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Nutritional and Proximate Composition of Portulaca quadrifida L. as Affected by Selected Drying Techniques

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Abstract:

Portulaca quadrifida L. commonly called as chickenweed, is a summer annual, underutilized green leafy vegetable known for this phytochemical importance. The aim of the present study was to evaluate the effect of sun drying and hot-air oven drying on the nutritional composition of P. quadrifida L. Pre-treated sample was subjected to sun drying and hot air oven drying and further analyzed for the nutritional composition using standard AOAC procedures. The nutritional composition of both dried powders differed significantly ($p < 0.05$) for proximate and mineral and vitamin content. From the results, they contain 5.38 to 6.0% of moisture, 29.12-28.26 g/100g of protein, 6.60-6.12 g/100g of ash, 8.44-7.37 g/100g of crude fiber, 1484.52-1324.84 mg/100 g of calcium, 137.67-126.21 mg/100 g of phosphorus, and 418.10-393.33 mg/100 g of magnesium and 260.59- 209.35 mg/100 g of vitamin A, which were all significantly higher in sun dried sample. On the contrary, fat content (3.18–3.65 g/100 g), carbohydrate content (47.82–48.09 g/100 g), iron concentration (18.01-17.61 mg/100 g) and vitamin C (215.87-197.11mg/100 g) though higher in sun dried sample, did not differ significantly across the drying processes ($p > 0.05$).

Keywords: Portulaca quadrifida L., Chickenweed, Nutritional composition, Sun drying, Hot-air oven drying

1. Introduction:

Portulaca quadrifida Linn., commonly called as chickenweed is a species of the Portulacaceae family. It is a prostrate, mat-forming summer annual or short-lived perennial herb with widely branched, spreading, articulated, fleshy stems up to 50 cm long or longer that root freely from the nodes, which are usually flushed reddish and have dense whorls of whitish hair. It has tiny, succulent leaves and yellow flowers. (Kirtikar & Basu, 2001). Although it grows best in sandy soils, the plant is tolerant and adaptable to a variety of soil types, including plain areas, rocks, and sandy or stony soils. Its seeds are easily dispersed by water, wind, or bird droppings. [2]. The plant species are distributed worldwide in tropical and subtropical areas as well as throughout India's tropical regions. In addition to being eaten as a vegetable, it has several

therapeutic uses. Asthma, cough, urine discharges, inflammations, and ulcers are reported to benefit from it. Hemorrhoids, erysipelas, and abdominal ailments are treated with a poultice of the plant. (Kirtikar & Basu, 2001). In Indo-China, a decoction is administered for diarrhoea, while leaf juice is applied to abscesses and used as a collyrium. The leaves are applied topically to swellings in Nigeria. [3]. Studies show that P. quadrifida L. leaves are the most popular plant species among wild leafy vegetables in Ethiopia and Indo-Pak. People utilise this herb as foods like salad and chutney[4]. The leaves are mixed with bajra, sorghum or pearl millet flour to make a kind of bread in a few parts of India like Rajasthan. Tender shoots and leaves are cooked and consumed as greens in Tamil Nadu. Studies also reveal the presence of tannins, flavonoids and triterpenoids in petroleum ether extract, alkaloids, flavonoids, triterpenoids, glycosides, tannins, amino acids and saponins in ethanolic extract and flavonoids, alkaloids, carbohydrates, glycosides, amino acids and saponins in aqueous extract of P. quadrifida L. [5]. Despite several studies on the pharmacological importance of P. quadrifida L. not much is known about the nutritional composition and the effect of processing on the nutritional profile of P. quadrifida L. Hence the present study aimed to study the effect of sun drying and hot-air oven drying on the nutritional composition of P. quadrifida L.

2. Materials and Methodology:

2.1 Materials:

P. quadrifida L. sample was collected from the fields in Vijayapura district and was brought to the Department of Food Processing and Nutrition, Karnataka State Akkamahadevi Women University, Vijayapura, Karnataka , India. Care was taken to obtain the fresh samples from multiple locations in order to even out the effects of different environments and soil types on nutrients. The sample was manually sorted to remove any other waste debris, roots and other impurities and washed with water and blanched by immersion in boiling water for 7 seconds then drained and left to dry on a cheese cloth for 15 min at room temperature (35 ± 2°C). Further it was divided into two groups (about 500 g/group) and dried using two different drying methods sun drying and hot air oven drying. Both the drying methods were carried out until constant weight was obtained. The dried samples were ground and kept in sealed glass jars in dark until further analysis.

2.2: Methods

2.2.1. Drying methods

2.2.1.1. Sun drying

For sun drying, sample was spread out in a single layer and exposed to direct sunlight. The average temperature was around 37°C ± 1 °C for about 20-hour drying process, which took place during peak sunlight (approximately 5 hours of daylight).

2.2.1.2. Hot air drying

Hot air drying was carried out in a hot air oven (Apollo Lab, Model: AP65). The capacity of the oven was 224 litre with control accuracy of + 0.5°C and a maximum working temperature of 200°C. Accumulated moisture during drying process was discharged by natural ventilation. Chickenweed sample was placed in a thin layer and dried at 65°C for 10 h.

2.2.2. Nutritional composition:

Three replicates of each composite sample were analyzed. Moisture, ash, protein, fat, crude fibre and phosphorous content were determined by the AOAC procedure [6]. Mineral element analysis of Fe, Ca, Mg was done by Atomic Absorption Spectrophotometer as described by [7]Total Carbohydrates was determined on 100 mg as described by [8]Vitamin C was determined as described by [9]) and Vitamin A as described by [10].

