooled, diluted with distilled water and the mixture made alkaline by adding excess of 40% NaOH. The ammonia liberated was distilled into a receiver containing 25ml of N/10 H_2SO_4. The excess of acid in the receiver was back titrated against N/10 NaOH using 3 drops of methyl red indicator. A reagent blank was similarly digested and distilled. This titre value was subtracted from the value obtained for the sample to get the true titre value „b‟.

Calculation: If „a‟ g of the sample was taken and if „b‟ and „c‟ ml of alkali of normality „d‟ were required for back titration and to neutralize 25ml of N/10 H_2SO_4 respectively then

$$Protein\ content\ (g/100g\ of\ sample) = \frac{(c - b) * (14 * d) * 6.25 * 100}{a * 1000} \qquad (4)$$

F. Estimation of ash [8]:

5g sample was weighed accurately into a porcelain crucible and was gently heated over a flame until the mass was completely charred. It was then transferred to muffle furnace, heated at 600°C for 4 hours, cooled in a desiccator and weighed again. To ensure completion of ash preparation the crucible was again heated in the muffle furnace for 4 hours. This was repeated till two consecutive weights were the same.

$$Ash\ content\ (g/100g\ of\ sample) = \frac{w_a * 100}{w_s} \qquad (5),$$

where w_a is the weight of ash and w_s is the weight of the sample.

G. Carbohydrate estimation [8]:

The content of the available carbohydrate was determined by difference, i.e., by subtracting from 100 the sum of the values (per 100 g) for moisture, protein, fat, ash and crude fiber.

H. Energy estimation [8]:

The energy value of the 100g of food sample was calculated by using the following formula –

$$Energy\ con\ tent = 4*w_c + 4*w_p + 9*w_f \qquad (6),$$

where w_c is the carbohydrate content (g/100g), w_p is the protein content (g/100g)and w_f is the fat content (g/100g).

3. Result and Discussion

Quantitative analysis of macronutrient content of cauliflower leaf powder revealed the following values.

Macronutrient contents of cauliflower leaf powder (CLP)

Sl. No.	Parameters assessed	Results	Units
1	Energy	319.88	Kcal/100g
2	Protein	27.77	g/100g
3	Carbohydrate	40.14	g/100g
4	Fat	5.36	g/100g
5	Crude fiber	8.55	g/100g
6	Ash	13.98	g/100g
7	Moisture	4.2	g/100g

Cauliflower leaf, a cheap, seasonal, nutritious green leafy vegetable, is economically within the reach of common man. These leaves are wasted by the common people due to their ignorance. Fresh cauliflower leaves, containing 80% moisture, are highly perishable but it can easily be converted into a dry, powdered, supplementary product which is rich in protein, calcium and iron.

Cauliflower leaf protein concentrate contains lysine and tryptophan in nutritionally adequate amounts but it is deficient in cystine and methionine. Since there is a similarity between the amino acid composition of pulses and cauliflower leaf powder (CLP), so it can be used to supplement cereal protein and as a substitute of pulse protein. It is useful to improve nutritionally poor diets. Many tasteful recipes can be prepared using CLP.

Laboratory estimation of cauliflower leaves powder showed that CLP is an energy rich (319.88 Kcal/100g), high protein (27.77g/100g), low fat (5.36g/100g), low carbohydrate (40.14g/100g) and fiber rich (8.55g/100g) food. Higher value of ash content (13.98g/100g) indicates high mineral content of the product. This dry food contains only little moisture (4.2g/100g) which increases the shelf life of the powder. In pre-cooked (roasted) CLP, the enzymes present in fresh cauliflower leaves were deactivated which further increases the shelf life of the food and makes the food ready-to-use.

4. Conclusion

Cauliflower (Brassica oleraceae) leaf is a widely grown, neglected, nutritious GLV which can be dried with a little time and effort to prepare a low cost, nutritious supplementary food. Quantitative estimation of macro-nutrients in domestically processed dry cauliflower leaf powder (CLP) indicates that it is rich in energy, protein and minerals which can be used to enrich common recipes like roti, puri, paratha, soup, besan, dal etc. Cauliflower leaves, which are generally thrown away, can be utilized to improve the nutritional status of the population.

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Authors' Profile

Sagarika Chakraborty received her B.Sc. and M.Sc. degrees in Food and Nutrition (Home Science) from University of Calcutta (C.U.) in 2003 and 2005 respectively. Currently, she is a registered Ph.D. scholar in Food & Nutrition in the Department of Home Science, University of Calcutta, Kolkata, India. She has published papers in various international journal and national conferences. She is interested in the development of low cost nutritious supplementary foods and their effects on experimental animals.

Prof. Santa Datta (De) obtained her B.Sc. and M.Sc. degrees in Food and Nutrition from University of Calcutta (C.U.) in 1977 and 1982 respectively. She was ranked 1st in merit list (gold medalist) in both the examinations. She was awarded Ph.D. in 1991 from University of Calcutta, and in the same year she joined as a lecturer in C.U. She has been working in the field of developing new supplementary foods for a long time.

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