GRAPHICAL CHEMICAL FINGERPRINTS OF PARSLEY, DILL, AND LOVAGE LEAVES

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ABSTRACT
The aim of this study is to emphasis the use of thermo gravimetrical water content and trace metals analysis to identify the *chemical graphical fingerprints of parsley, dill and lovage leaves.* Copper, zinc, manganese, iron, nickel and lead have normal concentration values that are not of any risk to human health. Cobalt, chromium and cadmium were not detectable in all studied samples. The water and present trace metals contents associated with mathematical models permits the identification of characteristics specific to the studied vegetable leaves as well as the graphical chemical fingerprints. The study is revealing similar distribution pattern.

Keywords: leafy vegetables, moisture dehydration process, trace metals content, mathematical models, graphical chemical fingerprints

INTRODUCTION

Dark-green leafy vegetables are probably the most concentrated source of nutrients among all basic aliments of our diet. They are a rich source of water and minerals (including iron, calcium, potassium and magnesium). The most commonly used leaves as herbs, green vegetables, and spices in Romania are parsley, dill and lovage.

Parsley (***Petroselinum hortense***) is a species of *Petroselinum* in the family *Apiaceae*, native to the central Mediterranean region, and widely cultivated as an herb, a spice and a vegetable. It is an herbaceous plant vegetable with high strain, cultivated for root systems and its aromatic leaves, used in feed and in folk medicine (EUROPLUSMED, 2006). Parsley is one of the richest nutrients factory of the nature, containing high amounts of minerals and phenol compounds. Phenol compounds found in parsley include various phenolic acids, caffeic acid (SHAN ET AL., 2005), minor amounts of quercetin and luteolin, and extremely high levels of apigenin (JUSTESEN AND KNUTHSEN, 2001). Like other members of the *Apiaceae* family, parsley also contains polyacetylenes, which are toxic to fungi, bacteria and some cancer cells, and have anti inflammatory and anti-platelet aggregating activity as well.

Dill (***Anethum graveolens***), depending on where it is grown, is either a perennial or annual herb, originated within an area around the Mediterranean and the South of Russia (GRIEVE, 2011). Like parsley, dill is rich in vitamins and minerals, and contains a large amount of chlorophyll. In addition, dill has a high antioxidant activity, and contains very high levels of quercetin (48–110 mg/100 g fresh weight), kaempferol (16–24 mg/100 g fresh weight) and isorhamnetin (5–72 mg/100 g fresh weight) (ZHENG AND WANG, 2001; JUSTESEN AND KNUTHSEN 2001).

Lovage (***Levisticum officinale***) is a tall perennial plant, from the genus *Levisticum*, in the family Apiaceae (PIMENOV AND LEONOV, 1993). Lovage is closely related to plants such as dill, parsley, angelica, carrot and celery, and shares their characteristic aromatic scent and flavor (THE HERBAL RESOURCE, 2006). Lovage appears to have low to moderate levels of phenolic and antioxidant activity, but very high levels of quercetin (170 mg/100 g fresh weight) and some kaempferol (7 mg/100 g fresh weight) (ZHENG AND WANG, 2001; JUSTESEN AND KNUTHSEN 2001).

The aim of the present study is to identify the chemical graphical fingerprints of parsley, dill, and lovage leafs by using the dehydration process, to establish their trace metal content and to find the best methods for preserving them.

MATERIAL AND METHODS

Samples collection and preparation

Parsley, dill and lovage leaves were harvested in Timisoara (Timis county, Romania), from a few house gardens. All samples were separated and rinsed in distilled water to wash off potential impurities. Next, about 5 grams of each sample were used for determining water content using thermo-gravimetric method. The rest of the samples were rinsed again in distilled water to wash off dust and potential air pollutants. Then, the leaf samples were oven dried at 105°C to constant weight. The dried samples were crushed with a mortar (Isolab SL-1372) and stored at room temperature (t = 22°C) before analysis. The trace metal content in vegetable leaves was carried out in HNO_3 solution resulted from leaves ash digestion (LACATUSU, 2008). Each sample solution was prepared with diluted HNO_3 (0.5N) and analyzed by flame atomic absorption spectrometry (FAAS). All analyses were performed in our laboratory (Food Analysis Research Test Laboratory, Banat`s University of Agricultural Sciences and Veterinary Medicine from Timisoara, Romania)

Reagents and solutions

Double distilled water (spectroscopic pure) was used for the preparation of reagents and standards. All chemicals were trace metal grade (Suprapur). The concentrated nitric acid (65%, ρ = 1.39 g/cm^3) was purchased from Merck KGaA (Darmstadt, Germany) and used to prepare the digestion solutions (0.5 N HNO_3).

Statistical analysis

The data were analyzed using two specialized statistical packages: MVSP 3.1 and PAST 2.14 (HAMMER ET AL., 2001).

RESULTS AND DISCUSSIONS

Moisture content (%) was determined using Sartorius semi-micro analytical thermo balance. This analytical balance allows monitoring of the dehydration process by continuous weighing during the evolution process. The measuring accuracy is 0.1% for samples with a mass greater than > 1g and 0.02% for those larger than 5g.

