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Evaluation of macro and micro plant nutrient contents and soil properties of three different Rosehip (*Rosa spinosissima, Rosa canina, Rosa villosa* subsp. *mollis*), species in different locations

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A B S T R A C T

Macro and micro plant nutrients have a very important role in the growth of plants. This study was carried out in the gateway belt connecting the Eastern Anatolia and the Eastern Black Sea Region.The study was carried out to determine the physical and chemical soil properties and macro and micro plant nutrient content of leaves and fruits of three rosehip species (*Rosa spinosissima, Rosa canina, Rosa villosa* subsp. *mollis*) that are widely used as food or medicinal plants. According to the results of physical and chemical analysis of soil samples, the soils were generally slightly acidic, salt-free, loamy, medium to high in organic matter, very little to low in lime, medium and adequate in phosphorus and potassium, according to the results of physical and chemical analysis of soil samples taken from the depth of plant roots (0-60cm). The highest NP contents were found to be 0.42% -0.57% in fruits of *Rosa spinosissima and* highest K contents were found to be 1.26% in fruits of *Rosa villosa* subsp. *mollis*, based on fruit and leaf analyses of rosehip species sampled from their natural habitats. The lowest Ca and Mg levels were found in the fruit of *Rosa villosa* subsp. *mollis* , while the highest Fe, Cu, Zn, and Mn levels were found in *Rosa villosa* subsp. *mollis* (fruit) at 752.1% and 5.7%, 66 ppm and 331 ppm, respectively, in *Rosa spinosissima* (leaf). The study is a study in which the macro and micro nutrient content of the fruits and leaves of the rosehip species grown in the passage zone connecting the Eastern Anatolia and the Eastern Black Sea Region and the soil properties they grow are determined. These results will contribute to the literature on the flora of Turkey and will provide useful contributions to the breeding studies of rose hips for food and health uses.

1. INTRODUCTION

Due to the differences in climate and ecology, Turkey is a vibrant country in terms of flora and fauna as it is located in three phytogeographical belts and has significant potential in terms of natural plants collected from nature for health and food purposes. The provinces of Erzurum and Bayburt, where the study was conducted, are climatically, geographically, and topographically rich in biodiversity, and medicinal and aromatic plants. 4000 of 20000 aromatic plant species are widely used all over the world according to WHO. Natural plants are used for nutrition and health mankind over centuries. Approximately 80% percent of the

world's population continues herbal treatment using traditional medicine and medicinal plants for health (Bhagirathy, 2003; Toksoy et al., 2003). According to the study, the use of natural medicinal and aromatic plants in Erzurum and Bayburt was for food and health purposes, with the leaves and fruit parts of the plants being the most commonly used (Kadioglu et al., 2017).

This study aimed to determine changes in mineral plant nutrient content, soil of physical and chemical properties of three rosehip species (*R. spinosissima, R.canina, R.villosa* subsp. *mollis*) commonly used in the region for food and health purposes in Erzurum and Bayburt provinces. In this study, plant and soil samples were taken and after macro and micro plant nutrients of the plant samples (leaf and fruit) were placed in the solution medium, the contents of N, P, K, Ca, Mg, Fe, Cu, Zn, and Mn were determined. Moreover, soil properties were determined by performing physical and chemical analyses on soil samples from the root depth of the plants.