2.2.3. Statistical analysis:

Nutritional composition data was analyzed using descriptive statistics and t-test was applied. The data was analyzed using MS-Excel and SPSS version 31.0.

3. Results and Discussion:

Table 1: Proximate Composition of the Sun and Hot air oven dried P. quadrifida L. powder

Parameter	Sun dried	Hot Air oven dried	t value	p value	Remarks
Moisture (%)	5.38±0.40	6.00±0.17	-4.24	0.025	S
Protein (g/100g)	29.12±0.07	28.26±0.17	6.96	0.009	S
Fat (g/100g)	3.18±0.23	3.65±0.33	-1.6	0.123	NS
Ash (g/100g)	6.60±0.18	6.12±0.30	3.61	0.036	S
Crude fiber (g/100g)	8.44±0.36	7.37±0.45	17.12	0.002	S
Carbohydrates (g/100g)	48.09±0.12	47.82±0.56	0.94	0.22	NS

Data are presented as mean ± SD, S: Significant, NS: Non-significant

Table 1 represents the proximate composition of the sun dried and hot air oven dried P. quadrifida L. powder. Sun-dried samples had significantly lower moisture content (5.38%) than hot air oven-dried samples (6.00%) ($p<0.05$), indicating better dehydration. Reduced moisture content in sun-dried sample could increase storage stability and decrease microbial susceptibility. The significantly lower moisture content observed in sun-dried Portulaca quadrifida powder are consistent with the findings of [11] who reported that adequate drying lowers moisture to levels that favour product stability during storage. Sun-dried powder exhibited a significantly higher protein content (29.12 g/100 g) than hot-air oven-dried powder (28.26 g/100 g) ($p<0.05$). Heat-induced amino acid breakdown and thermal denaturation may be responsible for the decrease in protein content during hot-air drying. Previous studies on leafy vegetables have also reported better protein and carbohydrate retention under sun drying dried conditions[12]. The total mineral matter, or ash content, was significantly higher in sun-dried samples (6.60 g/100 g) than in oven-dried samples (6.12 g/100 g) ($p<0.05$). This implies better mineral constituent retention during sun drying. Similarly, sun-dried powder had a significantly higher crude fibre content (8.44 g/100 g) than oven-dried powder (7.37 g/100 g) ($p<0.05$), suggesting that extended exposure to high temperatures may have an impact on structural polysaccharides and fibre integrity. Fat content (3.18–3.65 g/100 g) and carbohydrate content (47.82–48.09 g/100 g) did not differ significantly across the drying processes ($p > 0.05$). This suggests that both drying methods were equally effective in preserving these components. Significant differences were observed between the two drying methods for moisture, protein, ash, and crude fiber contents ($p < 0.05$), whereas fat and carbohydrate contents did not differ significantly.

Table 2: Mineral and Vitamin Composition of the Sun and Hot air oven dried P. quadrifida L. powder

Parameter	Sun dried	Hot Air oven dried	t value	p value	Remarks
Iron (mg/100g)	18.01±0.42	17.61±0.61	1.05	0.2	NS
Calcium (mg/100g)	1484.52±38.82	1324.84±20.94	6.59	0.01	S
Phosphorus (mg/100g)	137.67±2.22	126.21±2.67	4.77	0.023	S
Magnesium (mg/100g)	418.10±4.17	393.33±3.25	34.68	0.0003	S
Vitamin C (mg/100g)	215.87±13.20	197.11±6.62	1.64	0.12	NS
Vitamin A (mg/100g)	260.59±13.62	209.35±7.89	8.47	0.006	S

Data are presented as mean ± SD, S: Significant, NS: Non-significant

The mineral composition indicated significant variations between drying methods. The calcium (1484.52 mg/100 g), phosphorus (137.67 mg/100 g), and magnesium (418.10 mg/100 g) contents of sun-dried samples were significantly greater than those of hot-air oven-dried samples ($p < 0.05$). The conservation of calcium was especially significant; sun drying preserved around 12% more calcium than oven drying. The lack of prolonged exposure to high temperatures, which can speed up oxidation reactions and change mineral bioavailability, may be the cause of the better mineral retention in sun-dried samples. Similar findings have been reported for dried green leafy vegetables, where sun-dried plant samples contained the highest amount of N, P, K. Ca and Mg [12]. No significant difference was observed in iron concentration between the drying techniques (18.01 and 17.61 mg/100 g for sun and oven drying, respectively; $p > 0.05$). This implies that regardless of the drying method used, iron remained largely constant during dehydration. The drying technique had an impact on vitamin retention. Sun-dried samples had a higher vitamin C content (215.87 mg/100 g) than oven-dried samples (197.11 mg/100 g), although the difference was not statistically significant ($p>0.05$). Despite ascorbic acid's great susceptibility to heat degradation, the drying conditions employed in the present study might not have been harsh enough to result in significant losses. On the contrary, the drying process had a significant impact on vitamin A concentrations; samples that were sun-dried had greater values (260.59 mg/100 g) than samples that were hot-air oven-dried (209.35 mg/100 g) ($p < 0.05$).

4. Conclusion:

Overall, the findings suggest that sun drying showed improved retention of most nutrients, including minerals, protein, crude fibre, and vitamin A. According to the results, sun drying might be a more practical and cost-effective way to maintain the nutritional value of Portulaca quadrifida L. than hot-air oven drying. These findings provide support to the possible use of sun-dried P. quadrifida powder as a nutrient-rich component in the creation of functional foods.

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