

# Enhancement of nutritive value of traditional chutney powder by incorporation of calcium rich pumpkin leaf

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## Abstract

Pumpkin leaf is an underutilized green leafy vegetable containing good amount of calcium and iron. In addition, pumpkin leaf also provides magnesium, sodium, vitamin D, phosphorous and potassium. Fresh pumpkin leaf provides 271 mg of calcium and 5.58 mg of iron per 100 g. In the present research, a chutney powder was developed by using dehydrated pumpkin leaf as a main ingredient. 100 g fresh pumpkin leaf on dehydration yielded 19 g of powder. Dehydrated pumpkin leaf powder is a concentrated source of micronutrients. The Traditional coconut chutney powder was used as the basic recipe and varying quantities of dehydrated pumpkin leaf (42 percent and 71 percent) was incorporated. Sensory analysis of the developed product was conducted by semi trained panel using nine - point hedonic scale in the laboratory of Food and Nutrition Department of Maharani Cluster University, Bangalore. The result showed that the variation with 42 per cent of dehydrated pumpkin leaf powder was found to be most acceptable and was on par with basic product with respect to appearance, colour, texture, flavour and taste. The developed chutney powder provides 144.65 mg of calcium and 1.06 mg of iron per serving (15 g). Daily consumption of chutney powder as an accompaniment with breakfast, lunch and dinner can meet nearly half of a day's calcium requirement for an adult. Pumpkin leaf therefore has the potential to become an affordable source of micronutrients.

**Keywords:** Affordable, Dehydrated pumpkin leaf, Micronutrients, Nine - point hedonic scale

## 1. Introduction

According to Indian medicinal plants database the scientific name of pumpkin leaf is *Cucurbita maxima* Duchesne (Kirtikar and Basu, 2017). It is an underutilized green leafy vegetable rich in calcium. It also provides iron, magnesium, sodium, vitamin D, phosphorous and potassium (Longvah *et al.*, 2017). These nutrients are required for bone health, muscle contraction, fluid balance and chemical signalling between neurons (Anonymous, 1996). Pumpkin fruit is widely used in culinary preparations, although pumpkin leaf is edible, it is less popularly consumed as a regular green leafy vegetable (Manisha and Navjot, 2020). Currently the peel, seeds, leaves and flowers are treated as agro waste (Jahan *et al.*, 2023).

Pumpkin belongs to the Cucurbitaceae family, other members of the family include squash, cucumbers,

muskmelons, watermelons and gourds. According to the scientists, pumpkin first appeared in North America roughly 9,000 years ago. The oldest known pumpkin seeds are from Mexico and are thought to have originated between 7000 and 5550 BC (Oliveira and Davis, 2018). Pumpkin is a spreading, annual, more or less hairy vine. It grows well in all the tropical and subtropical areas of the world; it can tolerate hotter conditions. It is grown in summer and rainy seasons, and the best time is June to July and December to January (Dubey, 2012). Pumpkin leaf is believed to help in promoting heart health as well as in reduction of cholesterol absorption and symptoms of rheumatoid arthritis (Batoool *et al.*, 2022).

Pumpkin leaf grows on hollow stems and is large lobed leaf. Pumpkin leaf is heart shaped and it's edges are

frequently jagged. Three or more veins are present in them. Usually, the leaf is dark green in colour. But it can also be light or grey – green depending on variety. They are also referred to as pumpkin greens, and are edible, nutrient-dense and delicious (Nunez, 2024).