2. MATERIAL AND METHODS

In the study conducted in 2020 to determine the changes in the physical and chemical soil properties and macro and micro plant nutrient content of three rosehip species used (for food and health purposes) that grow in nature in Erzurum-Aşkale and Bayburt-Kopköy provinces, the plants taken from their natural environment in three replications were *R. spinosissima* L., *R.canina* L., *R.villosa* L. subsp. *mollis*. Support was received from Karabük University Forest Engineering Department of Botany for the identification of plant species. Soil samples were taken from each plant's habitat in triplicate, from root depths (0-60cm), and brought to the laboratory by numbering. After the soil samples were dried in the air, they were sifted through a 2mm sieve and were prepared for analysis. Texture in soil samples by the Bower method (Bower et al., 1965), soil reaction was calculated potentiometrically with glass electrode pH meter in suspensions prepared at the ratio of 1 (sample): 2.5 (water) (Mc Lean, 1982). The organic matter content was calculated by multiplying the organic carbon content determined by the modified Walkey Black method by the 1.724 coefficient (Walkey, 1946). The lime contents of the soil samples (mineral CO_2) were determined by Scheibler calcimeter. From the obtained mineral CO_2 results, lime ($CaCO_3$) was determined as the equivalent of calcium carbonate by the volumetric method (Nelson, 1982). In the saturation paste extracted from the soil sample, the electrical conductivity values were determined as mmhos cm^{-1} (Richards, 1954). The ICP OES spectrophotometer determined total phosphorus content (Perkin-Elmer, 2100 DV, ICP / OES, Shelton, CT 06484-4794, USA) in filtrates extracted with sodium bicarbonate and potassium content in filtrates extracted with ammonium acetate by flame photometry (Olsen and Summer, 1954).

Each plant specimen was taken from its habitat in triplicate, depending on the usage period (leaves in April, fruits in September-October). The plant samples taken were first dried at room temperature and then in the oven at 70C0 until they reached a constant weight, and then ground to an average thickness of 2 mm in a Teflon blade mill and made ready for analysis (Kacar and İnal, 2008). The plant samples' total nitrogen contents were determined by the micro Kjeldahl method after wet combustion with a mixture of sulfuric acid (AOAC, 1990). P, K, Ca, Mg, Fe, Cu, Zn, Mn contents were determined by Perkin Elmer (Optima 2100) Model ICP - OES device after wet combustion with the nitric, perchloric acid mixture (AOAC, 1990). Herbaceous plants using leaf parts for food or health purposes and plants in shrub form using fruit and leaves were separately subjected to statistical analysis. Soil and plants (fruit/leaf parts) were subjected to variance analysis according to the factorial trial design in random blocks depending on the locations. The differences between the means were determined according to the LSD (5%) multiple comparison test. Statistical analysis was done in JMP 5.0.1 program.

3. RESULTS AND DISCUSSION

3.1. Macro and micro plant nutrient contents

The macro and micro plant nutrient contents of three different rosehip species (*R. spinosissima, R.canina, R.villosa* subsp. *mollis*) taken from their natural environment and fruit and leaf parts were analyzed in separate randomized plots according to a factorial experimental design. N and K minerals, which are macro plant nutrients in total fruit analysis, were found to be significant at 1% between locations. It was determined that plant parameters and location x plant interactions were insignificant. Although P (1%) and Ca (location and plant parameters 5% and location x plant interactions 1%) were significant in all parameters, Mg proved insignificant in all parameters studied. In the overall analysis of fruit microelements, location-plant and location x plant interactions of Fe and Mn were found to be significant at 1% and 5% significance levels. In contrast, the Zn nutrient element was not found to be significant in all parameters. On the other hand, the Cu element was significant in plant parameters (5%), insignificant in location and location x plant interaction.

It was found that *R. spinosissima* had the highest values in N (0.42%), P (0.57%), Ca (0.43%), Fe (693 ppm), Cu (3 ppm) and Mn (174 ppm), *R. canina* in K (1.26%) and Mg (0.35%), and *R. villosa* in Zn (48 ppm), with the Erzurum location giving better results. The highest P levels, Ca, Fe, and Mn

