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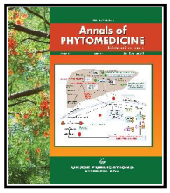

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Standardisation of ready to eat instant powder with an edible medicinal plant (*Leucas aspera* (Wild.) L.): Sensory, physical, functional, nutritional and antinutritional properties

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Abstract

Nutritionally rich instant powder was developed by the incorporation of a traditional green leafy vegetable. *Leucas aspera* (wild.) L. is a wild edible green leafy vegetable with good cultural, nutritional and medicinal importance. Dehydrated leaves were incorporated to the instant powders and subjected to evaluation of sensory, physical, functional, nutritional and antinutritional properties. Incorporation of leaf powder improved the protein (16.92 g/100 g), ash (16.59 g/100 g), crude fiber (14.32 g/100 g), vitamin C (11.15 mg/100 g), total carotenoids (1027.4 µg/100 g) and beta carotenoids (60.73 µg/100 g) content of instant powders. Calcium, iron, copper, zinc, phosphorus, potassium, manganese content of ICL (instant powder with *L. aspera* leaves) were highly increased than ICC (Control). As green leaves are good source of antioxidants, incorporation of leaf powder significantly increased the phytonutrient composition of instant powder. Development of nutritionally good products based on the local traditional food system might be accepted well and also helps to improves the nutritional status of all sections of the people in developing countries.

1. Introduction

Nowadays, it is a very big challenge to provide nutritional, safe and healthy food to undernourished and low-income people of developing countries. Increasing population and depletion of natural sources imposed a great impact on the global food security and economic development. Food scarcity, high cost and improper distribution of healthy food to all sections of people in poor countries resulted in finding and exploration of alternate, cheap, healthy and nutritious food. A number of wild plants were used by the previous man as a part of their diet. But due to loss of knowledge on the traditional usage of wild plants, many of them are current treated as underutilised. Food products developed with wild species can make an important contribution to prevent and control many nutritious problems in developing countries (Salvi and Katewa, 2016).

Plant-based medical systems have been able to meet the needs of primary healthcare since ancient times. Ancient medical procedures have made great use of natural resources. More than 80% of people on earth still rely on plant resources as food and medicine, particularly in developing and underdeveloped countries (Jeurkar *et al*., 2022; Vaidya *et al*., 2021).

L. aspera is a traditional medicinal plant belongs to family Lamiaceae, available throughout India form Himalayas to down Ceylon (Prajapati *et al*., 2010). In Africa, Asia temperate and other tropical countries, *L. aspera* is an aromatic plant and a very common weed (Chew *et al*., 2012). It is an annual herb and grows up to 15-60 cm height and it has quadrangular stem and branches. Leaves of *L. aspera* are yellowish green, obtuse or petiolate and pungent. Flowers of *L. aspera* are small, white in colour and directly attached to base without peduncle. Fruits of *L. aspera* are oblong in shape, brown in colour and smooth in texture (Jayakumar *et al*., 2015). Due to its potential medicinal properties, every part of the plant is used in traditional medicine to treat various health problems (Chew *et al*., 2012).

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2. Materials and Methods

Fresh *L. aspera* leaves were collected from the field areas of Nalgonda district, Telangana state and the edible portions of collected 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 (HJCB-0041:https://indiaflora-ces.iisc.ac.in/herbsheet. php?id = 7474 & cat=13).

2.1 Process description of *L. aspera* incorporated instant powders

Table 1: Different formulations of *L. aspera* incorporated instant powders

Ingredients	C	F1	F2	F3	F4	F5
Leaf 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 formulations were repeated three times.
All ingredients were measured in g.

