Middle East Journal of Applied Sciences 4(3): 448-454, 2014
ISSN 2077-4613

# Nutritional Quality of Purslane and its crackers

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## ABSTRACT

Purslane has been described as a ‘‘power food’’ of future because of its high nutritive and its anti-oxidant properties. Purslane, also, has a high content of phenols (179.89 mg/100gm). The radical scavenging activity (RSA) of purslane is high (89.23%). Linolenic acid (omega 3 fatty acid) was the most fatty acid abundant in purslane (44.29%). Therefore, in the current study, crackers were fortified with purslane by three levels of previously prepared puslane powder (5, 10 and 15%). The tested crackers samples were evaluated with respect to the physicochemical characteristics and sensory properties. The addition of purslane significantly increased the protein, ash and fiber contents of crackers as the amount of purslane increased. The addition of purslane caused, also, an increase in zinc and calcium content to almost two folds level and iron content to triple folds level. The total phenol content of the fortified crackers increased as the amount of purslane increased. The addition of 15% purslane caused an increase in antioxidant to 51.25% compared with 20.6% for control. It could be noticed that, the addition of purslane significantly increased linolenic (omega 3 fatty acid) and linoleic acid. Increasing the fortification with 5% purslane showed the most sensory preferable crackers fortified sample. Therefore, purslane could successfully be used to enrich crackers, giving alternative utilization opportunity to producers and healthy choice.

***Key words:*** Purslane, cracker, Nutritional Quality , antioxidant, sensory properties.

## Introduction

Purslane (*Portulaca oleracea*) is an annual green herb with ediblesucculent stems and leaves, slightly acidic and spinach-like taste. Purslane could be considered a source of omega-3 polyunsaturated fatty acids (PUFAs). Nowadays, marine organisms like fish, seafood and algae are considered an important source of PUFAs with the drawback that all of them may contain various environmental contaminants at which they are exposed in marine medium. These contaminants, like heavy metals (especially mercury and cadmium), pesticides and other dangerous substances, could produce bioaccumulation in marine organisms and then could contaminate human beings who are eating them. Between these alternatives of eating fish for their PUFAs content and the risk of bioaccumulation of chemical contaminants from fish, until the problems of marine pollution will be solved, the solution is to obtain omega-3 fatty acids from other sources, namely vegetal ones (Domingo, 2007).

*Portulaca oleracea* (Portulacaceae family) is listed in the World Health Organization (WHO) as one of the most used medicinal plants and it has been given the term “Global Panacea”. Purslane is one of the most used medicinal plants, being a common and a herbaceous succulent annual plant. It could be found all over the world in the temperate and tropical regions starting from Europe and continuing to Africa, Asia, America and Australia. It is used in traditional medicine to prevent or to treat various diseases having various pharmacological effects as: hypoglycemic, hypocholesterolemic; cancer and antioxidant (El-Sayed, 2011 and Dkhil *et al.,* 2011)

Recently, it has been demonstrated that purslane is also a good source of omega-3 fatty acids, β- carotene vitamins,essentialaminoacids,alkaloids,coumarines,28%flavonoids, polysaccharide, α-tocopherols, ascorbic acid,6-12% organic acids and glutathione, as well as phenols (Yazici *et al.,* 2007, Oliveira *et al.,* 2009 and Aberoumand, 2011).

Another study reveals that, purslane is effective as an antioxidant agent, as well as providing nourishment for the liver, kidneys and testes ( Dkhil *et al.*, 2011) in the experimental rats. It has also shown that purslane has an anti-oxidative effect in heart tissues in mice by increasing superoxide dismutase activity (Caballero-Salazar *et al.*, 2002). Purslane herb powder also extends the life span of drosophila by regulating telomerelength (Obied *et al.*, 2003).

Omega-3 polyunsaturated fatty acids (PUFAs) may make a protection against several diseases, such as cardiovascular, psychiatric, neurological, dermatological and rheumatologic disorders (Mazza *et al.,* 2007; Rubio-Rodriguez *et al.*, 2010) *Potulaca oleraceea* seeds could be regarded as a healthy source for polyunsaturated fatty acids (Stroescu *et al.*, 2013).