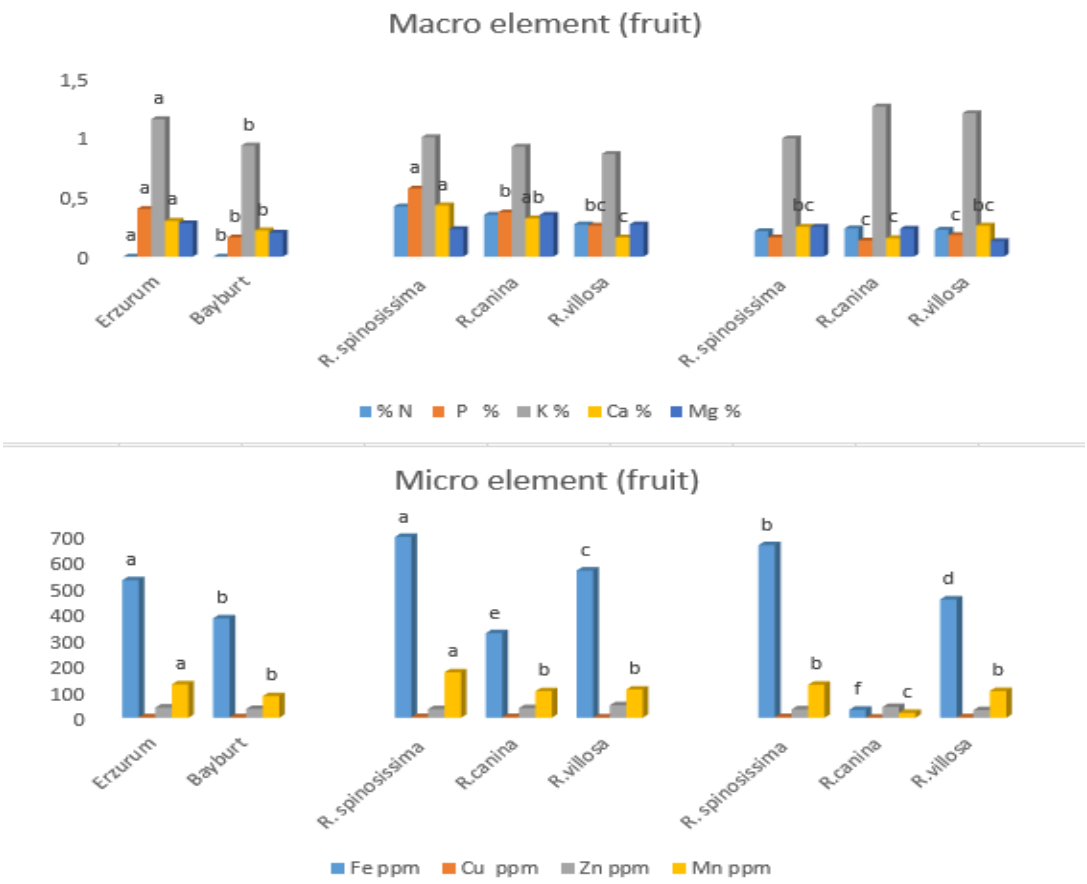

Figure 1. Plant-fruit mocro and micro nutrient contents

were found in *R. spinosisima* in Erzurum, with 0.57%, 0.43%, 693 ppm, and 174 ppm, respectively, when the location x plant interaction was studied (Figure 1).

According to the results of total leaf analysis, nitrogen from macro elements was insignificant in all parameters, while P was found to be significant in %1 location and plant parameters, and 5% in location x plant interaction. K was found to be insignificant in location and plant parameters, Ca in location parameters, Mg in location and location x plant interaction. It was determined that K was important in location x plant interaction (1%), Ca in plant parameter (1%) and location x plant interaction (5%) and Mg element in plant parameter (5%). In all parameters, Fe, Cu and Mn in microelements were determined to be significant at the 1% level. While the element Zn was significant (5%) for the parameter location, it was not significant for other parameters.

