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NUTRITIVE VALUE OF ELRASHAD (*Lepidium sativum* L.) SEEDS GROWN IN SAUDI ARABIA

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Lepidium sativum,

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ABSTRACT

Elrashad (*Lepidium sativum* L.) is a perennial plant that is cultivated in some regions of Saudi Arabia where the seeds are used for therapeutic and dietary purposes. The aim of this study was to obtain Elrashad seeds (Saudi cultivar) flour and analyse the flour for proximate, minerals, fatty acids, and amino acids compositions. The results of study showed that Elrashad seeds contain high levels of protein (20.84%), fat (23.83%), and crude fibre (7.15%), on a dry weight basis. This study showed that Elrashad seeds may be considered as a good source of essential minerals, such as potassium, phosphorus, calcium, and iron. The fatty acid analysis showed that Elrashad seed oil contains high levels of unsaturated fatty acids (82.15%) such as the essential fatty acid linoleic acid (11.25%), and linolenic acid (30.07%). Further, results also revealed that Elrashad seed protein has fair amounts of essential amino acids, and the limiting amino acids are methionine and cysteine. These results may highlight the potential of Elrashad seeds as a source of chemical constituents that may be considered for human nutrition. Further studies are needed to investigate other nutritional aspects of Elrashad seeds.

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1 Introduction

Lepidium sativum (L.) commonly known as garden cress is perennial edible herb that belongs to the family Cruciferae, and widely cultivated in temperate climates throughout the world (Adam, 1999). It is grown in many parts of Saudi Arabia, such as in North of El-hegaz, east of Naged and in the Eastern region. Elrashad (as locally known) plant is grown mainly for its seeds in Saudi Arabia (Al-Jassas & Al-Jasser, 2012). Elrashad seeds are used in traditional medicine to treat asthma, hypertension, hepatotoxicity and hyperglycaemia (Gokavi et al., 2004; Ghante et al., 2011; Behrouzian et al., 2014). Further, Mathews et al. (1993) reported that *L. sativum* seeds, known in India as Haliv, have traditionally been used in the diet of lactating women and are used for the treatment of diarrhoea and dysentery. The chemical composition of garden cress seeds (Indian cultivar) was investigated by Gokavi et al. (2004). They also explored the possibility of using the seeds as a nutraceutical food ingredient. *L. sativum* seeds contains 18–24% fat and 30% of the total fatty acids are alpha linolenic acid and the seed oil contains the essential alpha linoleic acid (Diwakar et al., 2008). The primary fatty acids in *L. sativum* oil are oleic (30.6 wt%) and linolenic acids (29.3 wt%), and the oil has been found to contain high concentrations of tocopherols. It also contains reasonable amounts of lignans, antioxidants, and the primary phytosterols such as sitosterol and campesterol (Bryan et al., 2009; Shail et al., 2016). *L. sativum* can be considered as under-utilized crop, and there have been very few reports in Saudi Arabia regarding the chemical composition of the seeds. However, Adam (1999) reported on the toxicological effects of *L. sativum* seeds incorporation into the diets of rats. Therefore, the aim of this study was to elucidate the proximate, mineral, fatty acid and amino acid compositions of Elrashad seeds from plants grown in Saudi Arabia.

2 Materials and Methods

2.1 Materials

Elrashad seeds were obtained from a local market in Riyadh city. The seeds were originally produced from a Saudi cultivar grown in the northern region of Al-hegaz. All chemicals used were of analytical grade.

2.2 Methods

After cleaning, the seeds were ground into a fine powder using a coffee miller and then sieved to pass through a 425 µm (USA standard sieve) mesh. The resultant flour was kept at 4°C for further analysis.

2.2.1 Proximate composition

The Elrashad seed flour was analysed by standard methods 934.01.988.05.920.39, 942.05 and 962.09 for moisture, protein

(NX6-25) fat, ash and crude fibre, respectively (AOAC, 2000).

2.2.2 Mineral analysis

Wet digestion method (AOAC, 2000) was performed prior to mineral contents determination in Elrashad seed flour. Total phosphorus was determined in the digested solution according to Taussky & Shorr (1993), and K, Ca, Na, Fe, Zn and Cu were determined using an atomic absorption spectrophotometer (Perkin–Elmer Instrument model 2380).

