DEVELOPMENT AND QUALITY CHARACTERISTICS OF *CORCHORUS OLITORIUS* LEAVES INCORPORATED INSTANT CHUTNEY POWDERS

Abstract:

Corchorus olitorius, is a popular nutrient dense and multipurpose traditional wild leafy vegetable of Nalgonda district, Telangana state. Due to its short shelf life and the limited harvesting time, processing such as drying techniques permit to preserve and provide it throughout the year. The present study has attempted to utilise dehydrated *Corchorus olitorius* leaves in the preparation of commonly used chutney powders and evaluated for its quality characteristics. Based on the sensory study, 33% leaf powder incorporated chutney powder was selected for the further study. Ash, crude fiber, and protein content of ICO was significantly ($p<0.01$) increased by 5.87%, 6.1%, and 28.13% respectively. The developed products have also a good source of minerals and antioxidant. The results of the study suggested that incorporation of *Corchorus olitorius* powder in instant chutney powders production could be used to develop functional food with enhanced minerals, protein and antioxidants.

Key wors: *Corchorus olitorius*, traditional green leafy vegetable, antioxidant activity

Introduction

In the recent years, there is an increasing incidences of many life style disorders like obesity, cardiovascular and diabetes problems are coupled with consumption of high energy high fat and high refined foods with low nutrient density. These increased life style disorders creating health concerns among the consumers and so, currently food choices of customers have significantly changed towards looking for and choosing nutritious, healthy and tasty alternatives. Thus, it drives the attention of the researchers, food scientists, technologists, and nutritionists towards development of tasting, healthy, therapeutic and functional foods with added nutritional benefits (Dega and Barbhai, 2023).

Corchorus olitorius is commonly called as a Tossa jute or Nalta jute in English. About 90% of this plant cultivated South Asia specially India and Bangladesh (Parvin *et al.,* 2015; Ghellam *et al*., 2022). This plant belongs to family Tiliaceae, it is also known as bush or wild okra, Jew's mallow, long fruited jute, Meloukia, Moroheia, Moroheiya, Mulukhiya (Abdel-Razek *et al*., 2022). The plant is consumed in Nigeria, Bangladesh, Philippines, Malaysia, Egypt, Sudan, India and Japan (Isuosuo *et al*., 2019; Loumerem and Alercia, 2016; Baiyeri *et*

al., 2022). The plant is cherished for its huge food, nutritional, nutraceuticals, economic and climatic resilient plant (Baiyeri *et al*., 2022). It is a rich source of protein, dietary fiber, beta carotene, chlorophylls, vitamins, minerals, phenols and other bioactive compounds. It is a traditional medicinal plant possesses antitumour, anti-pyretic, decrease serum and liver cholesterol, anti-inflammatory, anticonvulsive, antioxidant, gastroprotective, diuretic, anticarcinogenic, treatment of anemia, diabetes and hypertension management properties (Youssef *et al*., 2014; Biswas *et al*., 2020; Baiyeri *et al*., 2022). Different parts of *C. olitorius* are also used in folk medicine notably, leaves to relieve stomach pains, seeds as laxative and roots for treating toothache and the stems for treating cardiovascular disorder (Loumerem and Alercia, 2016).

Though it is a popular green leafy vegetable in many countries, countries like India, it is mainly cultivated for the jute purpose. But it is naturally grown in the field areas during rainy season. Still people in rural areas are consuming this as traditional wild green leafy vegetable. But the main drawback is this leafy vegetable is seasonal and perishable. Therefore, one way to preserve this kind of the seasonal traditional green leafy vegetable is dehydration. Dehydration is one the most commonly used method for preservation of leafy vegetables. Nowadays, market value of dehydrated vegetables has increased. As it increases the variety in the diet, reduces the wastage and also provides long-shelf-life products which are easy to store, handle and can also be used in the formulation of functional and nutraceutical products (Joshi and Mathur, 2010; Youssef *et al*., 2014).