Traditionally, pumpkin leaf is used in regional cuisines across India. In Kerala, pumpkin leaf is one of the ten leaves (*pathilakal*) which is cooked into a dish as part of seasonal regimen during monsoon month. (Raghi *et al.*, 2020) Similarly, pumpkin leaf is used with other greens in Bihar (as *dudyachya paanachi bhaji*), West Bengal (as *chachari*), and in Orissa (as *kakharu*). This mix of leafy vegetables is cooked on extremely low heat and consumed for health benefits. In addition, fresh pumpkin leaf is used in the preparation chutney, *pakoda* (fried fritters) and well-known “*saag*” dishes. *Saag* is a popular Indian dish wherein the greens are cooked into a spiced, saucy dish, it is an accompaniment with Indian bread (*roti*). They can also be consumed as sauteed or steamed pumpkin leaf along with garlic and olive oil. They can be substituted for winter green in any recipe. Tougher, older leaves can be wrapped much like grape leaves in steaming fish. Currently fresh pumpkin leaf is used in dishes as curries which have limited shelf life.

Dry chutney powder or chutney *pudi* is a dry flavoured powder made by roasting of pulses, oil seeds and spices and is used as a condiment in daily diets. It is a side dish but is used as a condiment in modest amounts. It serves as an accompaniment to nearly every breakfast dish. It is a nutritious substitute, and it is ready to eat and has a good shelf life as it is made with roasted ingredients and spices (Patil, 2025).

Research shows that calcium intake remains below the RDA for all age groups, genders and physiological conditions. According to Kumssa *et al.*, (2015) more than 3.5 billion people are at risk of calcium deficiency, of this 90% are in Africa and Asia. In a study conducted from 1963 to 2005, it was found that 52% of Indians suffered from nutritional bone disease mainly due to low dietary calcium intake and inadequate sunlight exposure Teotia and Teotia, 2008. In South India, urban, rural and metropolitan populations had mean intakes of,  $308 \pm 2.3$ ,  $268 \pm 2$  and  $526 \pm 8$  mg/day, respectively (RDA: 600 mg/day), indicating widespread insufficient intake. Trends over time of dietary calcium intake (g/CU/day) (grams per consumption unit per day) depicts that a decline from 606 (1975–79) (RDA–400) to 433 in year 2011–2012 (RDA–600). The median intake was 331 g/CU/day (Chittari *et al.*, 2019). These evidences show that calcium intake has been dropping over time. Calcium deficient diet has been linked to various health complications, especially the bone health. So, incorporating calcium-rich, locally available affordable food with good shelf life in the form of dehydrated pumpkin leaf chutney powder, offers a potential and sustainable option.

In this research it is planned to develop a product utilizing the less familiar calcium - rich pumpkin leaf. Fresh pumpkin leaf is seasonal and perishable and not commonly found in the vegetable market. These factors restrict its everyday consumption. In this research a product with higher shelf life was developed with pumpkin leaf which can be consumed as part of everyday diet.

The present study was carried out with the objective of understanding the availability of different chutney powders in the market and to develop and evaluate chutney powder using dehydrated pumpkin leaf powder as the main ingredient.

## 2. Materials and methods

### 2.1. Market survey of different types of chutney powders

A market survey was conducted to understand the availability of various types of chutney powders in Bangalore (both online and offline), focusing on identifying opportunities and determining the best way to introduce the product. The survey was conducted from September 10<sup>th</sup> to 20<sup>th</sup>, 2023, using various websites like Amazon, MTR foods, Mirchi, Eghfoods, Jiomart, Big basket, Flipkart, Zepto, Demart and local shops to collect relevant data on composition, and maximum retail price of each variant.

### 2.2. Identification and selection of ingredients for preparing chutney powder

The primary ingredients are chosen based on calcium content, availability and affordability.

*2.2.1. Nutritional composition of fresh pumpkin leaf:* From the Table 1, it can be inferred that pumpkin leaf (Fig. 1) contains significant amount of calcium and iron in addition to other nutrients such as Vitamin A, B<sub>1</sub>, B<sub>6</sub> and C, copper, fibre, folate, and manganese. Chutney powder was selected for incorporating matured pumpkin leaf as it is consumed daily in an Indian diet and has good shelf life. Pumpkin leaf was chosen due to high calcium content and is one of the underutilized greens not commonly sold in vegetable market. Based on the above considerations the following ingredients were selected for development of the chutney powder - pumpkin leaf, dry coconut, coriander seeds, sesame seeds, curry leaves, salt, dried chilli and coconut oil.