2.2.3 Fatty acid analysis

Oil from the whole flour of Elrashad seeds was extracted by shaking in n-hexane for two hours (solvent: flour ratio was 10:1). After filtration, the oil was desolventised using a rotary evaporator under vacuum. The oil was saponified with ethanolic potassium hydroxide and fatty acid methyl esters were formed by a reaction with borontrifluoride methanol (Andersson et al., 1999). A Perkin–Elmer gas chromatograph (Model F 22) with a flame ionization detector at 250°C was used for fatty acid quantification with nitrogen as the carrier gas. A glass column (2 m × 2.5 mm) packed with chrom Q 80/100 at a temperature of 240°C was used for the analysis and standard fatty acid methyl esters (Sigma Chemical Co. St. Louis, Mo, USA) were used for identification. The area under each peak was measured and the fatty acid percentages were expressed in terms of the total area.

2.2.4 Amino acid analysis

Samples containing 10 mg protein were hydrolysed for 24 h under vacuum at 110°C using 6.0N HCl. Cysteine levels were determined by subjecting the samples to performic acid oxidation prior to acid hydrolysis. The amino acid analysis was performed on a reverse phase–high pressure liquid chromatography (Shimadzu LC-LOAD, Shimadzu Corporation, Kyoto, Japan). The samples were analysed on a shimpack amino–Na type column (10 cm × 6.0 mm) obtained from the Shimadzu Corporation. The post column samples were derivatised with *O*-phthalaldehyde (OPA) and the data were integrated using Integrator Model C-R7A (Shimadzu chromatopac data processor). Amino acid scores were calculated using the FAO/WHO/UNU (1985) reference protein and the following formula:

$$\text{Amino acid score} = \frac{\text{gram essential amino acid per 100 g test protein}}{\text{gram essential amino acid per 100 g reference protein}}$$

2.2.5 Statistical analysis

The means and standard deviations of the results from the three replicates were determined by SAS Program software (SAS 9.2, 2015).

3 Results and Discussion

3.1 Chemical composition

The proximate composition of Elrashad seeds is shown in Table 1. The major component in Elrashad seeds was carbohydrate followed by oil and protein. These results differ slightly from those reported by Gokavi et al. (2004) for carbohydrates (41.25%), oil (27.48%) and protein (22.4%); but these values were close to the values reported by Zia-Ul-Haq et al. (2012), who found that the carbohydrate contents were $37.60 \pm 0.89\%$ to $32.87 \pm 0.29\%$ and the protein contents were $23.36 \pm 1.02\%$ to $24.18 \pm 1.54\%$ in garden cress seeds on a dry weight basis. The differences may be due to the use of different varieties, variations in agronomic practices, climatic and geographical conditions of the area from where the seeds were collected (Zia-Ul-Haq et al., 2011; Ahmed et al., 2013).

Table 1 Chemical composition of the whole seed flour (Fresh weight basis)

Nutrients	Mean
Moisture	4.89 ± 0.050
Protein	19.82 ± 0.205 (20.84)*
Oil	22.66 ± 0.007 (23.83)*
Ash	5.83 ± 0.389 (6.13)*
Crude fibre	6.80 ± 0.080 (7.15)*
Carbohydrates	40.00 ± 0.163 (42.06)*

Data are average of three replicates; $\pm$ followed by the standard deviation (%); * Protein, oil, ash, crude fibre and carbohydrates values between brackets are calculated on dry weight basis

3.2 Mineral composition

The mineral analysis results are shown in Table 2. Seven elements that are considered essential for human health were investigated. Potassium had the highest content in Elrashad seeds followed by phosphorus, calcium and iron (Table 2). Gopalan et al. (2000) also reported that 377 mg calcium, 723 mg phosphorus and 100 mg iron per 100 g sample were present in *L. sativum* seeds, and Gokavi et al. (2004) reported 1193.95 mg/100 g potassium in *L. sativum* seeds. Furthermore, these results were close to the value mentioned by Jain et al. (2016) for calcium and zinc (360.50 mg and 5.21 mg/100 g, respectively). The differences between the reported values for the Indian cultivars and the values obtained in this study (for the Saudi cultivar) could be due to varietal and locational differences. Elrashad seeds may contribute significantly to the overall dietary intake of these elements based on the recommended daily intake (Cuthbertson, 1989) and on the results of mineral composition in this study.