Generally, traditional preparations like chutneys, pickles and chutney powders are consumed along with rice, breakfast items such as vada, idly, dosa, chapathi, upma and samosa and various snack foods, etc., as a side dish, which also increase appetite. The chutney powder has significant amounts of proteins and minerals (Jyothirmayi *et al*., 2006). Traditional wild greens are good sources of nutrients like carbohydrates, β-carotene, ascorbic acid, folic acid, riboflavin, calcium, iron, zinc, copper, manganese, phosphorus and antinutrients. Throughout the world wild, semi cultivated species are of important research area of nutritional and phytotherapy research due their nutraceutical and antioxidant values (Choudary *et al.,* 2018).

Therefore, present study made an attempt to study the feasibility of incorporation of *Corchorus olitorius* leaf powder into instant chutney powders and analysed for its quality characteristics.

Materials and methods

The fresh leaves of *Corchorus olitorius* was collected from the farming areas of Nalgonda district, Telangana state. The edible portions of selected leaves were washed, and blanched, shade dried until samples became crisp and brittle to the touch. After drying the samples were powdered and used for product development. All the raw materials required for the product are procured from the local markets of Hyderabad, India.

Process description of *Corchorus olitorius* incorporated instant chutney powders: All the individually weighted and roasted ingredients (black gram, bengal gram, cumin seeds, coriander seeds, garlic, tamarind, chili powder and salt) were powdered and mixed together in blender, with salt and five different proportions of leaf powder is added.

Table-1 Proportions of the ingredients used in standardization of *Aerva lanata* incorporated chutney powder

Ingredients	**Control**	**F1**	**F2**	**F3**	**F4**	**F5**
Corchorus olitorius powder	0.0	5.0	10.0	15.0	20.0	25.0
Black gram dhal	6.5	6.5	6.5	6.5	6.5	6.5
Bengal gram dhal	5.0	5.0	5.0	5.0	5.0	5.0
Cumin powder	3.5	3.5	3.5	3.5	3.5	3.5
Coriander seeds	6.5	6.5	6.5	6.5	6.5	6.5
Garlic	5.5	5.5	5.5	5.5	5.5	5.5
Tamarind powder	7.0	7.0	7.0	7.0	7.0	7.0
Chili powder	10.0	10.0	10.0	10.0	10.0	10.0
Common salt	6.0	6.0	6.0	6.0	6.0	6.0

Note: All formulae were repeated three times.

All ingredients were measured in grams

Sensory evaluation of instant chutney powders and murukku

The sensory assessments were conducted in a sensory evaluation laboratory. Semi trained panel members (15) from the Foods and Nutrition Department at Post Graduate and Research Centre, PJTSAU, Rajendranagar, Hyderabad, were selected as panellists for the study. They were given written instructions and asked to evaluate the products for acceptability in terms of appearance, color, texture, taste, flavour, crispness and overall acceptability using a 9-point hedonic scale, where 1= dislike extremely, 2 = dislike very much; 3 = dislike moderately; 4 = dislike slightly;

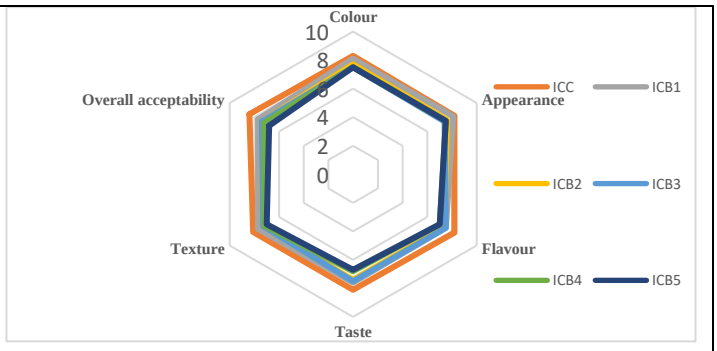
5 = neither like, nor dislike; 6 = like slightly; 7 = like moderately and 8 = like very much 9= Like extremely (Meilgaard *et al.,*1999). The samples were presented in plates coded with three-digit numbers in individual booths in sensory evaluation lab. Panelists rinsed their mouth with water after testing each sample.

Physico-chemical properties of developed products: Bulk density (Stojceska *et al*. 2008), tapped density (Narayana and Narasinga Rao 1984), flowability and cohesiveness (Jinapong *et al*. 2008), titratable acidity (Ranganna 2017), color (Hunter Lab 2013), chroma and hue (Pathare *et al*. 2012), total color difference (Martins and Silva 2002) and water activity (Abramovie *et al*. 2008) was estimated for both test and the control sample.

