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Evaluation of Sensory and Nutritional Quality of *Leucas aspera* Leaf Powder Incorporated Millet based Ready to Eat (RTE) Snack

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ABSTRACT

Background: Since last few years, there was a drastic change in the food habits and cooking methods. Ready to eat (RTE) products usage was highly increased in the last five years due their convenience, price, attractiveness, taste, texture and appearance. Consumption of convenience foods with health benefits attracted many sections of the population. Jowar is a millet with potential health benefits. *Leucas aspera* is a traditional green leafy vegetable available in entire India. Instead of regular murukku, jowar murukku with addition of an underutilised green leafy vegetable (*Leucas aspera*) adds variety, improve palatability and health. *Leucas aspera* leaf powder incorporated jowar murukku was developed and evaluated for sensory and nutritional qualities.

Methods: The work was done in the year 2020-2021. The leaves are collected from the Nalgonda district of Telangana state. After the preliminary processing, the dried leaf powder is added to jowar murukku in different formulations. The best selected formulation is analysed for both sensory and nutritional quality.

Result: The results of the study found that addition of leaf powder improved the sensory quality, protein, crude fiber, vitamin, mineral and antioxidant content of the jowar murukku than the control sample.

Key words: Antioxidants, Bioavailability, Jowar murukku, *Leucas aspera*, Ready to eat.

INTRODUCTION

Since last few years, there was a drastic change in the food habits and cooking methods. Due to urbanisation, changed lifestyle and busy life pressure, they mostly prefer quick cooked and ready to use products. The market for ready to eat products is expected to increase to 647 million by 2023 from 261 million in 2017 and grow over 16%. Ready to eat products are a category of food available in packed condition and can be used directly without any further processing. RTE usage was highly increased in the last five years due their convenience, price, attractiveness, taste, texture and appearance (Temgire *et al.,* 2021).

Sorghum is the fifth most important cereal crop in the world after rice, wheat, corn, barley and it serves as the main cereal food for over 750 million people living in semiarid tropical regions of Africa, Asia and Latin America. Sorghum has good nutritional and functional properties and so it can be used for a wide range of food applications (Abah *et al.,* 2020).

Leucas aspera is a traditional green leafy vegetable belongs to family *Lamiaceae*, available across the India form Himalayas to down Ceylon. It is an aromatic plant and a very common weed in Africa, Asia temperate and tropical countries. Due to its potential medicinal properties, whole plant is used in traditional medicine to treat various health problems (Chew *et al.,* 2012). The leaves of the plant are valued for its food, medicinal and cultural importance. The plant is usually consumed during festival seasons like Vinayaka chavithi. The present study has made an attempt to incorporate Leucas aspera leaves into jowar murukku. Incorporation of traditional green into traditional products is easily accepted by the consumers and also improves the palatability.

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MATERIALS AND METHODS

The experiment was conducted in the year 2020-2021 at post graduate and research centre, PJTSAU, Hyderabad, Telangana, India. The fresh leaves of *Leucas aspera* was collected from the fields of Nalgonda district, Telangana state. The edible portions of selected leaves were washed, blanched, shade dried until samples became crisp and brittle to touch. After drying the samples were powdered and used for product development. All the raw materials required for the product are procured form the local markets of Hyderabad, India.

Process description of *Leucas aspera* leaves powder incorporated jowar murukku

All the required ingredients were weighed individually according to the proportions (Table 1) were mixed together with butter added hot water and kneaded until if forms smooth dough. Then the prepared dough was kept aside for 10 min for conditioning. Prepared dough was then extruded to desired shape with the help of murukku pressor. Prepared murukku was deep fried in preheated oil and allowed to cool. After cooling murukku was stored in air tight containers and stored at room temperatures for further analysis. The leaf powder was incorporated at 5% (JML_1), 10% (JML_2) and 15% (JML_3).

