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Nutritional Abundance of Purslane: Assessment and Challenges

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Abstract:

Purpose: Purslane is a weed considered both grass and field crops and widely found in tropical and sub- tropical areas. It is traditionally used in Asian origin and widely accepted globally for its medicinal purpose and grows effectively on poor soils with less irrigation during germination and seedling. The significant potential of purslane in context of availability, pharmacology, nutraceutical properties and agriculture easiness emphasize on the vigorous investigations and assessment of purslane as compared to other similar crops. This review focuses on the current update on nutritional status of purslane and challenges in its wide acceptance.

Method: The online literature was searched using PubMed, Scopus, Google Scholar and Web of Science.

Result: Purslane is known for its endearing nutraceutical properties and one of the richest ω-3 fatty acid source among green plants. Despite of the reported antinutrient activity, the nutritional abundance of purslane is comparable to other conventional green edible crops in addition to its captivating pharmacological uses.

Conclusion: Purslane is a promising wonder crop due to its high nutritional value and acceptance into the human diet. Usage of purslane is restricted by its anti-nutritional content especially oxalate levels and its effect on the absorption of other nutrients but processing methods like boiling, blanching can be applied as remedial measure in reducing the antinutritional content.

Keywords: Purslane, Nutritional composition, Antioxidants, Vitamins, Oxalate.

INTRODUCTION

Purslane (*Portulaca oleracea* L.) getting a special attention in the present time, in both agriculture and nutrition field. Purslane is a weed can be counted in both grass and field crops (Kamal-Uddin et al., 2009; Uddin et al., 2010). The word "Portulaca" derived from Latin word in which "portula" means "small door" because of the way its capsule opens. In the second case, "porto" means carry and "lac" refers to the tender and juicy stems and leaves (Simopoulos and Jr, 1986). This weed is traditionally used in Asian origin (Iran, India, and southern Russian regions), for its medicinal purpose (Bermejo and León, 1994). This weed grows effectively on poor soils with less irrigation during germination and seedling. Summer is best season for the growth of Purslane. This weed grows with branching, ascending stems that are juicy, smooth, and reddish cylindrical body. The leaves are 3cm in length, opposite, oblong and juicy. A taproot is a type of root whereas flowers are yellow, tiny, and often solitary at the ends of branches that occur from July to September.

Purslane fruits contain large numbers of black seeds that are packed in capsules and good in taste with slight flavor. Purslane can be consumed fresh, cooked, or pickled. Due to its nutritional and therapeutic characteristics, this weed was called as "future power food" and "new crop"(Simopoulos et al., 1995). In Ancient Egypt, purslane was used as a medicinal herb because it contains higher amount of ω-3 fatty acid, α- tocopherol, ascorbic acid, β-carotene and glutathione content (Liu et al., 2000; Wenzel et al., 1990).

PHARMACOLOGICAL ROLE

Purslane leaves and stems consumed mainly in soups and mixed salads where it is admired for its succulence which is like to watercress / spinach. As this plant constituent of many phytochemicals, it was used as a febrifuge, antiscorbutic, antibacterial, antispasmodic, diuretic, vermifuge, refrigerant, and therapeutic purpose especially in the Middle East (Chan et al., 2000). Purslane extract is used to treat bacillary dysentery due to its aphrodisiac property. Beside it purslane has been shown to have analgesic and anti-inflammatory activities (Chan et al., 2000; Sanja et al., 2009). An active role of purslane was observed in the treatment of skin disease causing fungus like *Trichophyton equinum*, *Trichophyton verrucosum* etc. (Oh et al., 2000). A high amount of potassium content was recorded in the plant extract and potassium has an active role in muscle relaxation (Parry et al., 1993). It is used as an anti-diabetic by Chinese folk as it has the ability to maintain blood glucose level, glucose metabolism, and blood lipids profile in diabetes mellitus mice (Gong et al., 2009).

The polysaccharides of Purslane also have free radical scavenging properties, so this can be used to treat the ovarian cancer that occurs as a result of oxidative damage in animals (YouGuo et al.,

2009). Many researchers have revealed that consuming purslane can reduce the chances of cancer and heart disease due to its high catecholamine content (noradrenaline and dopamine, 0.15% and 0.25%, respectively (Simopoulos, 1991; Zhang et al., 2002). Noradrenaline can regulate the immune system and has anticancer capabilities. Besides it, purslane contains various bioactive elements, like antioxidants and ω-3 fatty acids (FA) in which α- linolenic acid (ALA) is most abundant. Fatty acid is the reason for the ability to reduce the chances of heart diseases, anticancer and anti-inflammatory properties (Ruxton et al., 2004; Simopoulos, 1999).