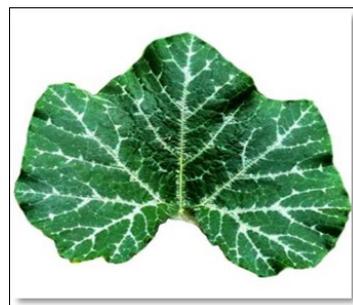


Fig.1. Leaf of *Cucurbita maxima* Duchesne

**Table 1.** Nutritional composition of fresh pumpkin leaf / 100 g (Longva *et al.*, 2017)

Sl. No.	Nutrients	Nutritive value
1	Energy	185 Kcal
2	Protein	4.21 g
3	Carbohydrate	4.75 g
4	Total Fat	0.74 g
5	Calcium	271 mg
6	Iron	5.58 mg
7	Zinc	0.90 mg
8	Manganese	1.14 mg
9	Phosphorous	64.54 mg
10	Vitamin A	1455 mcg
11	Vitamin B <sub>1</sub>	0.07 mg
12	Vitamin B <sub>2</sub>	0.13 mg
13	Vitamin B <sub>3</sub>	1.49 mg
14	Vitamin C	12.33 mg
15	Vitamin D	3.19 mcg

**2.2.2. Procurement of the ingredients:** The major ingredient, pumpkin leaf, was sourced from Bilidegalu village in Mandya district in south Karnataka. The remaining ingredients were procured from DMart and other reputed local grocery stores in Gandhi Nagar, Bangalore.

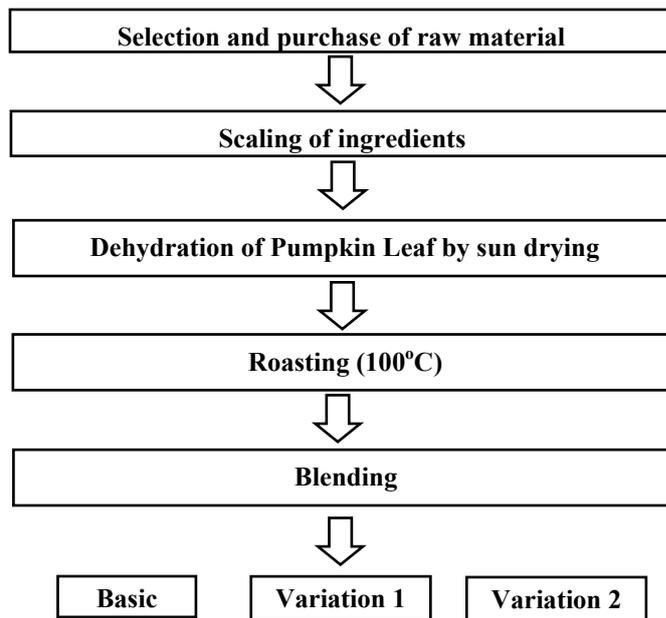
**2.2.3. Dehydration of pumpkin leaf:** Dehydration of pumpkin leaf was done by sun drying and domestic freeze-drying methods. In sun drying, pumpkin leaf was allowed to sun dry under direct sunlight till moisture content was completely evaporated and in case of freeze drying, pumpkin leaf was dried in a domestic refrigerator at 4 – 6°C.

### 2.3. Development of the chutney powder

Fig. 2 shows the steps involved in development of the product. Traditional dry coconut chutney powder recipe was taken as basic recipe and the product was developed by incorporating varying proportions of pumpkin leaf powder in place of coconut. Matured pumpkin leaf was washed, cleaned and weighed and allowed to sun dry till the leaf became crispy. Then it was cut into small pieces and was roasted at 100°C by using 10 mL of coconut oil till the colour changed to a light brown colour. All the other ingredients such as small dry coconut pieces (thin pieces measuring about 1 inch), coriander seeds, curry leaves, red chilli and sesame seeds were also roasted. All these ingredients were separately grinded, and all finely powdered ingredients were mixed and grinded to get a homogeneous mixture.