Table 2 Mineral composition of Elrashad seeds (mg/100gram)

Minerals	Mean
Potassium (k)	785.0 ± 7.51
Phosphorus (p)	616.50 ± 9.67
Calcium (ca)	253.0 ± 1.04
Sodium (na)	40.50 ± 0.05
Iron (fe)	53.81 ± 0.04
Copper (cu)	1.90 ± 0.09
Zinc (zn)	4.10 ± 0.07

Data are average of three replicates; $\pm$ followed by the standard deviation (%);

3.3 Fatty acid composition

The fatty acid profile (Table 3) showed that the major saturated fatty acid in Elrashad seeds oil were palmitic acid followed by arachidic and stearic acid. Oleic acid (24.49%) and eicosenoic acid (12.60%) were the major mono-unsaturated fatty acids. While the contents of linoleic acid and linolenic acid, were 11.25% and 30.07%, respectively. Bhakare et al. (1993) reported that linolenic acid (33.8%) was the major fatty acid in *L. sativum* seed oil. The unsaturated fatty acids represented 82% of the total fatty acid content in Elrashad seed oil (Table 3), Al-Jassir et al. (1995) reported that the unsaturated fatty acids in Saudi Samh seed oil represents more than 81% of the total fatty acid content. El-adawy & Taha (2001) found that oil samples from different sources had high levels of total unsaturated fatty acids. These were 78.35% for watermelon seed kernel oil, 76.46% for pumpkin kernels and 82.45% for paprika seed oil. The fatty acid composition of the Elrashad seeds analysed in this study agrees with the results reported by Al-Jassas & Al-Jasser (2012) and Jain et al. (2016).

Table 3 Fatty acid composition of Elrashad seeds oil

Fatty acid	Percentage
Myristic	1.50
Palmitic	8.80
Stearic	3.49
Oleic	23.49
Linoleic	11.35
Linolenic	30.07
Arachidic	4.06
Eicosenoic	12.60
Erucic	4.64
Saturated fatty acids	17.85
Unsaturated fatty acid	82.15

Table 4 Amino acid composition and scores for Elrashad seeds

Essential amino acids	Amino acid* composition (g/100 g protein)	Amino acid score	Reference** protein (g/100 g protein)
Lysine	2.26 ± 0.390	0.91	5.8
Threonine	5.39 ± 0.014	1.58	3.4
Valine	6.24 ± 0.007	1.78	3.5
Methionine	1.06 ± 0.000		
Cysteine	0.80		
Methionine + Cysteine	1.86	0.74***	2.5
Isoleucine	5.21 ± 0.014	1.86	2.8
Leucine	9.03 ± 0.007	1.37	6.6
Phenylalanine	5.80 ± 0.004		
Tyrosine	3.82 ± 0.000		
Phenylalanine + Tyrosine	9.62	1.53	6.3
Histidine	3.51 ± 0.007	1.85	1.9
Non-essential amino acids			
Arginine	2.89 ± 0.000		
Aspartic acid	11.47 ± 0.014		
Glutamic acid	19.68 ± 0.028		
Glycine	6.49 ± 0.014		
Alanine	5.85 ± 0.007		
Serine	5.30 ± 0.007		

*Mean ± standard deviation, **FAO/WHO/UNU (1985) ***First limiting amino acid

3.4 Amino acid composition

Table 4 shows the amino acid composition of Elrashad seeds. The results indicated that glutamic (19.68%) and aspartic acids (11.74%) were the most abundant amino acids, followed by leucine and valine. All essential amino acids in the protein found in Elrashad seeds had high amino acid scores, except for lysine and sulphur-containing amino acids where levels were relatively low. However, these results showed that Elrashad seeds contained reasonable levels of most essential amino acids. The results of this study were comparable to the results produced by previous studies on amino acid composition of *L. sativum* (Gokavi et al., 2004; Zia-Ul-Haq et al., 2011). Young & Pellet (1994) concluded that the essential amino acid levels found in plant proteins deserve further consideration. For human nutrition adequate quantities of lysine, methionine and tryptophan are critical in foods (FAO/WHO, 1991; Sujak et al., 2006). However, Elrashad seeds, when used as protein source in food formulations, require supplementation with complementary proteins (e.g legumes) to compensate for the deficiency in sulphur-containing amino acids in Elrashad seeds.

Conclusion

This study showed that Elrashad seeds are a good source of many nutrients, such as proteins, minerals, fibre and essential fatty acids. Elrashad seeds are already locally known and consumed by Saudi people for medicinal and dietary purposes. However, further research studies are needed to explore the nutritional, functional, toxicological and other characteristics of Elrashad seeds and their use in food applications.

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Conflict of interest

Authors would hereby like to declare that there is no conflict of interests that could possibly arise.

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