NUTRITIONAL COMPOSITION AND BENEFIT OF PURSLANE LEAVES

3.1 Proximate composition

According to USDA (USDA, 2007) purslane leaves contains 92 percent of water, 1.3g protein, 0.1g total fat, 0.12g total ash and 3.43g carbohydrate content.

3.2 Minerals

The amount of Calcium, Magnesium, potassium, iron and Zinc from the early stage to later be as 1612 to 1945 mmol/kg DW, 2127 to 2443 mmol/kg DW, 1257 to 1526 mmol/kgDW, 218 to 262 mmol/kg DW, and 128 to 160 mmol/kg DW, respectively. The same result was observed for the Na and Cl content that were higher at the early stage and lower at the mature stage in leaves, ranging from 356 to 278 mmol/kg DW and from 82 to 53 mmol/kg DW, respectively (Uddin et al., 2012). Mineral content of Purslane is compared to other green vegetables as shown in figure 1. Purslane is rich in potassium content whereas magnesium and phosphorus is comparable to other vegetables.

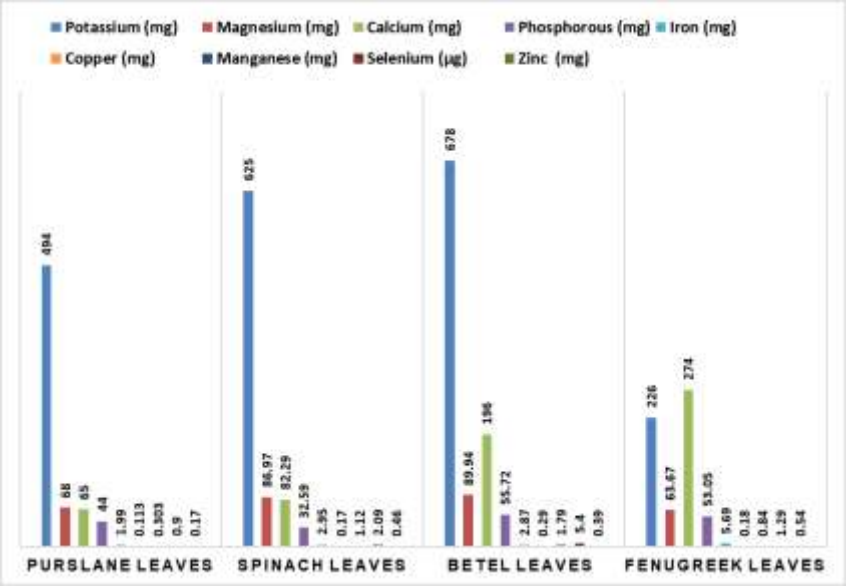

Figure 1 Comparison of minerals content of purslane leaf with other widely used green leafy vegetables (USDA, 2007)

3.3 Fatty acid

Purslane is known for its ω-3 fatty acid source among green plants. According to(Simopoulos and Jr, 1986), ω-3 fatty acids content was highest in purslane than any vegetable yet investigated, especially α-linolenic acid. Alpha-linolenic acid in stem, leaves and flowers as 0.47 percent, 0.51 percent and 0.54 percent, respectively. Polyunsaturated fatty acids (PUFA) were found most prevalent in all parts as 78.75 percent followed by saturated fatty acid (16.42 percent) and monounsaturated fatty acids (4.83 percent).The most abundant fatty acids were ω-3 and ω-6 fatty acid as 50 percent and 46 percent, respectively (Siriamornpun and Suttajit, 2010). According to Petropoulos *et al.* (Petropoulos et al., 2019) the fatty acid content of purslane stems was mainly palmitic and linoleic acid as (20.2-21.8% and 23.02-27.11%, respectively while leaves were found rich in α- linolenic acid (35.4-54.92%). In another study Omega-3 content of cultivated and wild purslane leaves were as 189.16 ± 25.52 mg/100g and 188.48 ± 6.35 mg/100g respectively on dry weight basis. Omega-6/omega-3 ratios (1:1-1:3) were low in both genotypes (Petropoulos et al., 2019). In stems and leaves, α-linolenic acid content lies between 149 to 523 mg per 100g, respectively. It was identified that 18:3n-6 was in high concentrations that was 46 percent in stems, 13 percent in leaves, and 10 percent in flowers. Purslane has 300–400mg of alpha-linolenic acid and 1mg of EPA per 100g. Purslane has the high concentrations of gamma-linolenic acid, eicosapentaenoic acid, docosahexaenoic acid and docosapentaenoic acid as 41.4-66.4, 0.8-12.6, 1.4-3.3, and 0.3-6.4 mg/100g, respectively (Omara-Alwala et al., 1991).