Both moisture and trace metal content (copper, zinc, manganese, iron, cobalt, chromium, cadmium, nickel and lead) were taken into account to identify chemical and graphical fingerprinting. This task was achieved by using FAAS method and statistical analysis programs, i.e. MVSP 3.1 and PAST 2.14.

The dehydration process is presented in *Figure 1*.

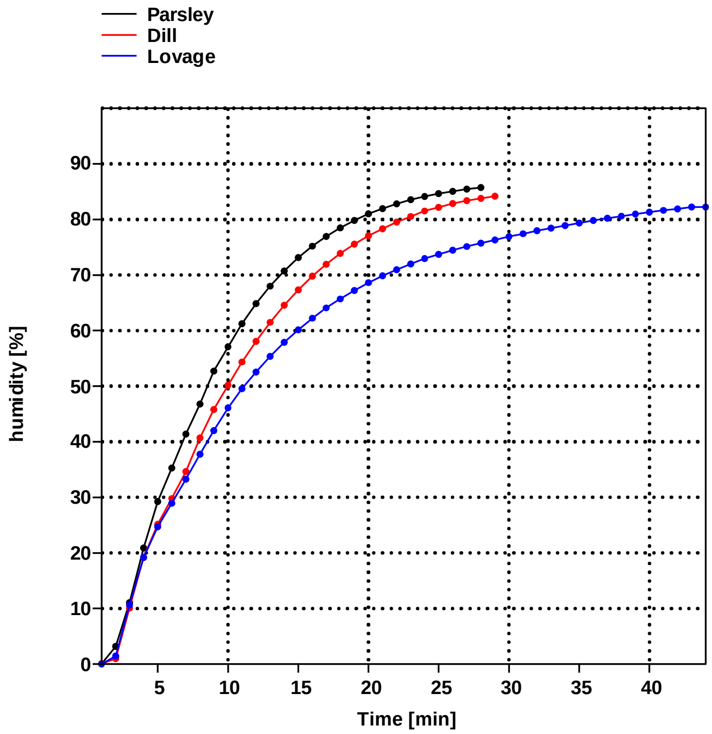

Figure 1. Moisture dehydration process.

The detected moisture contents are 85.73% for parsley, 84.16 % for dill and 82.23 % for lovage. These results are in accordance with USDA National Nutrient Standard Reference Database (USDA, 2006) values, which reveal for parsley 87.71 g water/100 g edible portion and for dill 85.95 g water/100 g edible portion.

The moisture graphical fingerprints are presented in *Figure 2*. It can be seen that parsley is much better preserved by drying method (continuous function - a) than by freezing procedure (multivariable linear function - b). In contrast, it is advisable to preserve dill by freezing procedure (multivariable linear function - b), whereas lovage can only be preserved in salt (long time dehydration process – 43 minutes for 5 g leaves).

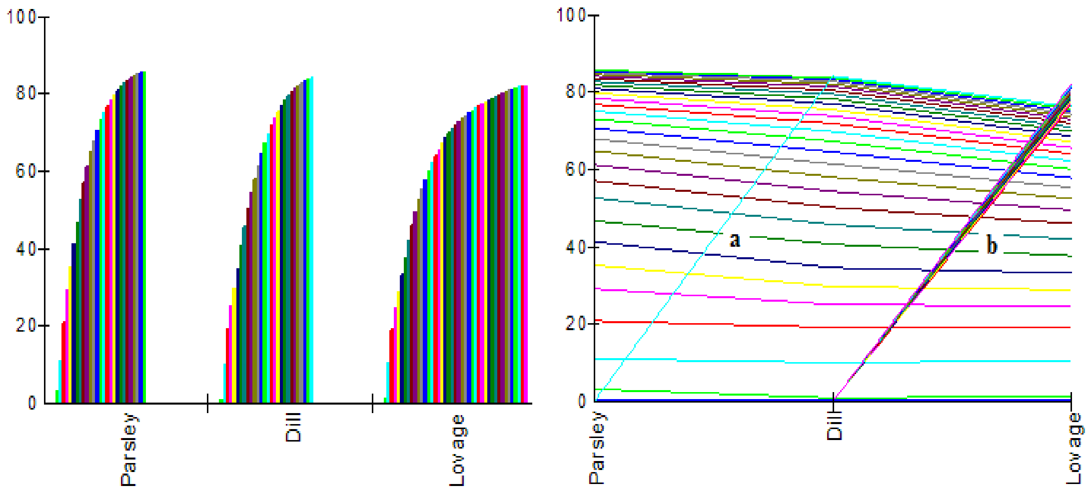

Figure 2. Moisture Graphical Fingerprint of Parsley, Dill and Lovage.