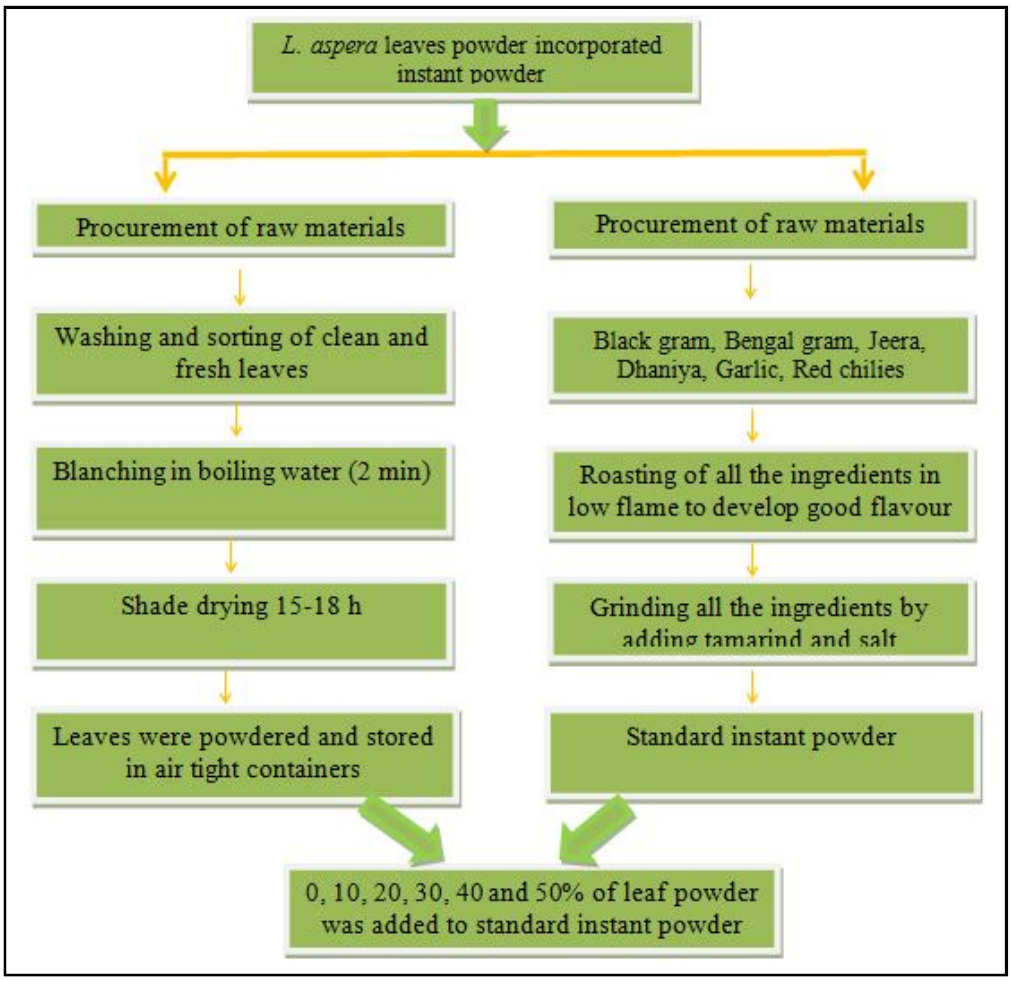

Figure 1: Stepwise preparation of developed instant powders.

2.2 Organoleptic evaluation of instant powder

The sensory assessments were conducted in a purpose-built sensory evaluation laboratory. The panel of 15 members consisted of staff and graduate students of the Department of Foods and Nutrition, Professor Jayashankar Telangana State Agricultural University, Hyderabad. All the products prepared with *L. aspera* powder along with control were coded using random three-digit numbers and served with the order of presentation counter-balanced. Panelists were provided with a glass of water and instructed to rinse and swallow water between samples. They were given written instructions and asked to evaluate the products for acceptability based on its colour, texture, taste, flavour, leafy odour and overall acceptability using nine-point hedonic scale (0=Dislike extremely to 9=Like extremely) (Meilgaard *et al.,* 1999).

2.3 Physical-functional properties

Physical-functional properties of developed products was analysed by standardised procedures with respect to rehydration capacity (Quintero-Ramos *et al*., 1992), rehydration ratio (Sheshma and Raj, 2014), tapped density (Narayana and Narasinga Rao, 1984), bulk density (Stojceska *et al*., 2008), flowability and cohesiveness (Jinapong *et al*., 2008), titratable acidity (Ranganna, 2017), total soluble solids (TSS) (Kathiravan *et al*., 2014), color (Hunter Lab, 2013), chroma and hue (Pathare *et al*., 2012), total color difference (Martins and Silva, 2002), water activity (Abramovie *et al*., 2008), water solubility and water absorption index (WAI; Anderson *et al*., 1969), water retention and oil-retention capacities (Beugre *et al*., 2014) and hydrophilic lipophilic index (Njintang *et al*., 2001).