Sensory evaluation of instant chutney powder

A semi-trained panel of 15 members from PGRC, PJTSAU using 9-point hedonic scale evaluated the developed jowar murukku for colour, texture, flavour, taste and overall acceptability. Scores were based on a hedonic scale of 1 to 9 where: 1=I dislike extremely (very bad) and 9= I like extremely (excellent). 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.

Table 1: Proportions of the ingredients used in standardization of *Leucas aspera* incorporated murukku.

Ingredients	C	F1	F2	F3
Leaf powder	0.0	5.0	10.0	15.0
Jowar flour	65.0	60.0	55.0	50.0
Bengal gram flour	20.0	20.0	20.0	20.0
Butter	5.0	5.0	5.0	5.0
Chilli powder	5.0	5.0	5.0	5.0
Sesame	1.5	1.5	1.5	1.5
Zeera	1.0	1.0	1.0	1.0
Salt	2.5	2.5	2.5	2.5

Note: All formulae were repeated three times.
All ingredients were measured in grams.

Nutritional profiling

Proximate analysis

Moisture, ash, protein (AOAC, 2005), fat (AOAC, 1997), crude fiber (AOAC, 1995), carbohydrate and energy (AOAC, 1980), free fatty acids (Sadasivam and Manickam, 2018) and starch (Southgate, 1976).

Vitamin analysis

Total carotenoids (Zakaria *et al*., 1979), β- carotene (Srivastava and Kumar, 1993) and ascorbic acid (Ranganna, 2017).

Mineral analysis

Calcium, iron, magnesium, manganese, copper, zinc, lithium, sodium, potassium and phosphorus was as analysed by the standard procedures (AOAC, 2012). Bioavailable calcium, zinc (Kim and Zemel, 1986) and iron (Narasinga and Prabhavathi, 1978) content was analysed.

Antioxidant properties

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), oxalate content (Mishra *et al*., 2017).

RESULTS AND DISCUSSION

Sensory evaluation of *Leucas aspera* incorporated jowar murukku

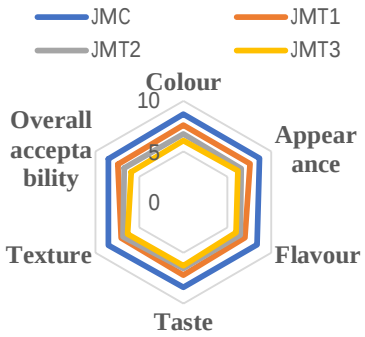
The mean sensory scores for *Leucas aspera* incorporated jowar murukku was given in Fig 1. The scores for colour of the jowar murukku was ranged from 6.07 to 8.67. JMC (8.67) was scored high for colour followed by JML_2 (6.73) and was low for JML_3 (6.07). The appearance of JMC (8.67) and JML_1 (7.60) was highest than other samples. The flavour, taste, texture and overall acceptability of JMC was best accepted followed by JML_1 and were found lowest in JML_3. Among the test samples, JML_1 scored high for appearance, taste, flavour, texture and overall acceptability



Leucas aspera



Leaf incorporated jowar murukku



Mean sensory scores of test sample

Fig 1: Nutritional rich jowar murukku with 5% leaf powder.

Table 2: Physical functional properties of *Leucas aspera* incorporated jowar murukku.

Sample	TA (%)	p^H	ORC	a w	RC	
JMC	0.0031^a±0.00	6.22^b±0.01	1.81^a±0.00	0.26^a±0.00	5.08^a±0.00	
JML	0.0041^b±0.00	6.13^a±0.00	1.99^b±0.00	0.22^a±0.00	6.67b±0.00	
			Colour parameters			
Sample	L*	a*	b*	E*	C*	h*
JMC	-46.65^a±0.26	20.48^b±0.33	44.06^b±1.07	67.17^b±0.58	48.59^b±0.90	57.77^b±2.54
JML	-57.51^b±0.29	14.59^a±0.33	31.07^a±0.74	67.05^a±0.44	34.46^a±0.78	55.29^a±0.21

(TA: Titratable acidity, L*- Lightness, a*- Green to red, b*- Blue to yellow, E*- Total colour difference, H*- Hue angle, C*- Chroma, ORC-Oil retention capacity, WRC- Water retention capacity, RC- Rehydration capacity, AW- Water activity).

