

Short Communication

Mineral content of the rocket plant (*Eruca sativa*)

Neriman Tuba Barlas*, Mehmet Eşref Irget and Mahmut Tepecik

Soil Sciences and Plant Nutrition Department, Agriculture Faculty, Ege University, Bornova, Izmir, Turkey.

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Rocket (*Eruca sativa*) is an endemic species of the Brassicaceae family which is produced mostly in Mediterranean countries such as Italy, Greece and Turkey. Historical research has shown that rocket was used both as a garden plant and as a kind of herb or spice (Yaniv et al., 1998). According to data from the Turkish Statistics Foundation (TUIK) for the year 2010, Turkey's rocket production in a year amounted to 4058 tonnes, and was used either raw in salads or cooked in various dishes. Apart from its use in nutrition, it is also used in the health and cosmetics industries as a result of the effectiveness of its phytochemical content. There have been few studies of these beneficial effects or of the mineral content of rocket; therefore, this study was performed as a survey, in which plant samples were collected from the province of Aydin in Turkey and evaluated for mineral content (N, P, K, Ca, Mg, Na, Fe, Cu, Mn and Zn). After chemical analysis of the samples by standard known methods, statistical analysis was performed using the statistics package SPSS 15.0. According to the results of these analyses, the average content of nutrient elements in rocket (*Eruca sativa*) was found as 4.32% N, 0.25% P, 5.13% K, 2.95% Ca, 0.58% Mg, 799.88 mgkg⁻¹Na, 350 mgkg⁻¹ Fe, 5.36 mgkg⁻¹Cu, 40.58 mgkg⁻¹ Mn and 64.86 mgkg⁻¹ Zn. Minimum and maximum values are given together with average values. The aim of this study was to determine the mineral content of samples of rocket (*E. sativa*) grown by conventional methods in the province of Aydin, and to correlate this to previous studies.

Key words: Rocket, arugula, *Eruca sativa*, rocket growing, mineral composition.

INTRODUCTION

Rocket (*Eruca sativa*) is an endemic species of the Brassicaceae family which is produced mostly in Mediterranean countries such as Italy, Greece and Turkey. It is a dark green annual plant, about 20 to 50 cm in height, with a spicy-pungent taste (Morales and Janick, 2002). Since ancient times, the rocket plant has been a source of nutrition, an herb, an aphrodisiac and a medical plant, and has other uses (Yaniv et al., 1998).

According to data from 2010, the annual production of rocket in Turkey was 4058 tonnes (Anonymous, 2010), but because most production is carried out by amateur gardeners or on small plots, it is difficult to know how much is actually produced (Eşiyok, 1996).

Many studies of vegetable foods have shown that many plants of the Brassicaceae family contain phytochemicals such as flavonoids and glycosinolates (Jin et al., 2009; Bogani and Visioli, 2007; Schaffer et al., 2005), which have beneficial health effects such as cancer prevention

(Ambrosone and Tang, 2009; Traka et al., 2008; Higdon et al., 2007; Tang et al., 2008; Thomson et al., 2007). In addition, it has been extensively reported in the literature that rocket has astringent, diuretic, digestive, emollient, depurative, laxative, rubefacient, tonic, stomachic, anti-inflammatory for colitis and stimulant properties (Uphof, 1968; Yaniv et al., 1998; Perry and Metzger, 1978; Bianco, 1994). In the cosmetics sector, it has uses such as, for promoting hair regrowth, the treatment of oily scalp (Ellison et al., 1980), and as a facial tonic (Anonymous, 1988). In addition, the aphrodisiac characteristics of rocket have been attested since ancient Egyptian and Roman times (Fernald, 1993; Michael et al., 2011). With all these qualities, it is also an easy plant to grow, and has often been chosen as experimental material by researchers (Germ and Osvold, 2005). The aim of this study was to determine the content of minerals in the rocket plant and the statistical relationships between them.

MATERIALS AND METHODS

This study was conducted as a survey, in which the mineral nutrient

*Corresponding author. E-mail: neriman.tuba.barlas@ege.edu.tr.

Table 1. Contents of nutrient materials in rocket (*E. sativa*).

Parameter	N	P	K	Ca	Mg	Na	Fe	Cu	Mn	Zn
	%					mgkg ⁻¹				
Minimum	2.94	0.12	3.99	2.20	0.33	552.00	183.30	2.60	25.60	47.18
Maximum	5.23	0.27	5.98	3.55	0.79	972.00	776.90	7.00	79.30	88.68
Average	4.32	0.26	5.14	2.95	0.58	799.88	350.78	5.37	40.58	64.86

Table 2. Pearson correlation coefficients for mineral composition in *E. sativa* based on combined data.