Nutritional and antioxidant properties: Moisture, ash, protein (AOAC, 2005), fat (AOAC, 1997), crude fiber (AOAC, 1995), carbohydrate and energy (AOAC, 1980), total carotenoids (Zakaria *et al*., 1979), β- carotene (Srivastava and Kumar, 1993), ascorbic acid (Ranganna, 2017), Calcium, iron, magnesium, manganese, copper, zinc, sodium, potassium, phosphorus was analyzed by the standard procedures (AOAC, 2012) bioavailable calcium, zinc (Kim and Zemel, 1986) and iron (Narasinga and Prabhavathi, 1978) content was analyzed. Antioxidant screening (Harbourne, 1993), flavonoid content (Zhishen *et al*., 1999), total phenols (Slinkard and Slingleton, 1997), antioxidant activity by DPPH (Dorman *et al*., 2004; Tadhani *et al*., 2007), tannins (AOAC, 2005).

Statistical analysis: All experiments were performed three times. All data were presented as mean ± standard deviation of the mean.

Corchorus olitorius



Mean sensory scores of chutney powders

Fig 1. Sensory evaluation of *Corchorus olitorius*

Results and discussion

Sensory quality characteristics of *Corchorus olitorius* leaves incorporated chutney powders

The results for sensory analysis of instant chutney powders showed that a significant difference was observed for sensory attributes of *Corchorus olitorius* leaves incorporated chutney powders ($p<0.01$). The control sample found highest scores for all sensory attributes. significant ($p<0.01$) decrease in overall acceptability was observed in all the leaf powder incorporated chutney powders. The results of the ICO1 were closer to the control. Eventhouth scores were decreased as the percentage of incorporation increases, but up to 33% incorporation of leaf powder also shows the good overall acceptability score. Therefore, ICO5 was selected for the further analysis.

Physical properties of instant chutney powders

The bulk and tapped density of developed chutney powder was decreased by 1.86% and 18.07% than the control sample due to incorporation of leaves. Flowability percentage of ICO was less whereas its was found highest in ICC. According to Carr index**,** ICO had fair flowability. Flowability is the ability of the powder to flow. According to husner ratio (HR) based on bulk and tapped densities, ICO (1.29) has intermediate cohesiveness, whereas ICC (1.57) had high cohesiveness. Titratable acidity of chutney powders was 0.003 (ICO) and ICC (0.014). When compared to ICC, titratable acidity of ICO, was decreased by 78.57% respectively. Due to addition of leaves P^H of chutney powders was increased by 16.21% in ICO, when compared to ICC.

The results of colour scores of chutney powders were presented as L*, a*, b*, C* and h* values and mentioned in Table-2. L* values of chutney powders were -61.16±0.88 (ICC) and -59.88±0.49 (ICO). The a* and b* values of ICO were 5.21±0.19 and 23.71±0.24 (ICO) respectively. The L* values of chutney powders were decreased by 2.09% in ICO than the control sample. It was found that a* and h* values of ICO was increased when compared to control sample. The E* and C* values of ICO was decreased by 2.48 and 10.584% respectively then ICC. There was no significant difference was found between the control and ICO5 for the L* and E* values. The water activity is inversely proportional to shelf life of the products. The water activity of *Corchorus olitorius* incorporated chutney powder was less than 0.5 and so the product can be best stored at room temperature.

Table-2 Physical properties of *Corchorus olitorius* incorporated instant chutney powders

Sample	BD (g/cm^3)	TD (g/cm^3)	CI (%)	HR	TA (%)	P^H
ICC	0.53^a±0.00	0.83^b±0.00	36.10^b±0.06	1.57^b±0.00	0.014^b±0.00	4.07^a±0.00
ICO	0.52^a±0.00	0.68^a±0.00	22.15^a±0.07	1.29^a±0.00	0.003^a±0.00	4.73^b±0.00
t-value	3.40	320.32	28.99	34.08	14.86	88.55
p value	0.00**	0.00**	0.00**	0.00**	0.00**	0.00**
Colour values						
Sample	L*	a*	b*	E*	C*	H*
ICC	-61.16^b±0.88	9.63^b±0.51	25.59^b±0.05	67.61^b±0.85	27.35^b±0.18	58.50^a±0.69
ICO	-59.88^a±0.49	5.21^a±0.19	23.71^a±0.24	65.93^a±0.49	24.28^a±0.25	64.90^b±0.36
t-value	1.26	8.14	7.58	1.71	9.78	8.21
p value	0.28NS	0.00**	0.00**	0.16NS	0.00**	0.00**