3.4 Vitamins and Antioxidants

Purslane possesses a good number of vitamins and antioxidants (Table 1), which made it essential for human health. Among green leafy vegetables, purslane had the highest content of vitamin A (1320 IU). Vitamin A maintains the health of eyes and strengthens immune system. Vitamin A is also important for organ health since it promotes proper cell division. It also has good amount of vitamin C and B-complex vitamins. The folate, niacin, pantethenoic acid, pyridoxine and thiamin content were 12µg, 0.480mg, 0.036mg, 0.073mg, 0.112mg and 0.047mg, respectively. Beside it, purslane leaf contains good amount of vitamin C (21mg/100g), which is necessary for maintaining healthy collagen and blood vessels, as well as aiding in the healing of injuries. Purslane leaves contains 12.2 mg α-tocopherol and 1.9 mg β-carotene (USDA, 2007).The β-carotene content of purslane provides the scarlet color to its stems and leaves.

Table 1 Antioxidant profile of Purslane

Antioxidants	22	19
Phenolic content (mg GAE/100g)	127-478	174.5-348.5
DPPH IC50 (mg/ml)	0.89-3.41	1.30-1.71
AEAC (mg AA/100g)	110-430	229.5-319.3
FRAP (mg GAE/g)	0.93-5.10	-

Purslane grown in a growth chamber had the highest levels of α-tocopherol as 22.2mg/100g and 130mg/100g on basis of fresh and dry weight, respectively and vitamin C as 26.6mg/100g and 506 mg/100gfresh and dry weight, respectively. Purslane leaves grown in the culture room and in the wild contained higher levels of α- tocopherol, vitamin C, and β-carotene. Vitamin C and β-carotene has potential to neutralize free radicals and helpful in preventing cardiovascular disease and cancer. Another study conducted in which purslane plants were harvested at different stages (29, 43 and 52 days after sowing (DAS). Results of the study revealed that leaves contained higher number of macronutrients than stems, especially at 52 DAS. The total tocopherols content and α-tocopherol content of leaves were as 197-327 µg/100 g (fw) and 302-481 µg/100 g (fw), for α-tocopherol, respectively (Petropoulos et al., 2019). Noradrenaline and dopamine content was 0.074 percent and 0.69 percent, respectively. Noradrenaline is an immune system modulator and has anti-cancer properties(Chen et al., 2003).Another study was conducted on wild and cultivated plants, in which green leaves of *P. oleracea* (wild and cultivated)contains good amount of phenolssuch as epigallocatechin (111 and 76 µg/g dw, respectively) and luteolin (43 and 10 µg/g, respectively). The total phenolic content of the leaves was 214mg GAE/100g DW and 171mg GAE/100g DW, respectively.

According to (Ercisli et al., 2008), purslane has 54.33 g/ml in IC50DPPH assay, phenolic compounds as 17.88 g GAE/mg DW and ascorbic acid content as 77.25 mg/100g FW. One of the bioactive compounds found in purslane is melatonin, which has been shown to have a wide range of functions, including free radical scavenging and antioxidant activity, as well as synergy with other compounds, like ω-3 fatty acids (Simopoulos et al., 2005). A comparative assessment of α-tocopherol, β-carotene and vitamin C content of purslane to other commonly used green leafy vegetable was done as shown in figure 2.