2.4 Nutritional profiling

Nutritional profiling of instant powders was carried out using standard procedures with respect to moisture (AOAC, 2005), ash (AOAC, 2005), 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), total carotenoids (Zakaria *et al*., 1979), α- carotene (Srivastava and Kumar, 1993) and ascorbic acid (Ranganna, 2017), Calcium, iron, magnesium, manganese, copper, zinc, lithium, sodium, potassium and phosphorus (AOAC, 2012), bioavailable calcium, zinc (Kim and Zemel, 1986) and iron (Narasinga and Prabhavathi, 1978).

2.4.1 Antioxidant properties

Antioxidant screening (Harbourne, 1993), flavonoid content (Zhishen *et al*., 1999), total phenols (Slinkard and Slingleton, 1997), antioxidant activity by DPPH (Tadhani *et al*., 2007; Dorman *et al*., 2004), tannins (AOAC, 2005), oxalate content (Mishra *et al*., 2017).

L. aspera leaves

L. aspera incorporated instant powder Mean sensory scores of developed instant powder

Figure 2: Nutritionally rich instant chutney powder with 50% leaf powder.

3. Results

3.1 Sensory quality characteristics of *L. aspera* leaves incorporated instant powders

The mean sensory scores for *L. aspera* leaf added instant powders were reported Figure 2. The scores for sensory attributes like appearance, colour, flavour, taste, texture and overall acceptability of developed instant powders ranged from 7.60 to 8.50, 7.20 to 8.40, 7.00 to 8.20, 6.90 to 8.50, 7.30 to 8.10 and 7.10 to 8.30, respectively. It was found that control instant powder scored high for all attributes than the test samples. Among the test samples, ICL_1 scored high for colour, texture and flavour attributes. Among all the samples, the overall acceptability of ICL_5 was high and so selected for the further analysis.

3.2 Physical-functional properties of instant powders

The bulk density influences the packaging design, higher bulk density has an advantage that provides greater quantity of food can be stored in a constant volume (David *et al*., 2015). Bulk and tapped density of ICL was decreased by 28.3% and 16.86% when compared to the control. Based on Carr index classification, ICL has bad flowability. According to hausner ratio (HR), ICL (1.80) had high cohesiveness which resists the flowability of powders. When compared to control, titratable acidity of ICL was decreased (35.7%) and p^H was increased (10.07%). Colour values of leaf powder incorporated instant powder are L* (-55.57), a* (14.08), b* (25.11), E* (61.36), C* (28.98) and h* (52.78). when compared to control, L* (9.13%), E* (9.24%), h* values of ICL were decreased whereas a*, b* and C* values are increased.

The water absorption index (WAI), oil retention capacity (ORC), water retention capacity (WRC), rehydration capacity (RC) of ICL was increased by 20.47, 26.63, 101.9 and 100.87%, respectively, when compared with control sample. Whereas, test sample water solubility index (WSI), hydrophilic-lipophilic index (HLI) and water activity (aw) found decreased than the control (ICC).

3.3 Nutritional composition of instant powders

Moisture, ash, fat, crude fiber, free fatty acids, carbohydrates, energy, starch and protein content were analysed and compared between control and test sample. The present study found that addition of leaf powder increased the moisture (0.94%), ash (14.57%), crude fiber (16.51%), protein (10.44%) and free fatty acid content (106.25%) of instant powder. Whereas, fat (6.29 g/100 g), carbohydrate (38.40 g/100 g), energy (277.9 kcal), starch (24.37 g/100 g) and free fatty acids content (0.66 mg/100 g) was decreased when compared to the control sample. *L. aspera* leaf powder improved the nutritional content of instant powder.