Mineral element	N	P	K	Na	Mg	Fe	Mn
P	0.759**						
Na	0.252	0.146	0.639**				
Mg	0.211	0.219	0.618*	0.500*			
Cu	0.565*	0.592*	0.568*	0.532*	0.361	0.638**	
Mn	0.082	0.276	0.356	0.356	0.555*	-0.283	
Zn	0.316	0.457	0.319	0.221	0.458	-0.313	0.804**

** Correlation is significant at the 0.01 level, 2-tailed; *correlation is significant at the 0.05 level, 2-tailed.

content of plant samples taken from 30 different gardens of conventionally-grown rocket in the province of Aydin in Turkey was determined. The leaves of rocket (*E. sativa*) used as the study material were dried under laboratory conditions and then ground, after which they were weighed and prepared for analysis of total N, P, K, Ca, Mg, Na, Fe, Cu, Mn and Zn. Samples were wet-burned in a mixture of nitric and perchloric acids, and P content was determined by spectrophotometry, K, Ca, and Na values were gotten by flame photometry, and Mg, Fe, Cu, Mn and Zn values were gotten by the atomic absorption spectrophotometric method. Total N analysis was performed by burning the sample in a Kjeldahl unit and after the distillation stage and titration, the consumed amounts was inserted into a formula (Kacar, 1972). The values obtained were analysed by means of the SPSS 15.0 package; average, minimum and maximum values were obtained and correlations were sought between the nutrient elements.

RESULTS AND DISCUSSION

According to data obtained in this study, average mineral content was 4.32%, 0.25%, 5.13%, 2.95%, 0.58%, 799.88 mgkg⁻¹, 350.775 mgkg⁻¹, 5.36 mgkg⁻¹, 40.58 mgkg⁻¹ and 64.86 mgkg⁻¹ for N, P, K, Ca, Mg, Na, Fe, Cu, Mn, and Zn, respectively. Analysis results for the experimental material, including maximum, minimum and average values are given in Table 1.

As a result of an insufficient number of studies classifying the mineral content of rocket according to adequacy, the data could not be evaluated for adequacy. However, Haag and Manami (1998) reported that amounts of Mg in rocket leaves varied between 37 and 41 mg/100g, Bianco (1995) reported an Mg content of 46 mg/100g, and Eşiyok et al. (2006) reported an Mg content of 0.19 to 0.23% in a study where organic fertilizer was applied, while in this study, the level was found to be 0.58%. Comparing the results of this study

with that of Eşiyok et al. (2006), the content was found to be higher in the data of this study than in organically grown rocket. The basic reason may be that fertilizer is applied in a more limited and controlled way in organic growing. However, the results obtained in this study are similar to those of Eşiyok et al. (1998) except for Cu and Mn. The wide gap between the minimum and maximum values obtained in this study can be said to arise from climatic differences.

Examining the correlation data given in Table 2, it can be seen that N has a positive correlation with P at the significant level of 1%, and a positive correlation with Cu at level of 5%. As in this study, Bozokalfa et al. (2009) reported that N had a positive correlation with P and Cu, and also found that N had a positive relationship with K, Ca, Fe, Zn and Mn. Many of the other correlations found by Bozokalfa et al. (2009) also showed similarity with the findings of this study.

Finally, if we take into account the fact that certain researchers (Grusak and Dellapenna, 1999) have stated that it is possible to obtain significant human nutrition and health benefits from an increase in the mineral contents of plant products, the importance of determining and evaluating the mineral content of plants can be better appreciated. Thus, this study aimed to determine the mineral content of conventionally-produced rocket (*E. sativa*), which is widely produced and consumed in the Mediterranean area including Turkey, in order to provide motivation for further studies.

REFERENCES

Ambrosone CB, Tang L (2009). Cruciferous vegetable intake and cancer prevention: Role of nutrigenetics (Philapa). *Cancer Prev.*