The mineral composition of samples (mg kg^{-1} fresh matter) is shown in *Figure 3*. Each value in the graphics is an average of 3 replicates. The levels of studied metals are within the normal concentrations and did not pose any threat to human health. Cobalt, chromium and cadmium are not represented in the graphical figures (see *Figure 3*) because their levels were not detectable.

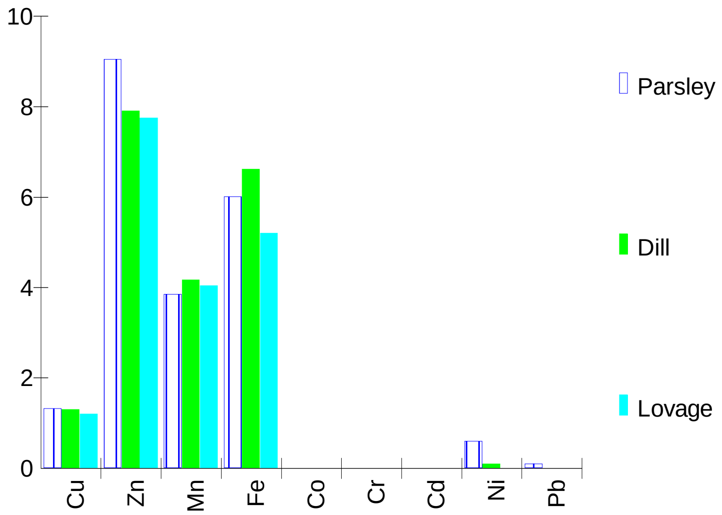

Figure 3. Trace metals composition of Parsley, Dill and Lovage leaves.

The trace metals values for parsley are in accordance to USDA National Nutrient Standard Reference Database (USDA, 2006) - 0.149 mg Cu, 1.07 mg Zn, 0.160 mg Mn, 6.2 mg Fe/100 g edible portions. According to USDA (2006) dill contains 0.146 mg Cu, 0.91 mg Zn, 55 mg Mn and 6.59 mg Fe/100 g edible portions. Our results did not exceed the safe limits of trace metals in leafy vegetables (mg kg^{-1}) as established by FAO/WHO: Cu - 40.00, Pb - 5.00, Cd - 0.30 (CODEX ALIMENTARIUS COMMISSION, 1995).

Figure 4 presents the area representation of trace metals distribution which is permitting to obtain the trace metals fingerprints of the studied samples.

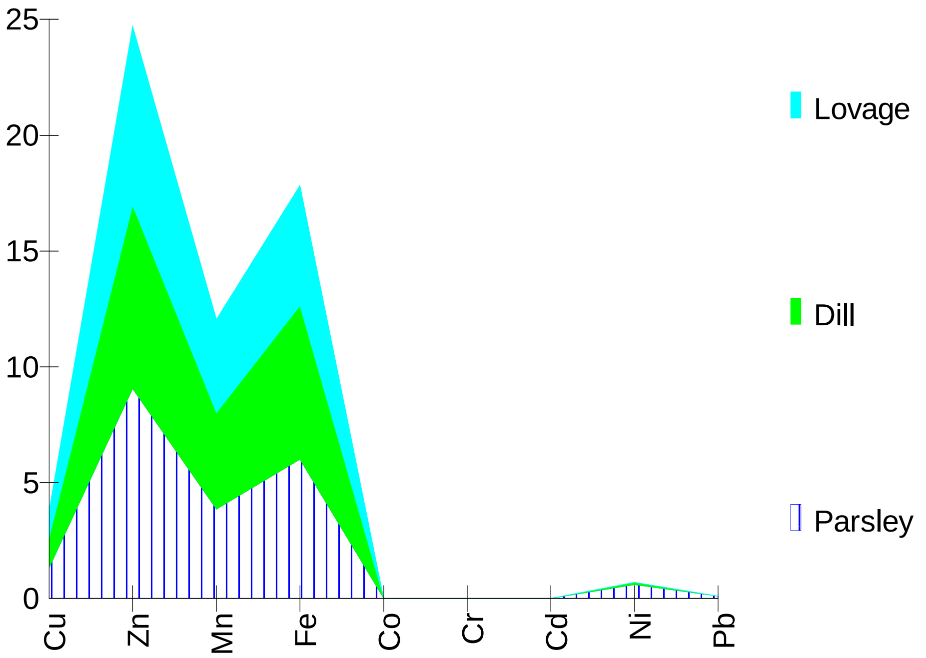

Figure 4. Trace metal Fingerprint of Parsley, Dill and Lovage samples.

CONCLUSIONS

The moisture contents - 85.73% for parsley, 84.16 % for dill and 82.23 % for lovage, are in accordance with the USDA National Nutrient Standard Reference Database values (USDA, 2006). Our results provide new information about lovage and complement data that are missing in the USDA database. A plant chemical fingerprinting requires the determination of a large number of elements but using adequate models we can obtain the needed graphical chemical fingerprints. Such information is extremely valuable for food processing industries because it reduces the amount of work, i.e. less chemical analysis. The moisture graphical fingerprints can be used to identify the best preservation methods for leafy vegetables.

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