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Full Length Research Paper

Roselle (*Hibiscus sabdariffa* L.) seeds as unconventional nutritional source

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The composition of roselle seed from oil, protein, ash, fiber, fatty acids and amino acids was determined and compared in three cultivars in order to use it as an unconventional nutritional source. Aswan cv. occupies the highest significant rank in protein (31.51), oil (23.70) and fiber (4.87%) contents. Aswan and Sewa cvs. had the highest significant unsaturated fatty acid composition, especially oleic and linoleic acids, with oleic acid having values of 36.22 and 33.34% and linoleic acid, 14.95 and 15.10% values. Protein of Aswan cv. had the highest significant values of seven essential amino acids and four non-essential amino acids, especially lysine and phenylalanine.

Key words: Amino acids, fatty acids, nutrition, oil, protein, roselle, unconventional crops.

INTRODUCTION

The nutritional compositions of roselle seeds as well as their functional properties are rarely studied as compared to the calyces. Roselle seed is among the highest protein-containing seed compared to other seeds. The seed is used for its oil in China and eaten in West Africa (Robert, 1996); in Sudan, it is used for edible oil production and poultry feeding (Al-Wandawi et al., 1984). To increase the world protein supply would be to make more protein plants available for human consumption. Some investigations on the nutritional value of plant seeds as unconventional sources of proteins have been done by researchers such as Oluwafemi (2009), But and Batool (2010), Mohan and Kalidass (2010), Ghaly and Alkoaik (2010), Ingale and Shrivastava (2011) and Narsing et al. (2011). Few studies have been carried out to assess the potential of roselle seed as a new source of protein and oil (El-Adawy and Khalil, 1994; Abu-Tarboush et al., 1997; Cook et al., 2000). Hainida et al. (2008) and Amin et al. (2008), found high protein content in roselle seeds, while Samy (1980) and Rao (1996) noted lower protein content.

The value of roselle seed fat was considerable even when compared with other seeds. Palmitic, oleic, linoleic acid and stearic acids were the major fatty acid constituents in roselle seeds (Rao, 1996; El-Adawy and Khalil, 1994). The main nutrients in roselle seeds included protein from amino acids and oil from fatty acids besides the composition from ash and fibers in the three roselle cvs. The main objective of this research was to focus on the nutritional value of roselle seeds as an unconventional protein plant and fat source.

MATERIALS AND METHODS

Pure seeds of three roselle cultivars: Aswan, Sewa and Sudan-1 were obtained from the production program of the Arid Land Agriculture Department, in the Agricultural Research Station, King Abdulaziz University, Hada Al-Sham, Saudi Arabia. A randomized complete block design with four replications was used. Seed samples were separately milled, and oil was extracted using Soxtech with N-hexane according to AOAC (2000). Defatted seeds were used to determine ash and fiber contents in seeds (AOAC, 2000).

Protein and amino acids composition

Roselle seed protein contents were determined using Kjetech

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Table 1. Means of protein (%), oil (%), ash (%) and fiber (%) of the studied roselle cultivars seeds.

Cultivar	Protein (%)	Oil (%)	Ash (%)	Fiber (%)
Sewa	33.31[a]*	21.85[b]	5.44[b]	4.24[b]
Aswan	31.51[a]	23.70[a]	5.05[c]	4.87[a]
Sudan-1	29.40[b]	24.08[a]	6.08[a]	3.77[c]

*Means followed by the same letter are not significantly different according to LSD at P ≤ 0.05 level. LSD, Least significant difference.

Table 2. Means of fatty acids of the three roselle cultivars oils.

Fatty acid	Cultivar		
	Sewa	Aswan	Sudan-1
Myristic	1.95[a]*	1.82[b]	1.61[c]
Palmitic	32.05[c]	34.00[b]	37.43[a]
Palmitoleic	2.22[a]	2.07[b]	1.91[c]
Stearic	3.46[b]	3.15[c]	3.66[a]
Oleic	36.22[a]	35.34[a]	33.34[b]
Linoleic	14.95a	15.10[a]	14.08[b]
Octadeconic	4.43[a]	4.32[a]	4.10[b]
Sterulic	2.75[b]	2.99[a]	2.56[c]
Malvalic	1.25[b]	1.20[c]	1.29[a]

*Means in each row followed by the same letter are not significantly different according to LSD at P ≤ 0.05 level. LSD, Least significant difference.

instrument according to AOAC (2000). Amino acid constituents were determined using reverse phase-high pressure liquid chromatography (LC-10 AD, Shimadzu Corp, Kyoto, Japan).

Fatty acids composition

Fatty acid composition was determined using gas liquid chromatography.

Statistical analyses

The obtained data of the studied traits were statistically analysed using the analysis of variance, then the statistically comparison between the means was done using revised least significant difference (RLSD) at (P≤0.05) according to El-Nakhlawy (2010) based on statistical analysis system (SAS) program (SAS, 2000).

RESULTS

Roselle seed composition from the main nutrients

The main nutrients in the roselle seeds included protein, oil, ash and fiber contents.

Protein content

Mean of protein contents in seeds of the three roselle cvs. (Table 1) shows that both Sewa and Aswan cvs. significantly dominated the Sudan-1 cv. without significant difference between Sewa and Aswan cv. Protein content ranged from 33.31% in Sewa seed cv. to 29.40% in Sudan-1 seed cv.

Oil content

Sudan-1 cv. produced the highest oil content (24.08%), while Sewa cv. produced the lowest value (21.85%) with significant difference between both (Table 1).