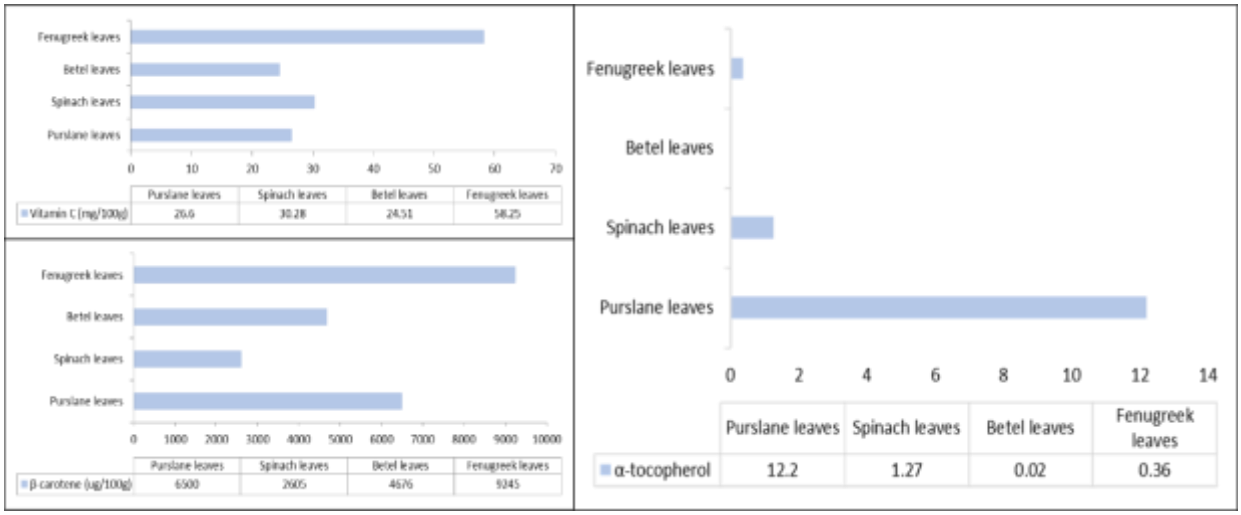

Figure 2 Comparison of α-tocopherol, β-carotene and vitamin C content of purslane to other commonly used green leafy vegetables. (Longvah et al., 2017; Simopoulos et al., 1992)

ANTINUTRIENT CONTENT: A CHALLENGE

Despite its high nutritional value and acceptance into the human diet, Purslane is hampered by its anti- nutritional content especially oxalate levels. Purslane leaves have an oxalate content of 671–869 mg/100g fresh weight, which is formed in plants as a metabolism end product (Mohamed and Hussein, 1994; Simopoulos et al., 2005). Oxalate can cause kidney stones and other disorders after ingestion, owing to the reduced bioavailability of cations (Ca^{2+}, Mg^{2+}, Fe^{2+}, K^{+}). It was revealed by (Noonan and Savage, 1999) that purslane

comes under the Group 1 species with the highest levels of oxalate (9.1 to 16.8 g /kg fw)which is sometimes higher than spinach (3.2-12.6 g/kg FW). According to(Elia et al., 1998), ammoniacal N nutrition can limit oxalate accumulation in vegetables. When the NH^{4+} content of the nutrient solution was increased from 0% to 75% of total N, the oxalate content of the leaves decreased from 6.2 to 3.8 g /kg FW (Palaniswamy et al., 2004).The reason for this may be that ammonium assimilation avoids the synthesis of organic acids, such as oxalates, that, on the contrary, are synthesized during nitrate assimilation to neutralize OH^{-} ions. Beside it the soluble oxalate content was reduced from 53 to 10.7% by addition of yoghurt to raw purslane leaves. The justification for this was that soluble oxalate is converted into insoluble oxalate by calcium coming from milk products (Moreau and Savage, 2009). According to (Poeydomenge and Savage, 2007) brief cooking for 5 minutes in boiling water can cause reduction up to 33.5% of soluble oxalate in the leaves and 18% in the stems. Despite its greater loss around 66.7% of soluble oxalate was caused by pickling of purslane in vinegar solution.

CONCLUSION

Taken together, it can be concluded that purslane is an incredible resource of ω-3 FAs and antioxidants. P. oleracea, as a key source of ω-3 fatty acid, could provide high biological value to vegetarian and other diets that do not include fish oils. Statistical study of its bioactive components has revealed that this common weed has exceptional antioxidant value, making it one of the crucially significant foods for the future. Purslane is a highly likely crop as a useful cosmetic ingredient due to its high content of antioxidants (vitamins A and C, α- tocopherol, β-carotene, and glutathione) and ω-3 fatty acids, tissue repair and antiseptic effects, and typical use in the topical treatment of acute and chronic conditions.

Declarations Ethical approval

Not applicable

Conflict of interest

Authors declare no conflict of interest.

Authors' contribution

M.V. and K.K. conceptualized the idea and wrote the main manuscript text. N.S. prepared figures, and critically reviewed the manuscript. All authors reviewed the manuscript.

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Availability of data and materials

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