Vitamin C, total carotenoid and beta carotene content of ICC and ICL are 1.07 mg and 11.15, 150.3 µg and 1027.4 µg, 13.87 µg and 60.73 µg, respectively. Value addition of leaves powder improved the vitamin C (942.05%), total carotenoid (583.57%) and beta carotene (337.85%) content when compared to the control sample.

Table 2: Physical-functional properties of *L. aspera* incorporated instant powder

Sample	ICC	ICL	Colour values	ICC	ICL	Functional properties	ICC	ICL
BD (g/cm^3)	$0.5^b \pm 0.00$	$0.38^a \pm 0.00$	L*	$-61.16^b \pm 0.88$	$-55.57^b \pm 0.56$	WAI	$1.22^a \pm 0.00$	$1.47^b \pm 0.01$
TD (g/cm^3)	$0.83^b \pm 0.00$	$0.69^a \pm 0.00$	a*	$9.63^a \pm 0.51$	$14.08^b \pm 0.74$	WSI	$1.25^a \pm 0.01$	$1.24^a \pm 0.00$
CI	$36.10^a \pm 0.06$	$43.21^b \pm 0.12$	b*	$25.59^b \pm 0.05$	$25.11^b \pm 4.20$	HLI	$0.53^a \pm 0.00$	$0.50^a \pm 0.00$
HR (%)	$1.57^a \pm 0.00$	$1.80^b \pm 0.00$	E*	$67.61^b \pm 0.85$	$61.36^a \pm 1.09$	ORC	$2.29^b \pm 0.00$	$2.90^a \pm 0.00$
TA(%)	$0.01^a \pm 0.00$	$0.009^a \pm 0.00$	C*	$27.35^a \pm 0.18$	$28.98^b \pm 3.58$	WRC	$2.10^b \pm 0.00$	$4.24^b \pm 0.00$
PH	$4.07^a \pm 0.00$	$4.48^b \pm 0.00$	h*	$58.50^b \pm 0.69$	$52.78^a \pm 2.53$	RC	$04.58^a \pm 0.00$	$09.20^b \pm 0.00$
						aw	$0.45^b \pm 0.00$	$0.37^a \pm 0.00$

(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, WAI- water absorption index, WSI- water solubility index, HLI- hydrophilic lipophilic index, ORC-oil retention capacity, WRC- water retention capacity, RC- Rehydration ratio, A_W- water activity).

Table 3: Nutritional composition of developed instant powders (100 g)

Nutritional	ICC	ICL	Nutrient	ICC	ICL
Moisture (%)	$7.43^a \pm 0.03$	$7.50^b \pm 0.02$	Carbohydrate (g)	$40.47^b \pm 0.01$	$38.40^a \pm 0.01$
Ash (g)	$14.48^a \pm 0.14$	$16.59^b \pm 0.08$	Energy (kcal)	$298.8^b \pm 0.00$	$277.9^a \pm 0.00$
Fat (g)	$8.41^b \pm 0.071$	$6.29^a \pm 0.091$	Starch (g)	$25.71^b \pm 0.19$	$24.37^a \pm 0.15$
Free fatty acids (mg)	$0.32^a \pm 0.04$	$0.66^b \pm 0.00$	Ascorbic acid (mg)	$1.07^a \pm 0.01$	$11.15^b \pm 0.08$
Crude fiber (g)	$12.29^a \pm 0.01$	$14.32^b \pm 0.00$	Total carotenoids (µg)	$13.87^a \pm 0.01$	$60.73^b \pm 0.25$
Protein (g)	$15.32^a \pm 0.00$	$16.92^b \pm 0.01$	Beta carotenoids (µg)	$0150.3^a \pm 0.20$	$1027.4^b \pm 0.10$

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 ($p \leq 0.05$).
ICC: instant powder control, ICL: instant powder with 50% incorporation dried *L. aspera* leaves.

3.4 Mineral and bioavailable mineral composition of instant powders

The minerals like Ca, Fe, Zn, Cu, Mg, Mn, Na, K and P were analysed for instant powders and the results were presented in Tables 4. When compared with control sample, test sample calcium (34.44%), iron (49.72%), zinc (68.05%), copper (33.78%), manganese (70.05%), phosphorus (0.96%), potassium (22.1%) and lithium content was increased whereas sodium content was decreased by 22.1%. The present study found that addition of leaf powder instant powder improved the bioavailable calcium (54.46%), iron (58.55%) and zinc (69%) content.