(BD: Bulk density, TD: Tapped density, CI: Carr index, HR: Hausner ratio, TA: Titratable acidity, L*- lightness, a*- green to red, b*- blue to yellow, E*- total colour difference, H*- hue angle, C*- chroma)

Note: Values are expressed as mean ± standard deviation of three determinations; Means within the same column followed by a common letter do not differ significantly at ($p \leq 0.01$) NS: not significant; ** significant at ($p \leq 0.01$); * significant at ($p \leq 0.05$)

ICC: Instant chutney powder control

ICO: *Corchorus olitorius leaves* incorporated instant chutney powder

Nutritional composition *Corchorus olitorius leaves* incorporated instant chutney powders: The results of the nutritional composition of the developed products were reported in Table-3. Moisture content was high in ICO and low in ICC. Ash, crude fiber, and protein content of ICO was significantly ($p<0.01$) increased by 5.87%, 6.1%, and 28.13% respectively due incorporation of leaf powder. As greens are low in fat and energy, ICO fat, carbohydrate and energy content was decreased by 2.25, 6.54 and 3.24% respectively when compared to the control sample.

Vitamin C, beta carotene and total carotene of ICC and ICO was 1.07mg/100g to 14.73mg/100g, 150.3µg-82.18µg/100g and 13.87µg/100g-763.18µg/100g respectively. Incorporation leaf powder increased the vitamin C, beta carotene and total carotenoid content of ICO by 1276.63%, 492.5% and 407.72% respectively.

Dehydrated greens are the concentrated source of minerals. Both macro and micro minerals crucial for the normal body functions. Addition of *Corchorus olitorius* leaf powder significantly ($p<0.01$) increased the mineral content of chutney powder (Table-3). The calcium, iron, zinc, copper, manganese and potassium content of ICO was increased by 30.1, 85.59, 74.3, 39.19, 104.81 and 27.86% than the control sample (ICC). The term bioavailability goes

beyond absorption from the gut and also includes the use and retention in body tissue (Melse-Boonstra, 2020). The study found that ICO had high available calcium content than ICC. Bioavailable iron and zinc content of ICO was 84.9% and 48.27% respectively.

Table-3: Nutritional and antioxidant composition of developed products

Proximate composition of developed products								
Sample	**Moisture (%)**	**Ash (g)**	**Fat (g)**	**Crude fiber(g)**	**Protein (g)**	**Carbohydrate (g)**	**Energy (kcal)**	
ICC	7.43^{a}±0.03	14.48^{a}±0.14	8.41^{b}±0.071	12.29^{a}±0.01	15.32^{a}±0.00	40.47^{b}±0.01	298.8^{b}±0.00	
ICO	9.22^{b}±0.04	15.33^{b}±0.08	6.61^{a}±0.005	13.04^{b}±0.00	19.63^{b}±0.00	37.82^{a}±0.04	289.1^{a}±0.00	
t-value	33.87	5.30	25.18	57.08	1085.15	22.89	878.30	
p value	0.00**	0.01*	0.00**	0.00**	0.00**	0.00**	0.00**	
Mineral content of developed products								
Sample	**Calcium**	**Iron**	**Zinc**	**Copper**	**Manganese**	**Phosphorus**	**Sodium**	**Potassium**
ICC	486.3^{a}±0.20	7.22^{a}±0.09	1.44^{a}±0.00	0.74^{a}±0.00	1.87^{a}±0.00	207.1^{b}±0.00	5830^{b}±0.00	592.6^{a}±0.00
ICO	632.7^{b}±0.20	13.40^{b}±0.11	2.51^{b}±0.00	1.03^{b}±0.00	3.83^{b}±0.01	200.1^{a}±0.10	3619^{a}±1.00	757.7^{b}±0.10
t-value	486.27	42.62	15413.15	332.20	1226.69	83.76	2523.61	1162.31
p value	0.00**	0.00**	0.00**	0.00**	0.00**	0.00**	0.00**	0.00**
Vitamin and antioxidant content of developed products								
Sample	**Vitamin C (mg/100g)**	**Beta carotene (µg/100g)**	**Total carotenoids(µg/ 100g)**	**Phenols (mg GAE/100g)**	**Flavonoids (mg RE/gm)**	**Tannins (mg TAE/100g)**	**Antioxidant activity (%)**	
ICC	01.07^{a}±0.01	13.87^{a}±0.01	0150.3^{a}±0.20	203.1^{a}±0.00	8.44a±0.06	16.27^{a}±0.01	31.09^{a}±0.00	
ICO	14.73^{b}±0.08	82.18^{b}±0.00	0763.1^{b}±0.10	261.4^{b}±0.00	90.71^{b}±0.14	27.29^{b}±0.01	50.81^{b}±0.00	
t-value	1505.89	741.80	3289.11	745.48	536.37	896.90	15968.61	
p value	0.00**	0.00**	0.00**	0.00**	0.00**	0.00**	0.00**	