### 2.4. Sensory evaluation

Descriptive analysis and nine -point hedonic scale were carried out at Department of Food and Nutrition in Smt. VHD Central Institute of Home Science, Maharani Cluster University, Bangalore. A score card was prepared by keeping in mind the quality characteristics of the developed chutney powder. A nine -point hedonic rating



**Fig. 2.** Flow chart for preparation of pumpkin leaf chutney powder

scale was used for rating the attributes such as colour, texture, flavour, appearance and overall acceptability. Highest score (9) was assigned to the most preferred characteristic and (1) to the most undesired characteristic (Stone and Sidel, 1985).

### 2.5. Cost calculation

Based on market survey, the actual cost of each ingredient was found out. Cost of the product was calculated by adding the actual cost of all ingredients used.

### 2.6. Nutritional analysis of pumpkin leaf chutney powder

Nutrients such as energy, carbohydrates, protein, fat, fibre, iron, potassium, magnesium present in each ingredient used in the preparation of pumpkin leaf chutney powder were calculated by using Indian Food Composition Table (Longvah *et al.*, 2017).

### 2.7. Shelf life of the product

Shelf life of the product was determined by storing the product in an airtight glass container at room temperature for 60 days and periodically assessed for changes in organoleptic properties.

## 3. Results and discussion

### 3.1. Market survey of the chutney powders

The results of the market survey on availability of various chutney powders are shown in Table 2. The retail price of chutney powders is in the range ₹40 to ₹200 per 100 g due to varying composition of various chutney powders. The primary ingredients used include pulses such as black gram, bengal gram, fried gram, green gram and oil seeds such as groundnut and sesame seeds. It was observed that there is only one chutney powder in the market containing a green leafy vegetable i.e. drumstick leaf. It indicates that consumers have a liking for a variety of flavours and

**Table 2.** Availability of various chutney powders in online and offline market

Sl. No.	Name of the product	Brand name	Ingredients	Nutritive value	Maximum retail price per 100 g
1	Chutney Powder	Adukale	Black gram dal, bengal gram dal, copra, red chillies, tamarind, salt, Asafoetida, curry leaves, sugar, veg. oil.	Energy- 77 kcal Protein – 3 g CHO – 9 g Fiber – 2 g Fat – 3 g Sodium – 287 mg Sugar – 1 g	70/-
2	Chutney powder with Jaggery	Adukale	Black gram dal, bengal gram dal, copra, red chillies, tamarind, salt, asafoetida, curry leaves, sugar, veg. oil, jaggery.	Energy- 77 kcal Protein – 3 g CHO – 10 g Fiber – 2 g Fat – 3 g Sodium – 274 mg Sugar – 2 g	70/-
3	Fried gram chutney powder	Adukale	Fried gram, salt, sugar, turmeric, asfoetida, copra, red chillies, vegetable cooking oil.	Energy- 74 kcal Protein – 4 g CHO – 10 g Fat – 2 g Sodium – 362 mg	67.5/-
4	Homemade chutney powder	Gramin Way	Chana dal, urad dal, red chilli, tamarind, curry leaves, mustard seeds, asafoetida, coconut, salt, jaggery.	Energy-320 kcal Protein – 26.4 g CHO – 58.4 g Fiber – 24.5 g Fat – 1.9 g	116/-
5	Instant mulagupodi Chutney	Agriclub	Bengal gram, spilt black gram, peanut, white sesame seeds, rice, red chilli powder, black salt, veg. oil, asafoetida, curry leaves, black pepper.	Energy- 439 kcal Protein – 10 g CHO – 66 g Fiber – 2 g Fat – 15 g Sodium – 510 mg	43/-
6	Dry garlic coconut chutney powder	Aazol	Garlic, coconut	Not mentioned on label	125/-
7	Chutney powder	Bhramins	Black gram, rice powder, salt, chili powder, asafoetida	Energy-356 kcal Total fat – 1.9 g Sodium-2552 mg Potassium-1133.7mg CHO – 58.4 g Protein – 26.4 g	150/-
8	Idli/dosa/chilli Chutney powder	MTR	Black gram dal, red chilli, salt, mustard, acidity regulator citric acid, tartaric acid, curry leaves and asafoetida	Not mentioned on label	155/-
9	Organic chutney powder	Pure & Sure	Not mentioned on label	Energy- 325 kcal	62.67/-
10	Coconut green chutney powder	Urban platter	Urad dal, coconut, fried dal, groundnut, green chilli, mustard seeds, curry leaves, salt	Energy- 563 kcal Protein – 23.43 g Fat – 39.31 g Sodium – 41 mg	142.50/-
11	Chilli chutney powder	Sakthi	Gram dal, black gram dal, sesame seed, chilli, salt, garlic, compounded asafoetida, curry leaves, refined coconut oil.	Not mentioned on label	40.34/-