Table 4: Mineral and bioavailable mineral composition of developed instant powders (100 g)

Mineral (mg)	ICC	ICL	Mineral (mg)	ICC	ICL
Calcium	$486.3^a \pm 0.20$	$653.8^b \pm 0.10$	Sodium	$5830^a \pm 0.00$	$3426^b \pm 0.00$
Iron	$7.22^a \pm 0.09$	$10.81^b \pm 0.11$	Potassium	$592.6^a \pm 0.00$	$723.6^b \pm 0.00$
Zinc	$1.44^a \pm 0.00$	$2.42^b \pm 0.00$	Lithium	$0.02^a \pm 0.00$	$1.12^b \pm 0.00$
Copper	$0.74^a \pm 0.00$	$0.99^b \pm 0.00$	Bioavailable calcium	$325.3^a \pm 0.20$	$356.1^b \pm 0.10$
Manganese	$1.87^a \pm 0.00$	$3.18^b \pm 0.00$	Bioavailable iron	$5.23^a \pm 0.01$	$6.33^b \pm 0.11$
Phosphorus	$207.1^a \pm 0.00$	$209.1^b \pm 0.60$	Bioavailable zinc	$0.58^a \pm 0.00$	$1.67^b \pm 0.00$

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 ($p \leq 0.05$).
ICC: instant powder control, ICL: instant powder with 50% incorporation dried *L. aspera* leaves.

3.5 Phytonutrient composition of instant chutney powders

The methanolic extracts of instant powders identified the presence of amino acids, proteins, carbohydrates, flavonoids, alkaloids, phenols, tannins, alkaloids, terpenoids, saponins, glycosides, phlobatannins and steroids. The results for phytonutrient composition of ICL per 100 g are: phenols-419.1mg GAE, flavonoids-97.20 RE, tannins-45.52 TAE, oxalates-3774 mg and high antioxidant activity with IC_{50} values of 0.16 ml. Leaf powder improved the phytonutrient content of instant powder above the control sample.

The antioxidant activity of the methanolic extracts of developed products was evaluated using the 2,2'-diphenyl-1-picrylhydrazyl

(2,2'-DPPH) test. The degree of discolouration *via* donating hydrogen reflects an antioxidant's ability to scavenge (Goel *et al*., 2022).

Table 5: Phytonutrient composition of developed instant powders (100 g)

Phytonutrients	ICC	ICL
Phenols (GAE mg)	203.1[a] ± 0.00	419.1[b] ± 0.10
Flavonoids (mg RE)	8.44a ± 0.06	97.20 [b] ± 1.32
Tannins (TAE mg)	16.27[a] ± 0.01	45.52 [b] ± 1.11
Oxalates (mg)	1506[a] ± 0.00	3774 [b] ± 0.00
Antioxidant activity (%)/0.5 ml of extract	31.09[a] ± 0.00	91.76 [b] ± 0.00
IC_{50}	0.80 ml	0.16 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 ($p \leq 0.05$).

ICC: Instant powder control, ICL: Instant powder with 50% incorporation dried *L. aspera* leaves

4. Discussion

Curry leaf incorporated instant chutney powder can be considered as a rich appetizing adjunct with a good amount of minerals and protein (Balaswamy *et al*., 2004). When compared to control, *L. aspera* leaves incorporated instant powders acceptance was gradually decreased by increasing leaves percentage in all attributes. But up to 50% incorporation of *L. aspera* leaves also showed good acceptability and so ICL_5 was selected further analysis.

Characterization of various physical properties of traditional greens helps to find their performance in food product development, handling, and packing properties. Addition of green leafy vegetables affected the flowing properties of instant powders (Godswill *et al*., 2019).