Note: Values are expressed as mean ± standard deviation of three determinations; Means within the same column followed by a common letter do not differ significantly at ($p \leq 0.01$) NS: not significant; ** significant at ($p \leq 0.01$); * significant at ($p \leq 0.05$)

ICC: Instant chutney powder control; ICO: *Corchorus olitorous* leaf powder incorporated instant chutney powder

Table-4. **Bioavailable mineral content of instant chutney powders**

Sample	Calcium		Iron		Zinc	
	mg/100g	%	mg/100g	%	mg/100g	%
ICC	325.3[a]±0.20	66.89	5.23[a]±0.01	72.43	0.58[a]±0.00	40.27
ICO	406.3b±0.20	64.21	11.45b±0.11	84.44	0.86b±0.00	34.26

ICC: Instant chutney powder control

ICO: *Corchorus olitorous* leaf powder incorporated instant chutney powder

Phytonutrient composition of developed products: Various types of photochemicals are present in green leafy vegetables such as polyphenols, phenolic acids, flavonoids, carotenoids, glucosinolates, isothiocyanate, phytosterols, and monoterpenes (Aslam *et al*., 2020). Phytonutrients are naturally occurring plant secondary metabolites which helps to prevent and protect against several infections, diseases and useful for human health and wellbeing (Chukwuebuka and Chinenye, 2015). These phytochemicals possess medicinal properties such as anti-diabetic properties, prevents cardiovascular diseases, anti-hypertensive, anti-carcinogenic, anti-anemic, and improves gut health (Aslam *et al*., 2020).

The screening of methanolic extracts of chutney powders identified the presence of proteins, amino acids, carbohydrates, phenols, flavonoids, tannins, alkaloids, saponins, glycosides, phlobatinins, steroids.

Phenolic compounds are the major antioxidant constituents of fruits and vegetables. There is a direct relationship between their antioxidant activity and total phenolic compounds (Arasaretnam *et al*., 2018). The total phenol content of chutney powder was increased by 28.7% due to incorporation of leaf powder. The flavonoid and tannins content of ICC and ICO was 8.44mg RE/gm-90.71mg RE/gm and 16.27mg TAE/100g-27.29mg TAE/100g respectively. Total antioxidant activity of ICC and ICO was 31.09% and 50.81% respectively. Overall incorporation of *Corchorus olitorius* leaves powder significantly ($p<0.01$) improved the phytonutrient composition of developed chutney powder.

Conclusion

Natural plant-based foods are the need of the hour. Public awareness on the consumption and general knowledge on the phytonutrients is increasing day by day. Being low in calories, traditional green leafy vegetables have immense nutritional and therapeutic benefits. Drying and value addition of traditional green leafy vegetables in the commonly

consumed foods like instant chutney powders have significantly increased the fiber, protein, vitamin, mineral and phytonutrient content. The developed product using *Corchorus olitorius* leaf powder could be one of the novel food items with nutrient density and also provides variety in the daily diet. It can be concluded that this product can be promoted as a functional food has the potential to prevent certain diseases associated with hidden hunger and oxidative stress.

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