12	Sesame seed chutney powder	Caicum	Sesame seeds, sunflower seeds, curry leaves, red chilli powder, rock salt, coconut oil, hing.	Energy- 85 kcal Protein – 4.4 g CHO – 2.5 g Fiber – 1 g Calcium – 50 mg Salt – 0.5 mg	198/-
13	Peanut chutney powder	Harika	Peanut, salt, curry leaves, red chilli, cumin, garlic	Energy- 40 kcal Protein – 0.6 g CHO – 4.5 g Fiber – 0.1 g Fat – 1.4 g	49.71/-
14	Peanut chutney powder	Healthy Panda	Coconut, chilli powder, garlic, salt	Energy- 570 kcal Protein – 20.78 g CHO – 24.91 g Fat – 43.05 g	79.60/-
15	Moringa chutney powder	Healthy Panda	Moringa leaves (Drumstick leaves), Guntur red chilli powder, salt, peanut, garlic, spilt black gram, tamarind, asafoetida, cumin seeds, dry coconut, spilt Bengal gram	Energy- 501 kcal Protein – 21.8 g CHO – 37.1 g Fat – 29.5 g	110/-

tastes with respect to chutney powders. It was observed that there was no chutney powder made from pumpkin leaf and no other product made from pumpkin leaf was found in the market. Various studies have shown that tamarind leaves chutney powder (Rao *et al.*, 2005), curry leaf chutney powder (Balaswamy and Tummala, 2006), instant chutney powder with incorporation of cabbage and green leafy vegetable (Prasoon *et al.*, 2020) have been developed in laboratories, but they are yet to be commercialized.

**3.2. Dehydration of pumpkin leaf**

The results of the dehydration of the fresh pumpkin leaf are shown in Table 3. Sun drying was found to be more economical and quicker method, so sun drying was used for dehydrating the fresh pumpkin leaf. Irrespective of the method of drying the same amount of pumpkin leaf powder was obtained after drying.

**3.3. Food composition of the developed chutney powder**

It can be observed from the Table 4, that traditional coconut chutney powder was used as a basic recipe and dehydrated pumpkin leaf was incorporated to the extent of 42 per cent in variation one and 75 per cent in variation two (Plate 1a-c).

**3.4. Sensory evaluation**

*3.4.1. Descriptive analysis:* The product was described as delicious, tasty and unique when compared with basic product. The members suggested that pumpkin leaf

chutney powder can be an accompaniment for rice, dosa, idli, or curd rice.

*3.4.2. Nine-point hedonic scale:* Fig. 2 depicts mean sensory score of the chutney powder as tested by the sensory panel on a nine-point hedonic scale. Overall, the developed chutney powders were found to be acceptable. The mean scores of variations one (with 42 per cent pumpkin leaf powder) was almost on par with that of basic recipe and therefore variation one was selected for further analysis.

