STATISTICAL EVALUATION OF HEAVY METAL CONTENT IN SOME CAPSICUM VARIETIES AVAILABLE ON THE ROMANIAN MARKET

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ABSTRACT
The aim of this study is to emphasis the heavy metals content in seven capsicum varieties of capsicum of the specie *Capsicum annuum* L., available on the Romanian market. From the analyzed Capsicum fruit samples, three Capsicum assortments were cultivated in Romania and the other four were imported from Italy and Turkey. The studied heavy metals (copper, zinc, manganese, iron, cobalt, lead, nickel, cadmium and chromium) have normal concentration values that are not of any risk to human health. Cadmium is not detectable in all studied samples. The heavy metal content associated with statistical analysis programs permits the identification of characteristics specific to the origin of products and the graphical chemical fingerprint of the studied capsicum species. The chemical fingerprinting of a plant demands the determination of a large number of elements (DJINGOVA ET AL., 2004). The study is revealing similar distribution pattern.

Keywords: Capsicum species, heavy metals, PCA, CA, graphical chemical. fingerprints

INTRODUCTION

The genus *Capsicum* (Family: Solanaceae) contains five commonly cultivated species (*C. annuum* L., *C. frutescens* L., *C. chinense* Jacq., *C. baccatum* L. and *C. pubescens* and appear in many varieties. *Capsicum annuum*, one of the major species includes bell peppers, cayenne, paprika, and jalapeños (ANTONIOUS ET AL., 2010). Although many people consider them vegetables, peppers in the Capsicum family are actually a berry form of fruit (CAPSICUM-INFORMATION, web site).
Sweet peppers are grown in most countries of the world. Over the past five years, world production increased by 15% (2.9% annual growth CAGR), reaching 26.1 million tons. (A.C.S.A. REPORT, 2009). China is the World leader in sweet pepper production (14 million tons or 54% of world production), followed Mexico, Indonesia, Turkey, Spain and USA. Romania is ranked 19th in world's top importers of sweet peppers (A.C.S.A. REPORT, 2009). The study is presenting the identification of the graphical chemical fingerprint as well as the statistical evaluation to emphasize the origin of the vegetables based on the heavy metal content of the studied Capsicum species. The chemical fingerprinting of a plant demands the determination of a large number of elements (DJINGOVA ET AL., 2004). The study of the heavy metals has been chosen because, "heavy metals are extremely persistent in the environment; they are non-biodegradable and non thermo-degradable and thus readily accumulate to toxic levels" (SHARMA ET AL., 2007). Due to agriculture's increasing reliance on the application of chemicals, pollution of soils by heavy metals has become a concern that may cause a long-term risk on environmental and human health

(WONG et al., 2002). Soils are receptacles for heavy metals released from industrial activities, municipal wastes, water sludge, urban composts, road traffic, atmospheric deposits and chemicals used in agriculture (phosphate fertilizers, pesticides) and spread out into the environment (ADRIANO, 1986). Plant uptake is one of the main pathways through which heavy metals enter the food chain (ANTONIOUS ET AL., 2010). Elevated concentrations of heavy metals in edible plants could expose consumers to excessive levels of potentially hazardous chemicals. Accumulation of heavy metals varied between plant species (ANTONIOUS ET AL., 2007; MELO ET AL., 2007).

MATERIAL AND METHODS

Samples collection and preparation

Seven varieties of Capsicum were obtained from Timisoara (Romania) shop centers, the declared country of origin of the fruits being considered as specified on the product label. Three studied assortments are cultivated in Romania and the other four are imported from Italy and Turkey.

All the collected samples were washed with double distilled water to remove impurities and pollutants. After washing, fruits samples were oven dried at 90°C to constant weight. The dried samples were ground, passed through a 2 mm sieve and stored at room temperature before analysis. The heavy metals content in Capsicum fruits was carried out in HNO_3 solution resulted from fruit ash digestion (KHAN ET AL., 2008, LĂCĂTUŞU, 2008). Each sample solution was prepared with diluted HNO_3 (0.5N), made up to a final volume of 50 mL and analyzed by flame atomic absorption spectrometry (FAAS) in University Environmental Research Test Laboratory.