It was found that the Bayburt location gave lower values than the Erzurum location, and *R. canina* received the highest values of N and Mg with 0.24% and 0.56%, respectively. In P, K, Ca, Fe, Cu, Zn, and Mn, *R. spinosissima* took the values of 0.36%, 0.76%, 0.67%, 356 ppm, 5.7 ppm, 66 ppm, and 331 ppm in location x plant interaction in Erzurum, *R. spinosissima* took the values of 0.36%, 0.77%, 356 ppm, 5.7 ppm and 331 ppm in the elements of P, Ca, Fe, Cu, and Mn. Furthermore, it was found that *R. canina* obtained the highest value of 0.82 at the Bayburt location (Figure 2).

3.2. Physical and chemical soil analysis results

Soil properties of three different rosehip species are given in Table 1. Soil physical and chemical properties of three different rosehip species used for food and health purposes in Erzurum and Bayburt locations were examined and it was determined that there was no difference in terms of pH, texture, organic matter, phosphorus and potassium and the locations were significant at 1% in terms of salt and lime content. When the soils of rosehip species were studied among themselves, it was found that texture and phosphorus contents were significant at 5% and other parameters were not significant. When the location x soil parameter was studied, it was found that there was no difference between the studied parameters. It was found that the Bayburt location gave relatively better results regarding the studied parameters; the values of *R. canina* and *R. villosa* were better than the soil values of *R. spinosissima* and the values of *R. canina* and *R. villosa* were higher in Erzurum and Bayburt locations in location x soil interaction.