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 ($p \leq 0.05$).

JMC: Jowar murukku control.

JML: Jowar murukku with 5% incorporation of *Leucas aspera.*

Table 3: Nutritional composition of *Leucas aspera* incorporated jowar murukku (100 gm).

Sample	Moisture (%)	Ash (g)	Fat (g)	Free fatty acids (g)	Crude fiber (g)	Protein (g)	CHO (g)	Energy (Kcal)	Starch (g)
JMC	3.86a±0.03	3.34^a±0.03	24.65^b±0.32	0.34^b±0.00	2.65^a±0.00	13.75^a±0.00	51.77^a±0.01	483.6^b±0.10	36.22^b±0.16
JML	4.00b±0.00	4.10^b±0.02	23.98^a±0.40	0.28^a±0.00	3.68^b±0.00	14.48^b±0.00	49.79^b±0.02	472.8^a±0.00	24.69^a±0.14

Table 4: Vitamin composition of *Leucas aspera* incorporated jowar murukku (100 gm).

Sample	Vitamin C (mg)	Total carotenoids (µg)	Beta carotenoids (µg)
JMC	0.23^a±0.00	10.55^a±0.06	5.02^a±0.00
JML	3.66b±0.00	134.54^b±0.02	22.50b±0.32

whereas JML_2 scored high for colour. Based on the scores obtained 5% *Leucas aspera* incorporated jowar murukku was selected for the further study.

Physical functional properties

Titratable acidity (%) of JML (32.25%) was increased and P^H was decreased by 1.44% when compared to the control sample. Colour is an important quality parameter of food and influences preference and choice of the consumers. It was also used as an indirect measure of other quality attributes like flavour, pigment content and appearance (Natabirwa *et al.,* 2016). The colour values of L* (23.27%), a*(28.75%), were increased whereas E* (0.17%), b* (29.48%), C* (29.08%) and h* (60.89%) values were decreased than the control sample.

The ORC (oil retention capacity) and rehydration capacity of JML increased by 1.51%, 9.94% and 31.29% than the control due to incorporation of leaf powder. Storage stability of food product decreases with increase in water activity. The water activity of experimental sample was less than 0.5 which indicates good storage stability of the products (Table 2).

Nutritional composition

Nutritional composition of jowar murukku like moisture, ash, fat, protein, free fatty acids, starch, carbohydrates, crude fiber and energy are analysed and given in Table 3. The ash (22.75%), crude fiber (38.86%), protein (5.31%), energy (2.23%) content of JML was improved and carbohydrate (3.82%), starch (31.83%), fat (2.71%) content decreased was observed in JMC.

During processing and storage fats and oils present in food undergo oxidation and this results in deterioration of taste, colour, odour, texture, appearance and finally decreases the nutritional quality of food. Being a hydrolytic degradation of fats and oils free fatty acids amount in treated sample act as an important quality parameter for the fried foods (Anitha *et al.,* 2016). It was found that free fatty acid content of JML was decreased by 17.64% than the control sample. Incorporation of leaf powder improved vitamin content of JML by 1143.47 (vitamin C), 1491.3% (beta carotene) and 348.2% (total carotenoids) than JMC (Table 4).