Purslane is a nutritious vegetable used for human consumption, and it was mentioned in Egyptian texts from the time of the Pharaohs (Mohamed and Hussein, 1994). Purslane is eaten raw as a salad and also is eaten

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cooked as a sauce in soups or as greens. Purslane is considered as a rich plant source of nutritional benefits (Sudhakar *et al.*, 2010). It is one of the richest green plant sources of omega-3 fatty acids and linolenic acid (Simopoulos and Salem, 1986). In areas where this 'weed' is eaten, there is a low incidence of cancer and heart disease, possibly due to purslane's naturally occurring omega-3 fatty acids (Simopoulos, 1991). Purslane has been used as an antiseptic, antidiuretic, vermifuge in oral ulcer and urinary disorders.

Recent researches show that purslane exhibits a wide range of biological effects, including skeletal muscle relaxant effect (Parry *et al.*, 1993), analgesic and anti-inflammatory effects (Chan *et al.*, 2000), antifungal activity (Oh *et al.*, 2000) and antifertility effect (Verma *et al.*, 1982). Also, it has shown other beneficial effects such as antidiabetic and wound healing properties (Rashed *et al.*, 2003). In addition, purslane may have a protective effect against oxidative stress caused by vitamin A deficiency (Arruda *et al.*, 2004). Also, purslane contains active molecules for the treatment of some parasitic infectious diseases such as leishmaniasis and trypanosomiasis (Costa *et al.*, 2007). However, Little information has been published regarding the antioxidant activity of purslane.

The current study aimed to evaluate the beneficial effect of utilizing the purslane as food and as an antioxidant that may make it one of the more important foods in the future. The present study has been undertaken, also, to determine the nutritional value of the crackers manufactured by adding purslane as a natural source of nutrients to the tested formalas.

## Materials and Methods

*Raw Materials:*

Wheat flour, eggs, fat and purslane were purchased from local market at Mecca, Kingdom of Saudi Arabia.

*Preparation of Samples:*

Purslane was cleaned with water then rinsed with distilled water, external moisture was wiped out with a dry cloth. The edible portion of the plant was separated, dried in a hot air forced oven at 50°C for 1 h. The dried samples were then powdered in blander and maintained in sealed packages until use.

*Preparation of cracker samples:*

The control cracker sample was prepared according to the method described by Sath et al. (1981). 5%, 10% and 15% purslane powder incorporated in crackers instead of the same amounts in the tested control crackers.

*Fatty acids analysis:*

The standard procedure for analyzing the fatty acid contents of plants was used and the fatty acids were extracted and separated by the method described by (Stroescu *et al.*, 2013)

2.5. Amino-acids analysis .Amino acid content was determined as described by Moore *et al.*, (1958).

*Chemical Analysis:*

Purslane powder, wheat flour and crackers were analyzed for its moisture, ash, protein and fat according to the standard (AACC 2000) methods. Nitrogen content was estimated by the Micro-Kjeldhal method and was converted to protein by using a factor of 6.25. Carbohydrate contents are calculated by difference. Crude fiber content was analyzed according to AOAC (1990).

*Determination of total phenols :*

The amount of total polyphenols were determined in purslane powder, wheat flour, and crackers using Folin-Ciocalteu reagent. The results are presented as gallic acid equivalent (mg GAE/100g) (Singleton *et al.*, 1999). All tests were conducted in triplicate.

*DPPH Radical Scavenging Activity:*

DPPH scavenging activity was determined using a modified method of Ohnishi *et al.*, (1994). The free radical scavenging activity of food extracts were tested, indicated as bleaching of the stable 1,1 -diphenyl-2-picrylhydrazyl radical (DPPH).

*Sensory evaluation of products:*

The sensory evaluation was carried out in order to estimate the consumer response acceptability of the tested crackers. Panelists evaluated the tested cracker samples with respect to texture, taste, color, and overall acceptability attributes according to the method described by Ibrahim *et al.*, (2012).

*Statistical Analysis:*

Statistical analyses were carried out by SPSS10 program. Data were expressed as means ± SE and the statistical analysis was performed using one-way analysis of variance followed by Duncan's tests. (SPSS, *2000)*

## Results and Discussion

*Chemical Composition of Purslane:*

Data in Table (1) showed that purslane had high contents in protein (24.0%), ash (22.66%) and fiber (8.0%). Such results agreed with the findings of Aberoumand (2009) who reported that the amount of protein, ash and fiber were 23.47, 22.66 and 8.0%, respectively. While the wheat flour contains low levels of protein, ash and fiber. Purslane contains moderate levels of fat (5.26%). It is apparent that purslane, also, is a good source of calcium (131.44 mg/100g). Obied *et al.,* (2003) reported that one cup of cooked purslane leaves contains 90 mg of calcium and 561 mg of potassium.