Evaluation of functional characteristics determines the behavior of special ingredients used during preparation, processing and also determines how the finished product will look, feels and taste (Godswill *et al*., 2019). Being rich source of nutrients, dried green leafy vegetables increase the density of nutrients due to moisture loss. Dehydration has impact on some vitamins but the dietary fiber and minerals components are unaffected (Kakade and Neeha, 2014). Traditional greens are the good source of nutrients than commercials greens. Addition of leaves improved the protein and crude fiber content. As green have less amount of carbohydrates and starch and so, resulted in decrease of carbohydrate, starch and energy content of instant powder than the control sample (Iyaka *et al.,* 2014).

The moisture content of any food product is used as a good measure of stability and susceptibility to microbial contamination. Proteins play a significant role in the synthesis and maintenance of enzymes, tissues and hormones required for healthy functioning (Rajashekar *et al*., 2021).

Vitamins and mineral are not synthesized by the body but required in very small amounts for normal functioning of the body. Consumption of green leafy vegetables provides the necessary vitamins and minerals for the body (Achikanu *et al*., 2013). Minerals like sodium and potassium are important constituents of intra and extracellular fluids, essential to maintain osmatic balance (Mounikaa and Hymavathi, 2021). When compared to the control sample, vitamin and mineral like beta carotenoids, total carotenoids, calcium, iron and zinc were highly increased. Incorporation of dried leaves improved the bioavailability of calcium, iron and zinc content of instant powders.

Green leafy vegetables are the source of immense variety of non-nutritive bioactive compounds helps in promoting health benefits beyond basic nutrition. Fortified instant powder has improved phenolic, flavonoid and total antioxidant activity. *L. aspera* has both food medicinal properties. Products developed from wild greens are adds variety and improves the nutritional status of people in a cost-effective way.

5. Conclusion

Nowadays, instant food products have an important place in the stores and super markets of India. Due to changing lifestyle of people increased the demand for new, high quality instant food products and this made many Indian companies to enter into the market with new food verities. Instant powder made with 50% incorporation of *L. aspera* leaves exhibited good sensory, nutritional and antinutrient properties. Development of products by the addition of wild plants adds diversity to the diet, provides nutrients in a cost-effective way.

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Conflict of interest

The authors declare no conflicts of interest relevant to this article.

References

Abramovic, H.; Jamnik, M.; Burkan, L. and Kac, M. (2008). Water activity and water content in Slovenian honeys. Food Control, **19**(11):1086-1090.

Achikanu, C.E.; Eze-Steven, P.E.; Ude, C.M. and Ugwuokolie, O.C. (2013). Determination of the vitamin and mineral composition of common leafy vegetables in south eastern Nigeria. International Journal of Current Microbiology and Applied Sciences, **2**(11):347-353.

Anderson, R.A.; Conway, H.F.; Pfeifer, V.F. and Griffin, E.L. (1969). Gelatinization of corn grits by roll and extrusion cooking. Cereal Science Today, **14**:4-12.

AOAC, Official method of analysis for fiber. Association of Official Analysis Chemist. (1995). 14th Edition. Washington DC. USA.

AOAC, Official Methods of Analysis for ash in flour. Association of Official Analytical chemists. (2005). 18th Edition.

AOAC, Official Methods of Analysis for fat (crude) or ether extract in flour, Association of Official Analytical Chemists. (1997). 16th Ed. 3rd Revision. Gaithersburg, Maryland, 20877-2417. AOAC 920.85, chap 32-05.

AOAC, Official Methods of Analysis for moisture in flour, Association of Official Analytical Chemists. (2005). 18th Ed, Arlington VA 2209, USA. AOAC 929.03, 32-02.

AOAC, Official Methods of Analysis for PH in fruits leather rolls. AOAC international 19th Edition. Volume II. Association of Official Analytical Chemists. Gaithersburg (2012).

AOAC, Official Methods of Analysis for protein. Association of Official Analytical Chemists. (2005). 18th Ed, Arlington VA 2209, USA. AOAC 984.13, chap 04, pp:31.

AOAC, Official methods of analysis, Association of Official Analytical Chemists. (1980). Washington, D.C. USA.

Balaswamy, K.; Jyothirmayi, T. and Rao, D.J. (2004). Studies on preparation of curry leaf (*Murraya Kkoenigii L.)* instant powder. Food Service Research International, **14**:175-187.