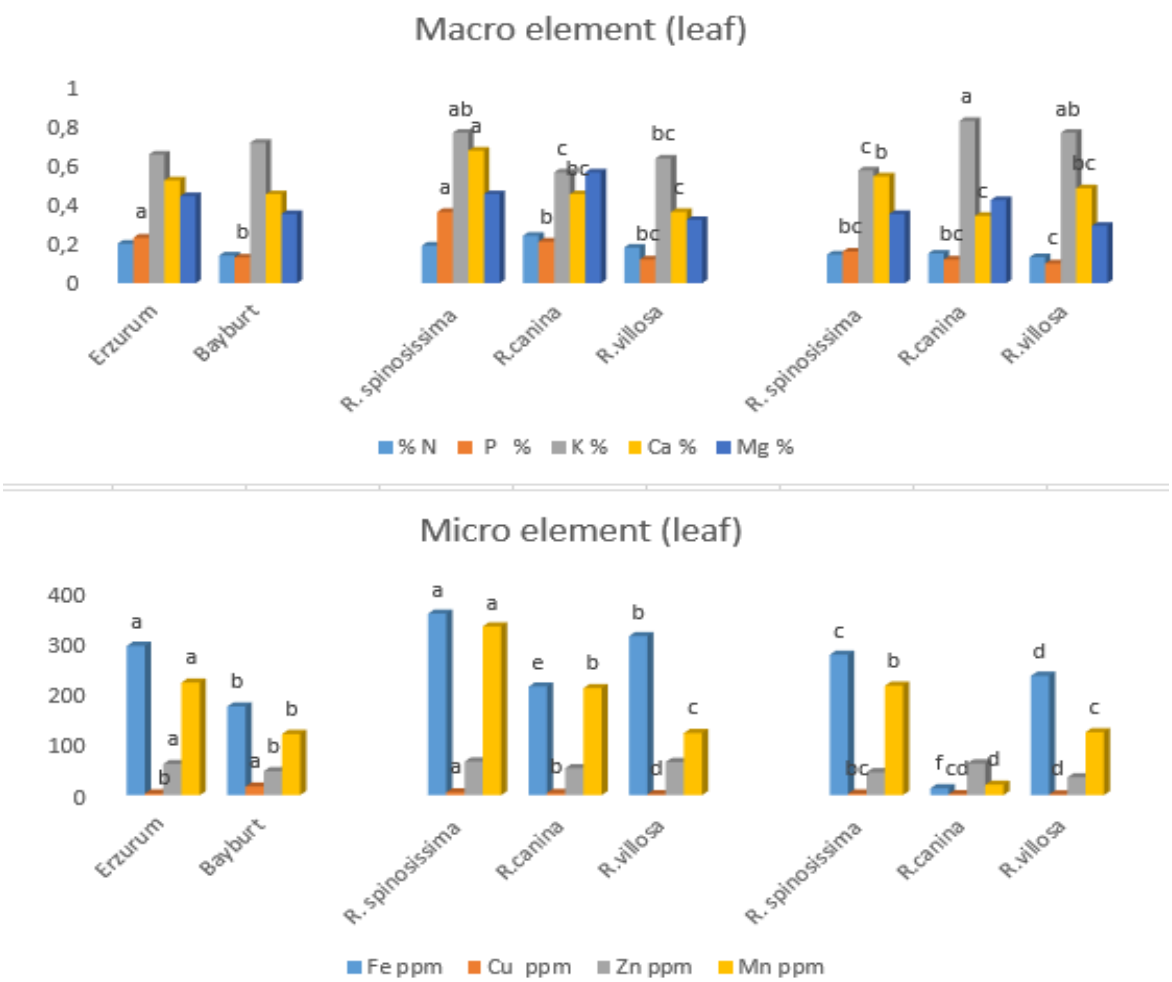

Figure 2. Plant-leaf mocro and micro nutrient contents

Table 1. Physical and chemical properties of plant soils

Location	Plant soil	pH	OM %	P %	K %	EC mmhos cm^{-1}	Texture (İşba)	$CaCO_3$ %
Erzurum	*R. spinosissima*	6.60	4.39	0.03	0.01	1.30	87	0.65
	R. canina	6.00	2.37	0.03	0.02	1.20	110	0.52
	R. villosa	6.30	3.27	0.02	0.02	1.36	75	0.42
Bayburt	*R. spinosissima*	6.90	3.36	0.03	0.01	0.6	96	2.32
	R. canina	6.70	4.20	0.03	0.02	0.4	102	2.00
	R. villosa	6.90	3.70	0.02	0.02	0.7	91	2.50

Rosehip is the name given to the fruits of plants belonging to the subfamily Rosaideae of the rose family (Rosaceae) called Fruktus Rosae in Latin (Ates, 1992). It is also known as itburnu (Anonymous, 2021), yabangülü, şillan, deligül, gül burnu, gül elması in Turkish (Rehder, 1949). The rosehip, which appears in nature as a "yabani gül" in many parts of our country, is a plant whose importance is not known enough in terms of health and nutrients that grow naturally (Anonymous, 2021). Although it is widely used in the manufacture of jams, it is also used in areas such as erosion control. It is a thorny shrub with a height of 1-3 m and is very resistant to harsh environmental conditions (Davis, 1977; Yamankaradeniz, 1983b). It is not affected by drought, as its roots reach up to a 4 m depth (Güleryüz and Ercişli, 1996a). Because it can grow in all kinds of environmental conditions, it can be found in valleys, roadsides, garden fences, and cemeteries (Yamankaradeniz, 1983b). *R. spinosissima*, locally known as gara gushbuni, has been reported to grow on limestone or volcanic rock on dry, rocky slopes at an altitude of 1200-2700, has erect spines and 7-11 oval leaflets. According to the results of the study, it was found that the soil structure was slightly acidic, salt-free, loamy, and good in terms of organic matter, lime content was low, phosphorus and potassium content was moderate and sufficient. Rosehip can be grown in a variety of soil conditions, depending on the climate. Although it shows promising growth in sandy soils, it develops best in loose, nutrient-rich soils (Anonymous, 2021). Rosehip is a plant that is widely found in the natural population and also plays an essential role in the food and pharmaceutical industries. Eating fruits and vegetables in the