The purslane contents of iron and zinc were 72.14 and 5.83 mg/100g, respectively. The resulted values were higher than the results of Aberoumand (2009) who reported that iron amount was only 0.48 mg/100 g, while zinc amount was 3.02 mg/100g. The variation in the results may be due to the difference in planting location and planting time as reported by Ezekwe *et al.,* (1999). The difference may be, also, due to the variation in growth stage of the plant (Mohamed and Hussein, 1994).

**Table 1:** Chemical composition (on dry weight bases) of purslane.

| Macronutrients (%) | Purslane | Wheat flour (72% ext.) |
|---|---|---|
| Protein | 24.00±0.03 | 10.35±0.05 |
| Fat | 5.26±0.70 | 0.99±0.01 |
| Carbohydrate* | 40.08±0.02 | 87.69±0.53 |
| Ash | 22.66±0.30 | 0.50.±0.0 3 |
| Fiber | 8.00±0.20 | 0.47±0.01 |
| Micronutrients | | |
| Zn (mg/100g) | 5.83±0.08 | 1.45±0.01 |
| Ca (mg/100g) | 131.44±3.21 | 97.04 ±0.03 |
| Fe (mg/100g) | 72.14±505 | 1.50±0.04 |
| Mg (mg/100g | 66.47±1.43 | 55.10±0.6 |
| Na (mg/100g) | 571.41±16.63 | 1167.23±12.2 |
| K (mg/100g) | 2842.38±91.68 | 941.22±12.1 |
| Mn (mg/100g) | 9.75±1.02 | 0.45±0.6 |
| Total phenols (mg GAE**/100g) | 179.89±0.03 | 3.70±0.02 |
| Radical scavenging activity (%RSA) | 89.23±0.05 | 65.00±0.05 |

Each value (mean of three replicates) is followed by ± SE.
*calculated by difference
** GAE= Gallic Acid Equivalent.

Purslane has a high content of phenols (179.89 mg/100g) compared with flour (3.70 mg/100g).The results are in range with findings o Lim and Quahf (2007) who reported that purslane phenols content was ranged between 157 and 304 mg/100g. Also, the radical scavenging activity (RSA) is high (89.23%). The present results are higher than those found by Abas *et al.,* (2006), but it was lower than that found by Odhava *et al.,* (2007) who reported RSA is 95% in fresh leaves.The variability could be due to environmental factors and collection period. Previous studies have indicated that the level of active compounds in plants increased when sunlight and temperature increased (Lim and Quah, 2007).

In general, it could be stated that purslane has high contents of protein, ash and fiber and a good source of minerals as reported by Domingo, (2007).

*Chemical Composition of crackers fortified with purslane:*

Due to that the purslane has a high nutritional value, since it has high protein, ash and fiber contents in comparison with some other edible plants, it was incorporated in the present cracker formula. The results of chemical composition of crackers fortified with purslane are shown in Table (2).

It can be noticed from Table (2) that the addition of purslane significantly increased protein, ash and fiber content of cracker. The increase of fortification level is directly proportional to the increase in protein, ash and fiber. This is mainly due to the high content of protein, ash and fiber in purslane than that found in wheat flour. Also, the addition of purslane, which had a high content of minerals, caused zinc and iron contents to be doubled. This is also due to the purslane high content of calcium, zinc and iron.

The total phenols content of the crackers fortified with purslane increased as the amount of purslane increased. The crackers with 15% purslane had the highest percent of phenols (4.84 mg/100g) compared with control (3.23 mg/100g). The antioxidant activity of crackers increased by the addition of purslane. The addition of 15% purslane caused an increase in antioxidant to 51.25% compared with 20.6% for control. This may be due to the high antioxidants in purslane as reported by Oliveira *et al.,* (2009) who stated that purslane may be useful as a potential source of antioxidant in food.