Reagents and solutions

Double distilled water (spectroscopic pure) was used for the preparation of reagents and standards. All chemicals were trace metal grade (Suprapur). Concentrate nitric acid (HNO_3 65%), was obtained from Merck Germany. The working solutions were prepared by diluting the stock solutions to appropriate volumes.

Statistical analysis

The data were statistically analyzed using a statistical package MVSP 3.1.

RESULTS AND DISCUSSIONS

Chemical and graphical fingerprinting was realized taking into account the content of copper, zinc, manganese, iron, cobalt, lead, nickel, cadmium and chromium using FAAS method correlated with statistical analysis program MVSP 3.1. The mineral composition of the studied samples ($mgKg^{-1}$ dry matter) is presented in *Figure 1*. Each value in the graphics is an average of 3 replicates. The studied metals have normal concentration values that are not presenting any risk for human health. Cadmium is not represented on the graphical figures because in all cases was not detectable.

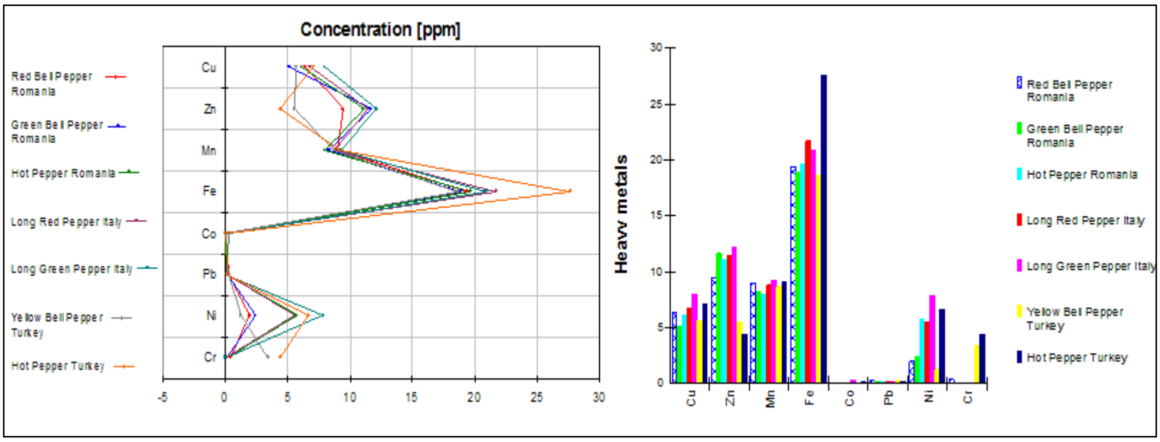

Figure 1. Graphical representation of FAAS mineral composition

Principal Components Analysis (PCA) allows an assessment of mineralogical content data corresponding to the samples of Capsicum species, using the square root of their transposed matrix (*Figure 2*).