Beugre, G.A.M.; Yepo, B.M.; Ble, S.H. and Gnakri, D. (2014). Effect of fermentation time on the physicochemical properties of maize flour. International Journal of Research Studies in Biosciences, **2**(8):30-38.

Chew, A.L.; Jessica, J.J.A. and Sasidharan, S. (2012). Antioxidant and antibacterial activity of different parts of *L. aspera*. Asian Pacific Journal of Tropical Biomedicine, **2**(3):176-180.

David, O.; Arthur, E.; Kwadwo, S.O.; Badu, E. and Sakyi, P. (2015). Proximate composition and some functional properties of soft wheat flour. International Journal of Innovative Research in Science, Engineering and Technology, **4**(2):753-758.

Dorman, H.J.D.; Bachmayer, O.; Kosar, M. and Hiltunen, R. (2004). Antioxidant properties of aqueous extracts from selected Lamiaceae species grown in Turkey. Journal of Agricultural and Food Chemistry, **52**(4):762–770.

Godswill, A.C.; Somtochukwu, I.V and Kate, E.C. (2019). The functional properties of foods and flours. International Journal of Advanced Academic Research Sciences, Technology and Engineering, **5**(11):139-160.

Goel, N.; Kumari, S,; Singh, S,; Moond, M,; Panghal, M,; Rani, I,; Sangwan, V. and Bhardwaj, K.K. (2022). Mineral content, bioactive ingredient identification and antioxidant activity of *Argemone mexicana* L. flowers extracts. Ann. Phytomed., **11**(2):478-483.

Harbourne, J.B. (1993). Phytochemistry, Academic press, London. pp:89-131.

Hunter lab. (2013). Hunter Assosiate Labaratory. Manual version-2.1. **60**:1014-323.

Iyaka, Y.A.; Idris, S.; Alawode, R.A and Bagudo, B.U. (2014). Nutrient content of selected edible green leafy vegetables. American Journal of Applied Chemistry, **2**(3):42-45.

Jayakumar, K.; Kannan, T.M.S. and Vijayarengan, P. (2015). *L. aspera* : Medicinal herb. International Journal of Traditional and Natural Medicines, **5**(1):1-5.

Jeurkar, M.M.; Kosalge, S.B.; Sheikha, N.W.A. and Telrandhe, U.B. (2022). *Cyperus rotundus* L.: Phytochemistry and pharmacological activities. Ann. Phytomed., **11**(2):186-19.

Jinapong, N.; Suphantharika, M. and Jamnong, P. (2008). Production of instant soymilk powders by ultrafiltration, spray drying and fluidized bed agglomeration. Journal of Food Engineering. **84**:194-205.

Kakade, S.B and Neeha, V.S. (2014). Dehydration of green leafy vegetables: A Review. International Journal of Innovative Research in Technology, **1**(8):58-64.

Kathiravan, T.; Nadanasabapathi, S. and Kumar, R. (2014). Standardization of process condition in batch thermal pasteurization and its effects on antioxidant, pigment and microbial inactivation of ready to drink (RTD) beetroot (*Beta vulgaris L.*) juice. International Food Research Journal, **21**(4):1305-1312.

Kim, H. and Zemel, M.B. (1986). *In vitro* estimation of potential bioavailability of calcium for sea mustard, milk and spinach under stimulate normal and reduce gastric condition, Journal of Food Science, **51**:957-963.

Martins, R.C. and Silva, C.L.M. (2002). Modelling colour and chlorophyll losses of frozen green beans (*Phaseolus vulgaris, L.*). International Journal of Refrigeration, **25**(7):966-974.

Meilgaard, M.; Civile, G.V and Carr, B.T. (1999). Sensory Evaluation Technique. 3rd Edition. CRC press, Boca Raton.

Mishra, D.P.; Mishra, N.; Musale, H.B.; Samal, P.; Mishra, S.P. and Swain, D.P. (2017). Determination of seasonal and developmental variation in oxalate content of *Anagallis arvensis* plant by titration and spectrophotometric method. The Pharma Innovation, **6**(6):105-111.

Mounika, M and Hymavathi, T.V. (2021). Nutrient and phytonutrient quality of nutricereals incorporated flour mix suitable for diabetics. Ann. Phytomed., **10**(1):132-140.