diet has been found to reduce cancer risk, as has their taste, aroma or smell and the vitamin and mineral values they contain (Kadakal, 2003). In the study of Yıldız and Nergiz (1996), the mineral plant nutrient content of rosehips was investigated, and the following values were obtained; Ca 99-342 ppm, P 1100-3320 ppm, K 4203 ppm, Na 18 ppm, Mg 152 ppm, Mn 880 ppm, Fe 21 ppm, Cu 3.20 ppm and Zn 1.90 ppm. In another study examining five different species of rosehips; 94 mg/100g Ca, 72 mg/100g Mg, 1.2 mg/100g Na, 461 mg/100g K, and 337 mg/100g P were found in the species *R. canina*, which is most commonly grown in the wild (Yamankaradeniz, 1982). The effect of plant nutrients has been known for 2000 years. Plants have a limited ability to absorb the nutrients necessary for their growth and development selectively. In this study, NPK elements known as a twig, off shoot and honey were higher in fruit parts than in leaf parts. This may result from the fact that more NPK is needed for fruiting in the plant. In this study, macronutrients and micronutrients were found to be between the limits (Kacar and Katkat, 2010). In various studies on the rosehip plant, it has been stated that it is an important source of nutrients, rich in vitamins and minerals, and contains K, Na, Ca, Mg, P, Fe, Mn, Cu, Zn in its structure (Chai and Ding, 1995; Yıldız and Nergiz, 1996; Uggla et al., 2003; Çınar and Çolakoğlu, 2005; Doğan et al., 2006; Ercişli, 2007). In the studies on the consumption of medicinal and aromatic plants in the region, it was found that rosehip is consumed seasonally, for food purposes as jam, tea and meal and for health purposes against diseases such as cold, flu, and anemia as it is a vitamin store (Kadioglu et al. 2018; Kadioglu et al. 2021a; Kadioglu et al. 2021). For a natural and healthy life, man has turned to nature and begun to consume plants found in nature. For many years, naturally occurring plants have been used in the region for health and nutritional purposes. Nitrogen, phosphorus and potassium, which are plant nutrients, were found relatively more frequently in the fruit parts of plants because they are plant nutrients needed for regular fruit formation and development and increase fruit quality.

4. CONCLUSION

While using medicinal and aromatic plants as food comes first, their use as herbal medicine to treat some diseases comes second. Plant nutrients affect plant development and human health. Nutrients ingested with plants are used in the human body as vitamins and minerals. It is well known that minerals are necessary for the healthy functioning and development of the human body. Lack or excess of minerals cause various diseases. Vitamins cannot fully perform their functions when minerals are deficient. Ca, Fe, Mg, P, K and Zn are some of the essential minerals that should be present in our bodies. Minerals in the soil and plants are taken from food and converted into the nutrient elements required in our body. In this study, the minerals found in soil and plant were investigated at different locations and as a result of the study, it was found that higher contents of N, P, K and Fe were present in fruit parts with respect to macro and micro plant nutrients whereas leaves were richer in terms of the elements Ca, Mg, Cu, Zn, and Mn. It was determined that the soil properties of *R. spinosissima* was 6.60 -6.88 pH, 1.30 - 0.60 EC mM, 87-96 texture %, 4.39-3.36 OM %, 0.65-2.32 CaCO3 %, 0.026-0.028 P %, 0.010-0.014 K %, *R. canina* 6.0 -6.70 pH, 1.20 - 0.40 EC mM, 110-102 texture %, 2.4-4.2 OM %, 0.52-2 $CaCO_3$ %, 0.032-0.032 P %, 0.015-0.019 K %, and the soil properties of *R. villosa* was 6.30 -6.90 pH, 1.36 -0.70 EC mM, 75-91 texture %, 3.3-3.7 OM %, 0.42-2.5% $CaCO_3$ %, 0.020-0.020 P %, 0.016-0.016 K %.

Compliance with Ethical Standards

Author Contributions

BK: Writing, Editing, Data curation, Visualization, Investigation, Conceptualization, Supervision, Methodology.

Conflict of Interest

The author does not have any conflicts of interest to declare.

Ethical Approval

For this type of study, formal consent is not required.

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