**Table 2:** Chemical composition (dry weight bases) of cracker fortified with purslane fortified with purslane.

| Macronutrients (%) | Control | Amount of purslane substitution (%) | | |
|---|---|---|---|---|
| | | 5 | 10 | 15 |
| Moisture | 5.50±0.17 | 6.20±0.34 | 6.6±0.00 | 6.83±0.40 |
| Protein | 12.46±0.23 | 12.94±0.01 | 13.77±0.01 | 13.98±0.05 |
| Fat | 18.72±0.18 | 18.52±0.14 | 18.50±0.01 | 18.47±0.17 |
| Carbohydrate* | 64.67±0.29 | 62.40±0.11 | 59.28±0.24 | 58.53±0.19 |
| Ash | 0.80±0.02 | 1.17±0.10 | 1.83±0.12 | 1.90±0.12 |
| Fiber | 3.35±0.12 | 4.97±0.35 | 6.62±0.11 | 7.12±0.28 |
| Micronutrients | | | | |
| Zn (mg/100g) | 0.90±0.01 | 1.00±0.02 | 1.35±0.01 | 1.53±0.03 |
| Ca (mg/100g) | 150.70±0.355 | 202.6±1.31 | 232.0±1.80 | 253.7±1.70 |
| Fe (mg/100g) | 1.45±0.06 | 2.19±0.02 | 2.73±0.06 | 3.81±0.04 |
| Total phenols(mg\100g) GAE**/100g) | 3.23±0.11 | 3.96±0.15 | 4.40±0.18 | 4.84±0.20 |
| Radicalscavenging activity (%RSA) | 20.60±0.80 | 31.591.15 | 44.22±2.10 | 51.25±1.75 |

Each value (mean of three replicates) is followed by ± SE.
*calculated by difference
** GAE= Gallic Acid Equivalent.

*Fatty Acid Composition:*

The results in Table (3) show that purslane contains large quantities of fatty acids. Linolenic acid (omega 3 fatty acid) was the most abundant one in purslane (44.29%), linoleic acid was the second in order of importance (24.03%). Such results are higher than that given by Oliveira *et al.,* (2009) who mentioned that linolenic acid was ranged between 24.48 and 39.06 % and linoleic was ranged between 4 and 6.31 %. Palmitic acid (16.34%) and oleic acid (9.59%) were lower than that reported by Oliveira *et al.,* (2009) who found that palmitic and oleic were ranged between 19.26 to 24.26 and 11.55 to 19.49%, respectively.

Purslane contained high amounts of omega-3 (C18:3n3) and omega-6 (C18:2n6) polyunsaturated fatty acids, which are essential dietary fatty acids that cannot be synthesized by humans but have to be ingested. 100 g of fresh purslane leaves (about 1 cup) contain 300–400mg of alpha-linolenic (YouGuo *et al.,* 2009). The difference in amount may be due to the difference in plant tissues and origin as reported by Liu *et al.,* (2000)

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who mentioned that the total fatty acid content ranged from 1.5 to 2.5 mg/g of fresh mass in leaves, 0.6 to 0.9 mg/g in stems and 80 to 170 mg/g in seeds. a-Linolenic acid (C ) accounted for around 60% and 40% of the total fatty 18:3n acid content in leaves and seeds, respectively.

From the results in Table (3), it can be noticed that the addition of purslane had significantly increased the linolenic (omega 3 fatty acid) and linoleic acid. The increase in linolenic (omega 3 fatty acid) and linoleic acid was due to the high level of these fatty acids in purslane which were 44.29% and 24.03%, respectively, in relative to that found in wheat flour.

**Table 3:** Fatty Acid composition (on dry weight basis) of purslane and crackers fortified with purslane

| Fatty Acid % | Purslane | Control | Amount of purslane substitution (%) | | |
|---|---|---|---|---|---|
| | | | 5 | 10 | 15 |
| Lauric (12:0) | - | 0.27 | 0.24 | 0.2 | 0.20 |
| Myristic (14:0) | 0.45 | 1.39 | 1.33 | 1.38 | 1.38 |
| Palmitic (16:0) | 16.34 | 34.91 | 36.28 | 37.31 | 38.57 |
| Palmitoleic (16:1) | 1.56 | 0.34 | 0.35 | 0.41 | 0.51 |
| Stearic (18:0) | 2.67 | 3.76 | 4.13 | 4.14 | 4.88 |
| Oleic (18:1) | 9.59 | 40.91 | 42.45 | 43.46 | 45.67 |
| Linoleic (18:2) | 24.03 | 13.30 | 14.25 | 14.73 | 15.47 |
| Linolenic (18:3) | 44.29 | 0.45 | 0.52 | 0.63 | 0.67 |
| Arachidic (20:0) | 0.83 | 0.32 | 0.47 | 0.55 | 0.59 |
| Gadoleic (20:1) | 0.20 | 0.19 | 0.21 | 0.23 | 0.25 |

*Amino Acids Content:*

Table (4) presents the amino acids of purslane. It is an important source of amino acids; it contains the essential amino acid, leucine. purslane proteins which are efficient in lysine, but contained adequate levels of the other essential amino acids . The essential amino acid leucine was the highest, while isoleucine and valine were in moderate amounts, but threonine and the sulphur containing amino acids were low**.** In the recent years it has been demonstrated that purslane is also a good source of essential amino-acids, (Stadtman and Levine, 2003 and (Stroescu *et al.,* 2013).

