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Determintion and comparison of important inorganic elements in Avocado fruits grown in North of Iran

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ABSTRACT

This study reports on the analyses of important inorganic elements such as Na, K, Mg and Fe in two varieties of Avocado, Fuerte (a natural hybrid originated from Atlixco, Mixico) and Hess (Seed planted La Habara Heights, California) adopted for growing in North of Iran. Element determination was performed by atomic absorption method. In both varieties, K concentration was found dominant among the aforementioned elements (in Fuerte it was higher than Hess), whereas Na content in Hess was more than that of Fuerte. Mg was in similar concentration range in both varieties. The amount of Fe and Ca was very low; however, they were higher in Hess. Since it is supposed that the structural composition of these fruits changes with respect to the variety and climate, an elemental analysis of Persian Hess was compared with that of Florida and California Hess and finally with the Persian Fuerte. Results revealed that variety and climate were two factors which could affect the amounts of elements in the samples under investigation. The soil in which the Avocado fruits had been cultivated was also analyzed and the findings indicated that there was no relationship between the concentration of the elements in the Avacado varieties and the corresponding elemental composition of the soil of cultivation.

KEYWORDS

Avocado;
Persia americana mill;
Hess;
Fuerte;
Persia hess;
Persia fuerte;
Important elements in Avocado.

INTRODUCTION

All fruits may be classified into two broad categories: Dry, and fleshy. Avocado falls into the latter category. The avocado (*Persia Americana mill*) belongs to the Lauraceae, a family of mainly (sub) tropical trees and shrubs; other well-known members are laurel, cinnamon, saffras and green-heart (a timber of the Guianas). The English name was derived from a Spanish word abogada, which changed into avocat in French[1]. Avocado is a single-seeded berry and is the matured ovary of a flower. Basically, it consists of the ovary wall, or pericarp, which encloses one or more seeds[2]. The pericarp is developed into three layers of tissues: the outer layer is exocarp, which is commonly called the skin or rind. The middle layer is mesocarp which, generally, makes up the bulk of the pericarp. The inner layer is called endocarp. In some fruits it is tough, leathery

FULL PAPER

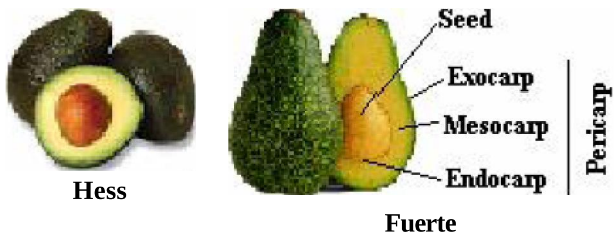

Figure 1 : Shapes of Hess and Fuerte avocados

or hard, whereas in others it is soft or fleshy. Figure 1 shows the shapes of two varieties of this fruit cultivated in northern part of Iran.

Avocado has existed for thousands of years, and it is still a popular food in Central America. It is a nutritious fruit with low sugar content; therefore, it can be recommended as a high energy food for diabetics[1,3]. Determination of major, minor and trace elements in foods is necessary for proper assessment of their nutritional and/or toxicological effects on human beings. An initial step in this assessment is the evaluation of naturally occurring background levels in agricultural products. Kikuta and Erickson[4] compared five elements including K, Na, Ca, Mg and Fe in Hess avocados cultivated in two provinces of United States, Florida and California. This study has analyzed and characterized the elemental composition of two varieties of Avocado fruits which was cultivated in Iran, Babol city. The high oil content of the fruit has attracted special attention with regard to its composition, but unfortunately, nearly a few studies[5-10] have been done on the components of mesocarps of avocado fruits. Since there is not enough information concerning the structural composition of this fruit and its probable changes as a function of variety or climate, the present study is an attempt in this regard. That is, to that aim, this research has compared the components of the mesocarps of Hess and Fuerte avocado grown in North of Iran. The elemental analysis of important inorganic elements e.g. Na, K, Mg and Fe was then performed by atomic absorption method. Finally, the obtained data were compared with those reported by Kikuta and Erickson[4] regarding Hess variety cultivated in California and Florida. Therefore, the present study was supposed to investigate the effect of climate or variety on the structural composition of this fruit. Research in this area (especially on the analysis of volatile constituents) is still in progress.