**3.5. Nutrient composition of the dehydrated pumpkin leaf powder**

526.3 g of fresh pumpkin leaf was dehydrated to get a yield of 100 g of dehydrated pumpkin leaf powder. Nutritive value of pumpkin leaf powder is shown in Table 5. From table 5, it can be observed that pumpkin leaf powder is a concentrated source of micronutrients. It can be used in preparing chutney powder or can be directly added to enhance the nutritive value of the dishes. It can also be consumed directly as an accompaniment with rice as the bitterness is reduced due to dehydration.

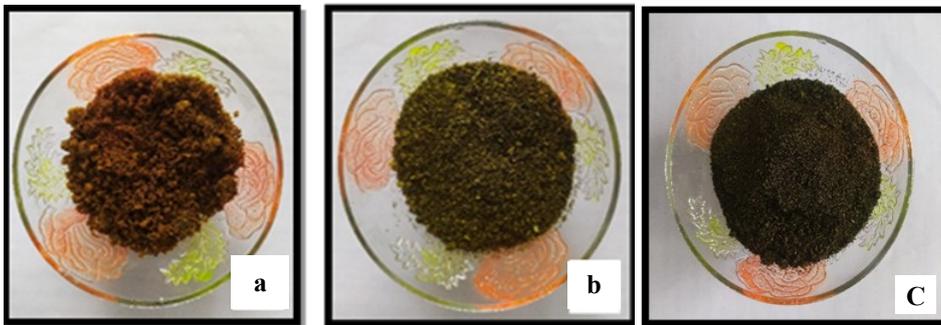
The developed chutney powder’s nutritive value is given in Table 6. It indicates that pumpkin leaf-based chutney powder is rich in minerals such as calcium. The developed chutney powder has 964.39 mg of calcium per 100g. Normally the serving size of the chutney powder is 15 g. Therefore, it provides 144.65 mg of calcium per serving. It can be consumed along with breakfast, lunch and dinner. If it is consumed as an accompaniment in

**Table 3.** Dehydration of fresh pumpkin leaf

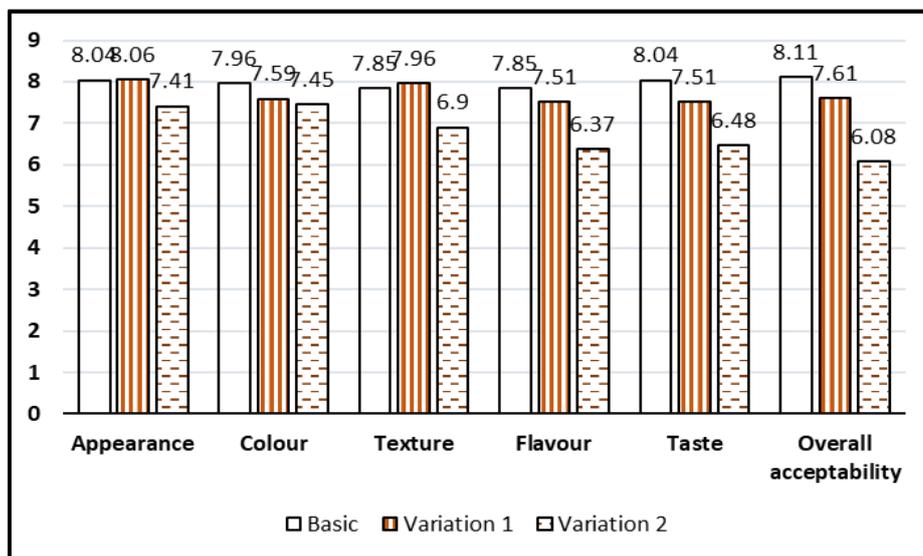
Weight of fresh pumpkin leaf (g)	Sun drying			Freeze drying using domestic refrigerator		
	Weight – After drying (g)	Duration of drying	Quality of the leaf	Weight – After drying (g)	Duration of drying	Quality of the leaf
100	19	8 hours	Colour changed to dull green colour	19	7 Days	Retention of green colour