**Table 4:** Amino acids content (mg/100g) in purslane and crackers fortified with purslane:

| Amino acid | purslane | control | Amount of purslane substitution (%) | | |
|---|---|---|---|---|---|
| | | | 5 | 10 | 15 |
| Valine | 0.79 | 0.44 | 0.43 | 0.44 | 0.47 |
| Isoleucine | 0.63 | 0.39 | 0.41 | 0.41 | 0.47 |
| Leucine | 1.14 | 0.76 | 0.81 | 0.81 | 0.86 |
| tyrosine | 0.57 | 0.40 | 0.40 | 0.40 | 0.45 |
| Phenylalanine | 0.80 | 0.52 | 0.56 | 0.57 | 0.58 |
| Histidine | 0.41 | 0.23 | 0.26 | 0.25 | 0.0.25 |
| Lysine | 0.80 | 0.16 | 0.19 | 0.19 | 0.19 |
| Arginine | 0.72 | 0.74 | 0.42 | 0.43 | 0.47 |
| Aspartic acid | 1.31 | 0.22 | 0.44 | 0.47 | 0.50 |
| Methionine | 0.38 | 0.25 | 0.90 | 0.96 | 0.96 |
| Threonine | 0.57 | 0.30 | 0.35 | 0.39 | 0.39 |
| Serine | 0.58 | 0.47 | 0.55 | 0.57 | 0.59 |
| Glutamic acid | 1.99 | 3.91 | 3.92 | 3.95 | 4.17 |
| Proline | 0.68 | 1.27 | 1.37 | 1.42 | 1.47 |
| Glycine | 0.76 | 0.41 | 0.42 | 0.43 | 0.44 |
| Alanine | 1.08 | 0.35 | 0.36 | 0.36 | 0.37 |
| Cystine | 0.20 | 0.21 | 0.23 | | 0.20 |

*Sensory Evaluation of crackers fortified with purslane:*

Results mentioned in Table (5) indicated that crackers with purslane had high sensory scores, except in aftertaste, in comparison with control. There were no significant difference between the control and 5% fortified samples, except in after taste. With respect to the color preference, a significant difference could be detected between 10% and 15% snack products. The most preferable purslane fortified samples, was the 5% fortified samples.

Similar results were obtained by Tarkergari *et al*., (2013) who found significant differences in a few of the recipes fortified with purslane than of control.

**Table 5:** Sensory Evaluation of crackers fortified with purslane

| Attribute | Control | Amount of purslane substitution (%) | | | LSD |
|---|---|---|---|---|---|
| | | 5 | 10 | 15 | |
| Color | $9.60^a±0.63$ | $9.33^a±0.72$ | $8.96^b±0.86$ | $8.40^c±1.50$ | 0.72 |
| Taste | $9.70^a ±0.59$ | $8.90^a ±1.01$ | $8.46^b ±1.41$ | $7.83^c ±1.79$ | 0.93 |
| Odour | $9.46^a ±0.83$ | $8.93^a ±0.79$ | $8.40^b ±0.82$ | $8.20^c ±1.56$ | 0.77 |
| Crispness | $9.46^a ±0.91$ | $9.33^a ±0.72$ | $9.07^b ±0.96$ | $8.75^c ±1.14$ | 0.69 |
| After taste | $9.63^a ±0.61$ | $8.89^b±0.83$ | $8.50^c±1.20$ | $8.13^d±1.90$ | 0.90 |
| *General Appearance* | *$9.66^a ±0.48$* | *$8.9^b 3±0.77$* | *$8.03^b ±1.47$* | *$7.73^c ±1.68$* | *0.88* |
| Overall | $9.53^a ±0.83$ | $9.25^a ±0.73$ | $8.66^b ±1.09$ | $8.20^c ±1.97$ | 0.93 |

*Values, within the same raw, with different letters are significantly different ($p \leq 5.05$)

*Conclusion:*

According to the above mentioned results, purslane could be regarded as an alternative source of some nutrients for human consumption. The addition of purslane increases the nutritional quality of crackers.

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