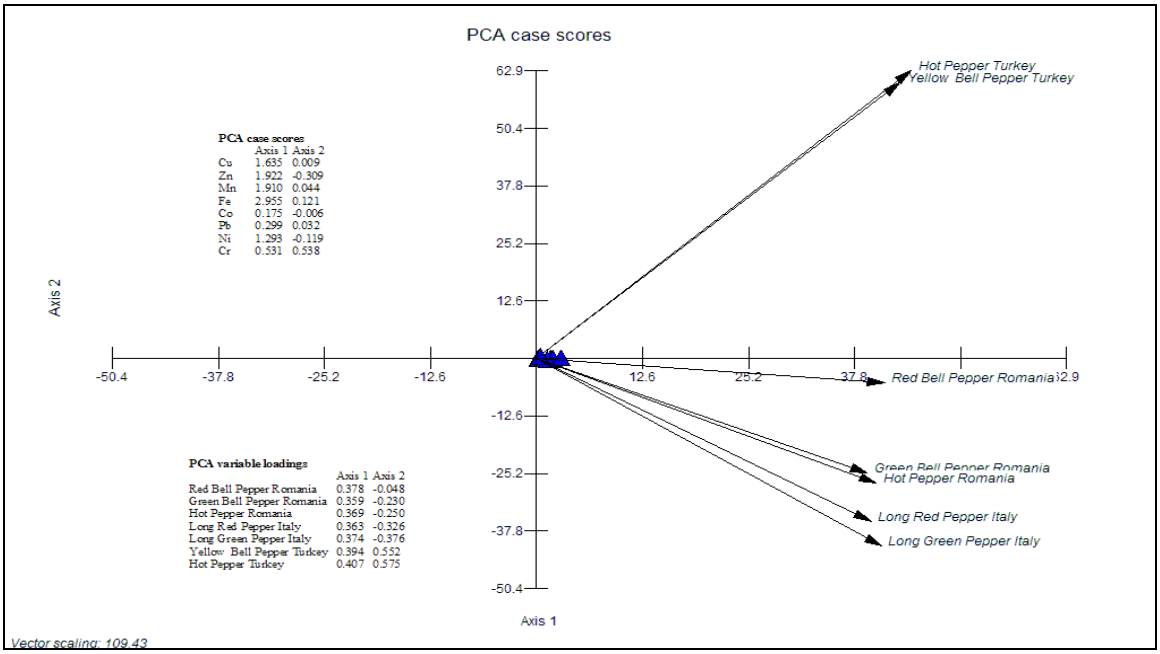

Figure 2. PCA joint-plot graphical representation

The join-plot representation of the calculated case scores permits the identification of the declared origin of the analyzed Capsicum species. In quarter I, we can observe the vectors for the Capsicum varieties from Turkey and in quarter IV, the vectors for those with the declared country origin Romania (closer to the Axis 1) and the species from Italy (more centered vectors). The vectors are represented taking in consideration the heavy metal composition of the studied samples (*Figure 2*).

In *Figure 3* we can identify the graphical chemical fingerprints of the trace metals. As we can observe the heavy metals content is having small variations between species but the profile that is revealing the fingerprint is similar (*Figure 3*). "Related plant species show similar distribution pattern!" (FRÄNZLE, S., MARKERT, B., 2000).