**Table 4.** Food composition of the developed pumpkin leaf chutney powder (per 100g)

Sl. No.	Ingredients	Percent composition		
		Basic	Variation 1	Variation 2
1	Dehydrated Pumpkin leaf ( <i>Cucurbita maxima</i> Duchesne)	0	42	75
2	Coconut ( <i>Cocos nucifera</i> L.)	65	23	9
3	Coriander seeds ( <i>Coriandrum sativum</i> L.)	11	11	5
4	Sesame seeds ( <i>Sesamum indicum</i> L.)	11	11	5
5	Dry curry leaves ( <i>Berger akenigii</i> L.)	6	5	2
6	Coconut oil ( <i>Cocos nucifera</i> L.)	4	4	2
7	Red chilli ( <i>Capsicum annum</i> L.)	2	2	1
8	Table Salt (Rock salt)	1	2	1



**Plate 1.** a. Basic product of chutney powder; b-c. Two variations of chutney powder prepared by varying the type and proportions of ingredients



**Fig. 2.** Mean sensory scores of developed pumpkin leaf chutney powder

**Table 5.** Micronutrient composition of the dehydrated pumpkin leaf powder (per 100g)

Sl. No.	Nutrients	Nutritive value
1	Calcium	1426 mg
2	Magnesium	443.2 mg
3	Potassium	2226.25 mg
4	Iron	29.37 mg
5	Sodium	64.21 mg
6	Vitamin D	16.79 mcg

**Table 6.** Micronutrient composition of pumpkin leaf chutney powder per serving (15g/day)

Sl. No.	Nutrients	Nutritive Value	Percentage (%)
1	Calcium	144.65 mg	18.08
2	Magnesium	22.81 mg	5.18
3	Potassium	95.48 mg	2.72
4	Iron	1.06 mg	7.06
5	Sodium	2.37 mg	0.11
6	Vitamin D	2.74 mg	0.68

**Table 7.** Periodic changes in sensory properties of pumpkin leaf chutney powder

Sl. No.	Sensory parameter	After 15 days	After 30 days	After 45 days	After 60 days
1	Appearance	Good	No change	No Change	Small lumps were seen.
2	Colour	Good	No change	No Change	Colour faded
3	Texture	Good	No change	No change	No change
4	Flavour	Good	No change	No identifiable changes	Slight rancid odour
5	Taste	Good	Slight change in the taste which is hard to detect	Slight diminution in taste	No longer fresh

breakfast, lunch and dinner it provides 433.95 mg of calcium per day meeting half of day’s requirement for an Indian adult. Chutney powder also provides other minerals like potassium, sodium, and magnesium.

**3.6. Shelf life of developed product**

Table 7 shows that the shelf life of the product is 30 days, when the product is stored at room temperature in an airtight container.

**3.7. Cost of the developed product**

The primary ingredient, pumpkin leaf is not available in market and so were procured from a local farm. Therefore, the cost of pumpkin leaf has not been added. The final product cost is 16 rupees per 100g.

**4. Conclusion**

Pumpkin leaf is an underutilized green leafy vegetable rich in calcium and iron. So, in the present study a commonly consumed coconut chutney powder was used as a base and dehydrated pumpkin leaf powder was incorporated to develop a chutney powder. Sensory evaluation was done using nine-point hedonic scale and descriptive analysis and the product the product was found to be highly acceptable. It provides 144 mg of calcium per serving. If consumed thrice a day it can almost meet half of a day’s calcium requirement of an Indian adult. It is low cost, calcium rich product with a shelf life of 30 days. There is a need to scale up and explore the commercial production of pumpkin leaf chutney powder.

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