Ash content (%)

Concerning seed ash contents in the three roselle cvs. seeds, data in Table 1 reveals significant differences between the cvs. Means of ash (%) were 6.08, 5.44 and 5.05% in Sudan-1, Sewa and Aswan cvs., respectively.

Fiber content (%)

Aswan cv. had the highest fiber content in its seed (4.87%) and significantly differed from Sewa (4.24%), while Sudan-1 cv. was the lowest in fiber content (3.77%) as shown in Table 1.

According to the roselle composition from both protein and oil, fiber and ash contents, roselle seeds might be used as source of protein and oil in human foods either as a separate material or in combination with other foods for enrichment of human foods.

Fatty acid constituents

The analysis of fatty acid in the three roselle cvs. oils showed nine fatty acids in the oil and significant differences between the three roselle cvs. Means presented in Table 2 show that the main saturated fatty acid was palmitic acid and the main unsaturated fatty acids were oleic and linoleic acids.

Oleic and linoleic acids made around 50% of the total oil, while palmitic acid made around 34% of the roselle oil overall the three studied cvs. Accordingly, roselle oil is classified as an edible and healthy oil for humans.

Table 3. Means of amino acids (g/100g protein) constituents of the three roselle cultivars seeds.

Amino acid	Cultivar		
	Sewa	Aswan	Sudan-1
Leucine	6.22[b*]	6.11[b]	6.25[a]
Methionine	1.76[b]	2.03[a]	1.57[c]
Tryptophan	1.26[b]	1.07[c]	1.45[a]
Valine	4.72[a]	4.67[a]	4.32[b]
Isoleucine	4.65[b]	4.77[a]	4.46[c]
Phenylalanine	5.30[b]	5.58[a]	5.06[c]
Threonine	4.98[a]	4.53[c]	4.82[b]
Cystine	3.11[c]	3.44[a]	3.22[b]
Tyrosine	3.11[c]	3.76[a]	3.42[b]
Lysine	6.88[b]	7.28[a]	6.42[c]
Asparatic	9.55[c]	9.98[a]	9.76[b]
Glutamic	16.75[a]	16.01[c]	16.62[b]
Arginine	7.56[a]	7.31[b]	7.68[a]
Proline	5.16[c]	5.77[a]	5.52[b]
Serine	5.11[c]	5.71[b]	5.84[a]
Histidine	2.74[a]	2.08[c]	2.26[b]
Alanine	5.32[c]	6.17[a]	5.73[b]
Glycine	6.11[c]	6.73[a]	6.42[b]
Serine	5.11[c]	5.71[b]	5.84[a]

*Means in each row followed by the same letter are not significantly different according to LSD at P ≤ 0.05 level. LSD, Least significant difference.

Amino acids

19 amino acids were detected as a result of the roselle seed analysis. Significant differences were found between the studied cultivars in both essential and non-essential amino acids (Table 3). Aswan cv. significantly dominated the other two cvs. in seven essential amino acids (%) of methionine (2.03%), valinc (4.67%), isoleucine (4.77%), phenylalanine (5.58%), tyrosine (3.76%), lysine (7.28%) and alanine (6.17%) and four non-essential amino acids of cystine (3.44%), asparatic (9.98%), proline (5.77%) and glycine (6.73%). Also, Aswan cv. occupied the 2nd rank in three amino acids of leucine (6.11%), arginine (7.31%) and serine (5.71%). Sewa cv. was similar to Aswan cv. In amino acids composition, it was the highest in amino acids (%) of valine (4.67%), threonine (4.98), glutamic (16.75), arginine (7.56) and histidine (2.74), while Sudan-1 had the highest values in four amino acids (%) of leucine (6.25), tryptophan (1.45%), arginine (7.67) and serine (5.84).

DISCUSSION

The value of roselle seed due to its oil content is considerable especially when compared with other seeds. Fatty acids constituents in the result of this study showed that more than 50% of roselle oil was unsaturated fatty acids, especially oleic and linoleic acids. Also, the ratio between saturated and unsaturated fatty acids was 1:~2. Accordingly, this oil is considered as an edible oil and healthy for human consumption. These findings were confirmed with that of El-Adawy and Khalil (1994) and Mohiuddin and Zaidi (1975). The obtained results indicate that roselle seeds are rich in the amino acids of lysine, arginine, leucine, phenyalanine and glutamic acids, but not rich in cysteine and methionine. This might be due to the high albumin that elevates sulphur-containing amino acids (cysteine and methionine), according to Murrag and Roxburgh (1984). The resulted amino acid profile of roselle seeds made researchers (Sliddhuraju et al., 1996; Vose, 1980; Al-Wandawi et al., 1984; Hainida et al., 2008) to recommend the use of roselle seed as an unconventional source of protein.

The results of amino acid composition in roselle seed showed the possibility of using roselle seeds especially Aswan cv. as a source of protein and amino acid composition for human nutrition. These results are confirmed with the results of Deshpanda et al. (2000) and Al-Adawy and Khalil (1994) which showed that roselle seeds can be used as a strong source of protein and the protein quality depends on the amino acid composition. Also, the results of Bashir and Babilker (2009) and Suliman et al. (2009) revealed that sheep feed with roselle seeds increased linearity as roselle seeds increased in the diet.

Conclusion

Roselle seeds especially Aswan cv. could be used as a rich source due to amino acids of protein especially lysine, arginine, leucine, phenylalanine, and glutamic acids. Accordingly, roselle seeds could be used as a supplement food or as a diet enrichment especially in the low protein diets. A high content of unsaturated fatty acid constituents in the roselle seeds and the ratio between saturated and unsaturated fatty acids could be used also as a source of edible oil which has similar properties with cotton seed oil.

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Principal Investigator

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