TABLE 1 : Wavelengths and detection limits

Limit of detection (ppm)	Wavelength (nm)	element
0.070	589.0	Na
0.081	766.5	K
0.051	285.2	Mg
0.044	248.3	Fe
0.080	422.7	Ca

MATERIALS AND METHODS

A sample of avocado fruits consisting of Hess and Fuerte varieties was prepared from the same origin (Babol city in Iran) to consider the effects of climate and cultivation site. All stages of sample preparation and analysis were carried out in a clean air environment. Prior to sample analysis or digestion, all glassware and plasticware were scrupulously cleaned, rinsed several times with double-distilled water, and dried out in a clean air environment. The avocados were first cleaned and washed with water and then washed several times with double-distilled water. After separating the Mesocarps of avocado fruits (1000 g per each variety), we dried them out at 60°C for 48 h. The heating, coding, and weighing cycle was repeated as many times as it was required to achieve successive weights that do not differ from one another by> 0.2-0/3 mg. The dried samples were burnt and the obtained ashes were placed in electro thermal furnace at 700°C for 6 to 7 h. A wet-ashing procedure was employed to convert the elements of interest into a susceptible form through common analytical techniques. In this study, the reagent of nitric/hydrochloric acid mixtures had been used for digesting of the avocado ashes.

Elemental analysis was conducted using atomic absorption and emission spectroscopy. Distribution of elements in these two varieties of avocados had been investigated. Standard addition solutions were made and their absorption was read by atomic absorption apparatus. Concentration was determined by using calibration curves. Elemental analysis had been measured using a Varian atomic absorption spectrometer Perkin Elmer 2010, spectra AA-10. Other devices, which were utilized included BP211D balance, electro thermal mantel, and electro thermal furnace. The analytical wavelength with corresponding detection limits used in this study, are listed in TABLE 1.

Hydrochloric acid (37%), nitric acid (65%), perchloric acid (70%), methanolic potassium hydroxide, n-hexane and standard solutions including sodium, potassium, calcium, magnesium and iron, were obtained from Fluka chemicals; sodium sulfate was purchased from Merck chemicals.

Moreover, some soil was collected in the same area where the Avocado fruits are growing. To obtain a truly representative gross sample, a random sample of soil that weighed ~5 kg was removed from a bulk of materials by chance. At this stage the preliminary steps of mixing solid laboratory samples were employed for all cases. Decomposition of samples had been performed by fluxes. To that aim, the sample in the form of a very fine powder was mixed with ~10-fold excess of the flux; the fluxes used in this analysis were a mixture of boric anhydride (B_2O_3) and lithium carbonate (CO_3 Li_2). Fusion with these reagents was performed at ~700°C for 2 h.

RESULTS AND DISCUSSION

The concentration of metal elements such as Na, K, Mg, Fe and Ca in the two varieties of avocado (Hess and Fuerte) was investigated. The method of least-squares was applied for all measurements to draw calibration curves. Statistical factors consisting of least square equations, and correlation coefficients, have been shown in TABLE 2, for avocados. As it can be seen the factor of regression for most cases is more than 0.980.

TABLE 3 demonstrates the concentration of K, Mg, Fe, Ca and Na in mg per 100g of fresh weight of avocados cultivated in Iran. Results drawn from the analyses of different varieties of Avocado for sodium, potassium, magnesium, iron and calcium were listed in TABLE 3 and were shown in histogram of figure 2. Figure 2 indicate the elemental analyses of two different varieties of avocado fruits. Comparison of the potassium concentration with the other elements in the two varieties demonstrated that its concentration was significantly higher than that of the other elements; that is, in average, the potassium concentration was ~15 times more than that of the other elements. K and Na were determined through emission techniques and atomic absorption was applied for measuring Mg, Ca and iron. It

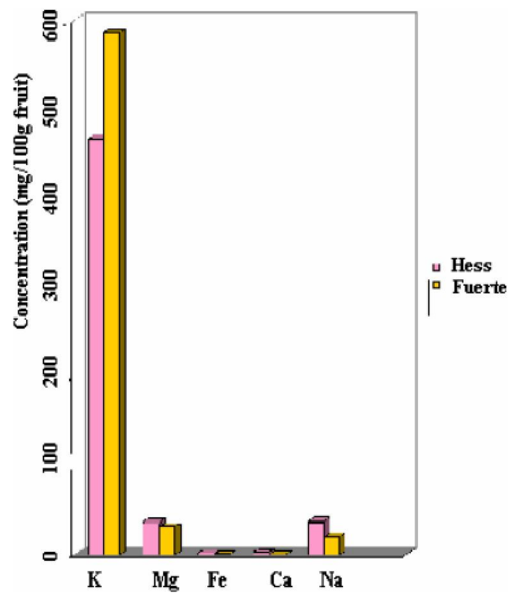

Figure 2 : Elemental analysis of K, Mg, Fe, Ca, and Na for Iran Hess and Fuerte avocados

should be noted that the concentration of these elements has been represented as w/w%, and therefore they are comparable with other concentration.