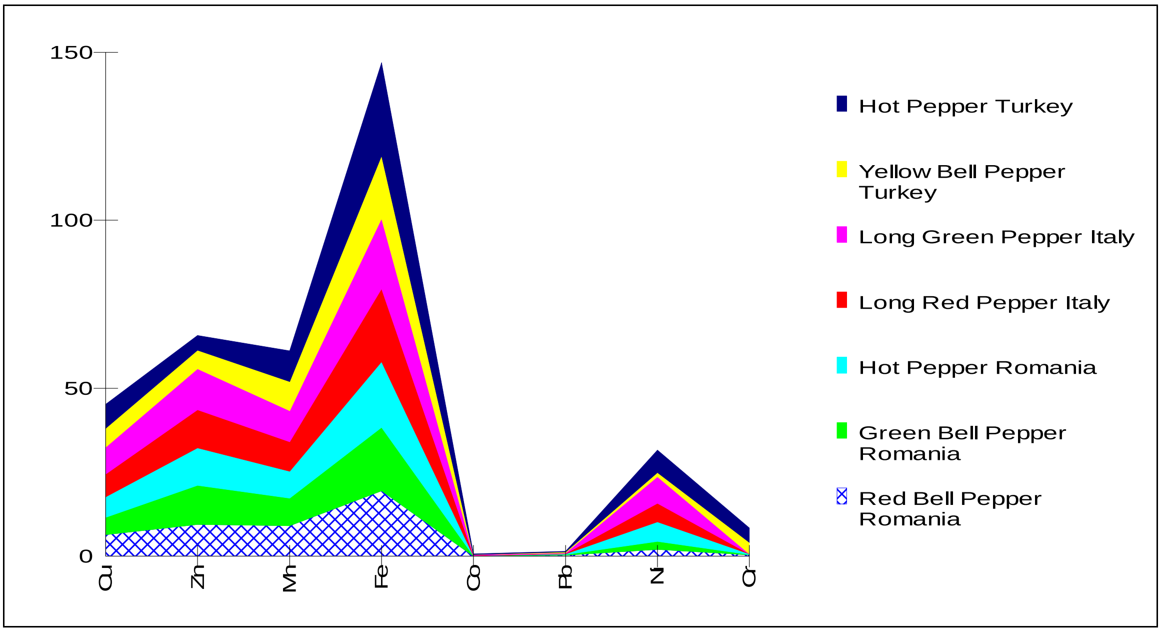

Figure 3. Trace Metals Fingerprints of Capsicum Species

The CA analysis presents the correlation between the analyzed samples and identifies the strength of correlation between the samples (*Figure 4*).

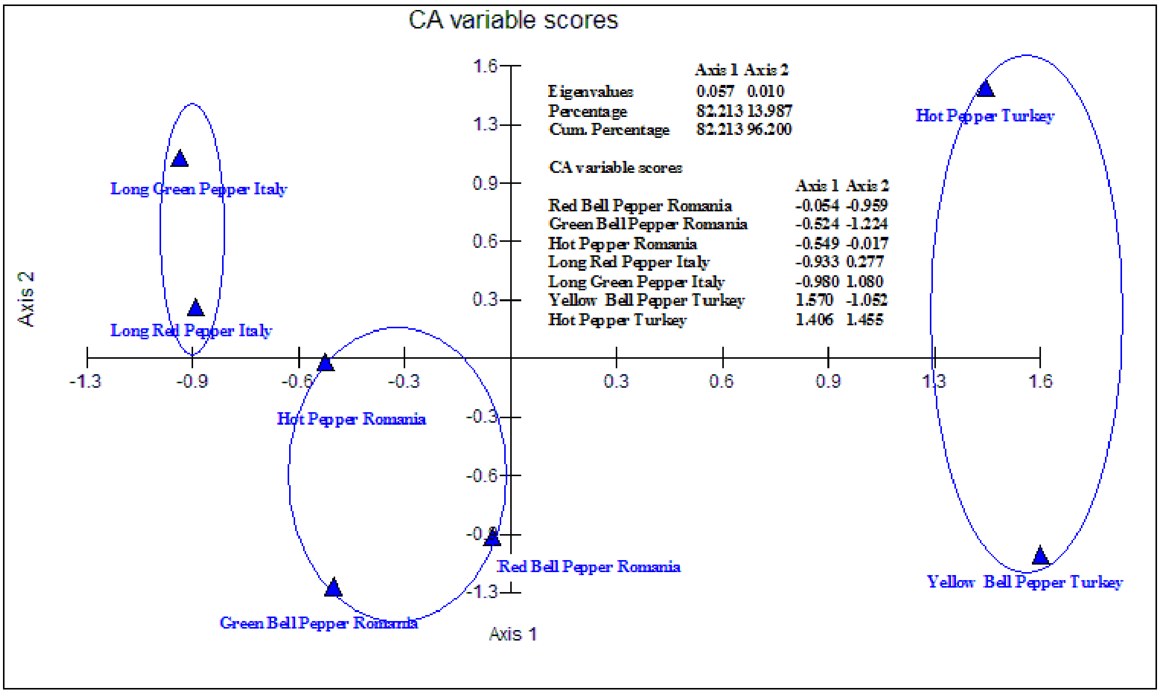

Figure 4. Graphical Representation of CA Variables Score

CONCLUSIONS

Mineral composition and chemical fingerprint can be used as fruit and vegetables quality markers for the cultivators, as well as for the processing food industries.

Graphical chemical fingerprint can be used to verify the declared origin of vegetables and fruits. PCA (*Figure 2*) and CA correlation analysis (*Figure 4*) allows highlighting mineralogical components specific to each Capsicum species and country, separately, and permits the identification of the declared origin of used species and varieties.

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