Minerals are important for many physiological functions of the body (Table 5). Minerals like calcium (109.87%), iron (44.22%), zinc (41.55%), copper (8.33%), phosphorus (3.92%) and potassium (3.97%) were increased whereas manganese (34.56%) and sodium (1.34%) content of test sample was decreased than the control sample. Lithium is the lighest of alkali metals and normally present in all organs and tissues (Schrauzer, 2014). The lithium content of both samples was within the normal range of consumption. The results for bioavailable minerals were given in Table 6. When compared to the control sample bioavailable calcium (68.43%), iron (54.78%) and zinc (81.19%) content of *Leucas aspera* incorporated jowar murukku was increased.

Antioxidant screening of developed products

The antioxidant screening of methanolic extracts of murukku were identified the presence of proteins, amino acids, carbohydrates, phenols, flavonoids, tannins, alkaloids,

Table 5: Mineral composition of *Leucas aspera* incorporpoaretd Jowar murukku (mg/100 g).

Sample	Calcium	Iron	Zinc	Copper	Manganese	Phosphorus	Sodium	Potassium	Lithium
JMC	200.6^{a}±0.30	6.67^{a}±0.12	1.54^{a}±0.00	0.48^{a}±0.00	2.43b±0.00	168.1^{a}±0.00	1113^{e}±0.00	405.5^{a}±0.30	0.01a±0.00
JML	421.0^{b}±0.10	9.62^{b}±0.06	2.18b±0.01	0.52^{a}±0.00	1.59a±0.01	174.7b±.60	1098b±0.00	421.6b±0.20	0.11b±0.01

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 ($p \leq 0.05$).
JMC: Jowar murukku control.
JML: Jowar murukku with 5% incorporation of *Leucas aspera.*

Table 6: Bioavailable mineral content of *Leucas aspera* incorporated jowar murukku.

Sample	Bioavailable calcium		Bioavailable iron		Bioavailable zinc	
	mg/100 g	%	mg/100 g	%	mg/100 g	%
JMC	156.4^{a}±0.20	77.96	4.57^{a}±0.01	68.51	0.49^{b}±0.00	31.81
JML	288.1^{b}±0.10	68.43	5.27^{b}±0.09	54.78	1.77^{d}±0.00	81.19

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 ($p \leq 0.05$).
JMC: Jowar murukku control.
JML: Jowar murukku with 5% incorporation of *Leucas aspera.*

Table 7: Phytonutrient composition of *Leucas aspera* incorporated jowar murukku (100 gm).

Sample	Phenols (mg GAE)	Flavonoids (mg RE/g)	Tannins (mg TAE)	Oxalates (mg)	Antioxidant activity (%)/0.5 ml of extract	IC_{50}
JMC	78.04a±0.03	5.35^{a}±0.06	11.09^{a}±0.00	1866^{a}±0.00	1.86^{a}±0.00	13.51 ml
JML	85.67b±0.01	75.37b±0.12	13.34^{b}±0.01	2623^{b}±0.00	4.64b±0.00	05.38 ml

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 ($p \leq 0.05$).
JMC: Jowar murukku control.
JML: Jowar murukku with 5% incorporation of *Leucas aspera.*

terpenoids (except JMC), glycosides, phlobatinins, steroids, quinones.

The phytonutrient composition of the developed products was given in Table 7. Incorporation of *Leucas aspera* powder improved the phenols (9.77%), flavonoid (1308.78%), tannins (20.28%), oxalate (40.56%) content of jowar murukku when compared to control sample. Antioxidant activity and IC_{50} values of *Leucas aspera* incorporated murukku were determined with DPPH by spectrophotometric method. The antioxidant activity was found highest for JML (4.64%) and its IC50 value was seen at 5.38 ml (JML) concentration of the sample.

CONCLUSION

Ready to eat foods have attracted all sections of the population across the world. The present study has developed *Leucas aspera* leaf powder incorporated jowar murukku and analysed for organoleptic and nutritional properties. The results of the study concluded that addition of leaf powder improved the sensory quality and increased the mineral and phytonutrient content. Use of local leaf varieties is the best strategy to combat many nutritional related problems.

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Conflict of interest

All authors declare that they have no conflict of interest.

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