Comparison of the sodium concentration in two different verities of avocados revealed that the presence of sodium was different. As it was seen, the concentration of sodium in Hess was ~2 times more than that of Fuerte. According to the findings, Fuerte contains more concentration of potassium than Hess. Fuerte and Hess contained the least concentration of calcium and iron respectively. Though K and Fe were found to be higher in Fuerte in comparison with Hess, Hess benefited from more concentration of other elements under investigation. Analysis of magnesium in the two varieties of avocados reveal that they had comparable concentration in this regard, and the sodium content was very close to magnesium. Against the Hess avocado cultivated in Iran, the Hess of California and Florida showed significantly more amount of sodium about 5-10 fold.

Furthermore, in order to consider the idea that the structural composition of this fruits, changes as function of climate, we compared Hess variety avocados cultivated in north of Iran with those of California and Florida (TABLE 3). The analysis of California and Florida Hess varieties has been listed in TABLE 3 was extracted from reference[4]. The Comparison of the elements of the variety cultivated in Iran we those growing in California and Florida indicated that the amount of elements dif-

FULL PAPER

TABLE 2 : Statistical factors for Hess and Fuerte avocados cultivated in northern Iran

Statistical factors for Fuerte avocado		Statistical factors for Hess avocado		
Correlation coefficient	Least square equation	Correlation coefficient	Least square equation	Element
0.9927	A=0.0060C+0.0492	0.9994	A=0.0062C+0.0791	Na
0.9987	A=0.0025C+0.0742	0.9978	A=0.0027C+0.0531	K
0.9955	A=0.0281C+0.3399	0.9809	A=0.0191C+0.2534	Mg
0.9983	A=0.0053C+0.0019	0.9729	A=0.0054C+0.0008	Fe
0.9552	A=0.0036C+0.0003	0.9465	A=0.0036C+0.0009	Ca

TABLE 3 : Concentrations of Na, K, Mg, Fe, and Ca in 100 g of fresh weight of Iran cultivated avocados of Fuerte and Hess and as well as Hess of Florida and California (4)

Florida Hess avocado (100 g)	California Hess avocado (100 g)	Iran Hess avocado(100 g)	Iran Fuerte avocado (100 g)	element
351 mg	507 mg	466.440 mg	548.37 mg	K
24 mg	29 mg	35.861 mg	32.652 mg	Mg
0.2 mg	0.6 mg	0.439 mg	0.882 mg	Fe
10 mg	13 mg	0.741 mg	0.205 mg	Ca
2 mg	8 mg	37.823 mg	20.181 mg	Na

fered depending on different climates, and in all of them the amount of potassium was significantly higher than that of the other elements. The sodium concentration in Persian Hess was much more than that of California and Florida Hess. It is interesting to compare the concentration of calcium in Iran Hess on one hand and California & Florida Hess on the other. The finding indicated that Ca content in California and Florida Hess was much more than the Persian one (~20 fold more). Iron was found to be a little in all of them, and magnesium had nearly similar concentration range so did sodium. However, K was entirely dominant in the all avocados. Fe had the least concentration among the other elements in Hess varieties. Contrary to the above results, the most amount of Na existed in the Persian Avocado.

Elemental analysis of the soil collected from the areas where different varieties of Avocados were growing also revealed that the concentration of the elements among corresponding areas were the same and this confirmed that there was no relationship between concentration of the elements in the varieties of avocados and the corresponding elemental composition of the soil of cultivation. The same result was obtained for Kiwifruits reported by Samadi-Maybodi et al.[11]. Consequently, it could be deduced that different concentration of each element in different varieties of avocados referred to the kind of avocado and climate not to the soil of cultivation.

CONCLUSION

This study reported on the elemental analysis of K, Mg, Fe, Ca, and Na in different varieties of Avocado fruits (Hess and Fuerte) grown in the northern part of Iran, and California & Florida Hess avocados as well. Results indicated that the amount of metal elements varied not only in different varieties but also in different climate. Furthermore, among the elements of interest in this research, K concentration was found dominant. Finally, the analysis of soil revealed that there was no relationship between the concentration of the elements in different varieties and the corresponding elemental composition of the soil.

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