Narasinga Rao, B.S. and Prabhavathi, T. (1978). An *in vitro* method for predicting the bioavailability of iron from foods. American Journal Clinical Nutrition, **31**:169-175.

Narayana, K. and Narasinga Rao, M.S. (1984). Effect of partial hydrolysis on winged Bern (*Psophocarpus tetragonolobus*) flour. Journal of Food Science, **49**:944-947.

Njintang, N.Y.; Mbofung, C.M.F. and Waldron, K.W. (2001). *In vitro* protein digestibility and physicochemical properties of dry red bean (*Psophocarpus tetragonolobus*) flour. Journal of Food Science, **47**(5):1534-11538.

Pathare, P.B.; Opara, U.L and. Al-said, F.A.J. (2012). Colour measurement and analysis in fresh and processed foods. A review. Food and Bioprocess Technology, **6**(1):36-60.

Prajapati, M.S.; Patel, J.B.; Modi, K. and Shah, M.B. (2010). *L. aspera*: A review. Pharmacognosy reviews, **4**(7):85-87.

Quintero-Ramos, A.; Bourne, M.C. and Anzaldfia-Morales, A. (1992). Texture and rehydration of dehydrated carrots as affected by low temperature blanching. Journal of Food Science, **57**:1127-1128.

Rajashekar, R.B,; Sachindra, N.M,; Shivanna, N. and Sakriyanaik, L (2021). Effect of drying methods on proximate analysis and antioxidant activities of ripe and unripe fruits of *Diplocyclos palmatus* (L.) C. Jeffery. Ann. Phytomed., **10**(2):398-408.

Ranganna, S. (2017). Handbook of analysis and quality control for fruits and vegetable products. Second edition, McGraw Hill Education (India) Private Limited, Chennai, Tamil Nadu, pp:105-110.

Sadasivam, S. and Manickam, A. (2018). Biochemical methods. Third edition. New Age International Pvt. Ltd. Publishers, pp:21-22.

Salvi, J. and Katewa, S.S. (2016). A review: Underutilized wild edible plants as a potential source of alternative nutrition. International Journal of Botany Studies, **1**(4):32-36.

Sheshma, J. and Raj, J.D. (2014). Effect of pre drying treatments on quality characteristics of dehydrated tomato powder. International Journal of Research on Engineering and Advanced Technology, **2**(3):1-7.

Slinkard, K. and Slingleton. (2004). Total phenolic analyses: Automation and comparison with manual method, American Journal Enology and Viticulture, **28**:49-55.

Southgate, D.A.T. (1976). Determination of food carbohydrates. 108, 109, Appiled Science Publishers Ltd. London.

Srivastava, R.R. and Kumar S. (1993). Important methods for analysis of fruits/vegetables and their products. Fruit and Vegetable preservation Principles and Practices 2nd Edition, pp:321-339.

Stojceska, V.; Ainsworth, P.; Plunkett, A. and Ibanoglu, S. (2008). The advantage of using extrusion processing for increasing dietary fiber level in gluten free products. Food Chemistry, **121**:156-164.

Tadhani, M.B.; Patel, V.H. and Subhash, R. (2007). *In vitro* antioxidant activities of *Stevia rebaudiana* leaves and callus. Journal of Food Composition and Analysis, **20**:323-329.

Vaidya, D.; Pandit, A.; Sharma, A.; Kaushal, M.; Saini, H.K.; Anand, A.; Sharma, R. and Gupta, A. (2021). Morphological, functional characterization and evaluation of biological value of microencapsulated *Aloe vera* (L.) Burm. f. Ann. Phytomed., **10**(2):137-144.

Zakaria, M.; Simpson, K.; Brown, P. and Krstulovic, A. (1979). Use of reverse phase HPLC analysis for the determination of provitamin A carotenes in tomatoes. Journal of Chromatography, **176**:109-117.

Zhishen, J.; Mengcheng, T. and Jianming, W. (1999). The determination of flavonoid contents in mulberry and their scavenging effects on superoxide radicals. Food Chemistry, **64**(4):555-559.

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