- Res., 2: 298–300
- Anonymous (1988). *Il grande Libro dele erbe*, 1st. Edn., Peruzzo Editore, Italy.
- Anonymous (2010). Türkiye İstatistik Kurumu bitkisel üretim istatistikleri. <http://www.tuik.gov.tr/bitkiselapp/bitkisel.zul>
- Bianco VV (1994). Rocket, an Ancient Underutilized Vegetable Crop and It's Potential. Rocket Genetic Resources Network, Report of the First Meeting, 13-15 November 1994, Lisbon, Portugal.
- Bianco VV (1995). Rocket an ancient underutilized vegetable crop and its potential. 35-37. Rocket Genetic Resources Network. Report of First Meeting, 13-15 November 1994. Rome, Italy.
- Bogani P, Visioli F (2007). Antioxidants in the Mediterranean diets: An update. *World Rev. Nutr. Diet.*, 97: 162–179.
- Bozokalfa MK, Yagmur B, İlbi H, Esiyok D, Kavak S (2009). Genetic variability for mineral concentration of *Eruca sativa* L. and *Diplotaxis tenuifolia* L. Accessions. *Crop Breed. Appl. Biotechnol.* 9: 372-381, Brazilian Soc. Plant Breed. Printed in Brazil.
- Ellison JA, Hylands P, Peterson A, Pick C, Sanecki K, Stuart M (1980). *Enciclopedia delle erbe*. 1st. edn. A. Mondadori, Verona.
- Eşiyok D (1996). Marketing and Utilisation of Rocket in Turkey. *Rocket A Mediterranean Crop*.
- Eşiyok D, Okur B, Delibacak S, Duman İ (1998). Effect of Manure Doses and Different Growth Media on The Productivity and Mineral Composition of Rocket Leaves (*Eruca sativa*). International Workshop on: Improved Crop Quality - by Nutrient Management, (Edited by Anaç D, Martin-Prével P, Chapter 54, s.237-240, Kluwer Acad. Pub.
- Eşiyok D, Ongun AR, Bozokalfa K, Tepecik M, Okur B, Kaygısız T (2006). Organik Roka Yetiştiriciliği. VI. Sebze Tarımı Sempozyumu. Eylül 2006. Kahramanmaraş.
- Fernald, ML (1993). *Gray's Manual of Botany*. 1 st. Edn., 2. Dioscorides Press Portland, Oregon.
- Germ M, Osvald J (2005). Selenium treatment affected respiratory potential in *Eruca sativa*. *Acta agriculturae Slovenica*, 85 - 2, november 2005 str. 329–335.
- Grusak MA, Dellapenna D (1999). Improving the nutrient composition of plants to enhance human nutrition and health. *Annual Review of Plant Physiology and Plant Mol. Biol.* 50: 133-161.
- Haag HP, Minami K (1988). Nutrição mineral de hortilicas. LXXVII. Demanda de Nutrients por de Rucula. *Annl. Esc. Sup. Agric. Luiz de queroz piracicaba*. 45(2): 589-595
- Higdon JV, Delage B, Williams DE, Dashwood RH (2007). Cruciferous vegetables and human cancer risk: Epidemiologic evidence and mechanistic basis. *Pharmacol. Res.*, 55: 224–236.
- Jin J, Koroleva OA, Gibson T, Swanston J, Magan J, Zhang Y, Rowland IR, Wagstaff C (2009). Analysis of phytochemical composition and chemoprotective capacity of rocket (*Eruca sativa* and *Diplotaxis tenuifolia*) leafy salad following cultivation in different environments. *J. Agric. Food Chem.*, 57(12): 5227-5234.
- Kacar B (1972). Bitki ve Toprağın Kimyasal Analizleri. 2. Bitki Analizleri, Ankara Üniv. Ziraat Fak. Yayın no: Ankara. 453.
- Michael HN, Shafik RE, Rasmy GE (2011). Studies on the chemical constituents of fresh leaf of *Eruca sativa* extract and its biological activity as anticancer agent *in vitro*. *Journal of Medicinal Plant Research*, April 2011, vol./is. 5/7(1184-1191), 1996-0875;1996-0875
- Morales M, Janick J (2002). Arugula: A promising specialty leaf vegetable. In: *Trends in New Crops and New Uses*. Janick J, Whipkey A (eds.). Alexandria, VA: ASHS Press, pp. 418–423.
- Perry LM, Metzger J (1978). *Medicinal Plants of SE Asia: Attributed Properties and Uses*. The MIT Press: Cambridge, London, UK; Massachusetts, USA, pp. 23–24.
- Schaffer S, Schmitt-Schillig S, Muller WE, Eckert GP (2005). Antioxidant properties of Mediterranean food plant extracts: geographical differences. *J. Physiol. Pharmacol.*, 56(Suppl. 1): 115–124.
- Tang L, Zirpoli GR, Guru K, Moysich KB, Zhang Y, Ambrosone CB, McCann SE (2008). Consumption of raw cruciferous vegetables is inversely associated with bladder cancer risk. *Cancer Epidemiol. Biomarkers Prev.*, 17: 938–944.
- Thomson CA, Rock CL, Caan BJ, Flatt SW, Al-Delaimy WA, Newman VA, Hajek RA, Chilton JA, Pierce JP (2007). Increase in cruciferous vegetable intake in women previously treated for breast cancer participating in a dietary intervention trial. *Nutr. Cancer*, 57: 11–19.
- Traka M, Gasper AV, Melchini A, Bacon JR, Needs PW, Frost V, Chantry A, Jones AM, Ortori CA, Barrett DA, Ball RY, Mills RD, Mithen RF (2008). Broccoli consumption interacts PLoS One with GSTM1 to perturb oncogenic signalling pathways in the prostate. 3: e2568.
- Uphof JCT (1968). *Dictionary of Economic Plants*; Verlag Von J. Cramer Publ.: New York, USA.
- Yaniv Z, Schaffer D, Amar Z (1998). Tradition, uses and biodiversity of rocket (*Eruca sativa*, Brassicaceae) in Israel. *Econ. Bot.*, 52(4): 394–400.