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Moisture content as a marker for fruits, nut fruits and vegetables fingerprint

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Abstract

Fruits and vegetables are important for the diet, because of the high nutritional value, varied colors, flavors and textures that they contribute with. Dehydration or drying of food using thermo-balance is a method that involves the removal of moisture in the presence of temperature. Fingerprinting is a technique widely used for quality control and differentiation of food products. Therefore, thermogravimetric and statistical analysis were employed to reveal the variation of dehydration profiles of the studied samples. Based on the obtained results walnuts might be used with any of the studied products while carrot pulp is recommended to be used with chestnuts.

Keywords: quince, carrot, walnut, chestnut, dehydration curves

1. Introduction

Fruits and vegetables are an important component of human diet. The use of the terms fruits, nuts and vegetables are questioned by many debates, but it depends on whether it's speaking from a botanical or a culinary point of view.Fruits and vegetables are important for the diet, because of the high nutritional value, varied colors, flavors and textures that they contribute with. A report published by WHO/FAO recommends 400g of fruit and vegetables, as a minimum daily intake for the prevention of chronic diseases and micronutrient deficiencies alleviation [1].

Quince (*Cydonia oblonga*) member of the *Rosaceae* family is well known for its pleasant characteristic smell and its distinctive taste. But as it is the case with other fruits, it is perishable; therefore, drying is very advantageous, reducing water activity of the material, thus reducing microbiological activity up to the point of preventing deterioration [2, 3].

Nuts are a key source of nutrients for the natural world, since nuts generally are a highly regarded energy supplier.When comparing the nutritional value of walnuts (*Juglans regia*) versus European chestnuts (*Castanea sativa*), chestnuts present fewer calories (213 Cal/100g) which rank them lower than walnuts (654 calories). Walnuts offer approximately ten times more minerals,total saturated fats (Bad Fats)and monounsaturatedfat (Good Fats), while chestnuts are remarkable due to their high content of carbohydrates, and water content [4].

The carrot (*Daucus carota*) is an important vegetable that has a high utility and nutritional value. The carrot belongs to the *Umbelliferae* family, genus *Daucus*, species *Carota*, and is one of the root vegetables that are cultivated in the entire world for its edible fleshy pulp. Being a cold season root vegetable, it is cultivated extensively in various countries and particularly during winter in tropical regions [5]. Many applications can be found in day to day usage such as extracting carrot juice,

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powdered carrot, carrot flavored sweets, soups, carrot flakes used in stews, etc.[6, 7].

Drying is one of the most relevant and challenging operations, considering a large number of food products undergo at least one drying operation over the course of the entire production process. Dehydration or drying of food is described as a procedure that involves the removal of volatile substances in the presence of temperature with the goal of obtaining a dried solid [5].

Mathematical models are mathematical constructions based on real phenomena created to resemble the behavior of analyzed samples [8].

Chemical fingerprint is a unique pattern indicating particularities (molecules, elements, structures etc), based on specialized analytic techniques.The graphical representations help to visualize the model profile and/or fingerprints of the analyzed samples.

2. Materials and Methods

2.1. Sample collection and preparation

Carrot, quince, chestnuts and walnuts samples were acquired from the local farmers market. The samples were prepared, rinsed under water to remove dirt and other impurities. Following this, 1 gram of each part (skin, pulp and leaves) ofboth carrot and quince and the same amount of walnut and chestnut kernelwere collected and used for moisture content determination.

2.2.Thermo-gravimetric analysis

The moisture content was determined using the thermo-gravimetric method, aided by a Sartorius scale MA-50 at 105ºC, as described by Bordean et al, 2011 [9].

2.3.Statistical analysis and mathematical modeling

The analysis of data was performed using two statistical programs: MVSP, version 3.22 and PAST version 2.17.

3. Results and Discussions

The knowledge regarding moisture content is very important to food scientists because it helps to predict the behavior of foods during processing, considering that texture, taste, and the stability of different foods depend on theamount ofwater they contain [10]. Thermogravimetric method is a simple method to determine water content in vegetables and fruits and not only.

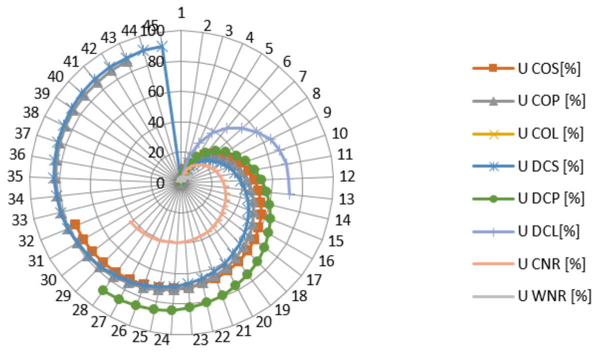

Figure 1. Representation of samples dehydration curves

Legend: U COS[%] = moisture content of quince peel; U COP [%] = moisture content of quince pulp; U COL [%] = moisture content of quince leaf; U DCS [%] = moisture content of carrot peel; U DCP [%] = moisture content of carrot pulp; U DCL[%] = moisture content of carrot leaf; U CNR [%] = moisture content of chestnut kernel; U WNR [%] = moisture content of walnut kernel

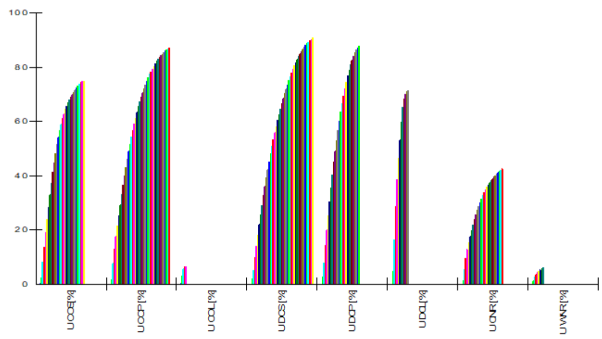

Figure 2. Profiles of samples dehydration in time

Legend:U COS[%] = moisture content of quince peel; U COP [%] = moisture content of quince pulp; U COL [%] = moisture content of quince leaf; U DCS [%] = moisture content of carrot peel; U DCP [%] = moisture content of carrot pulp; U DCL[%] = moisture content of carrot leaf; U CNR [%] = moisture content of chestnut kernel; U WNR [%] = moisture content of walnut kernel.

Figure 1 presents the dehydration curves of carrots, quince, chestnuts and walnuts samples. As we can observe the highest content of moisture is visible in carrot peel (90,74 %) followed by carrot pulp (87,80 %), quince pulp (87,04 %), quince peel (74,91 %), carrot leaf (71,43 %), chestnut kernel(42,46 %), quince leaf (6,49 %) and walnut kernel (6,05 %). The dehydration time is varying from 6 to 46 minutes for the mentioned samples.

Each minute is registered the dehydration process at a temperature of 105 ºC and the evaporated water is quantified. The profiles of each sample based on the quantity of water evaporated during the dehydration process is presented in figure 2. The samples present more or less similar pattern.

By modelling the data were obtained the profiles of the dehydration phenomenon at the temperature of 105 ºC for all the samples.Principal component analysis (PCA) was performed using standardized data and is presented in figure 3.

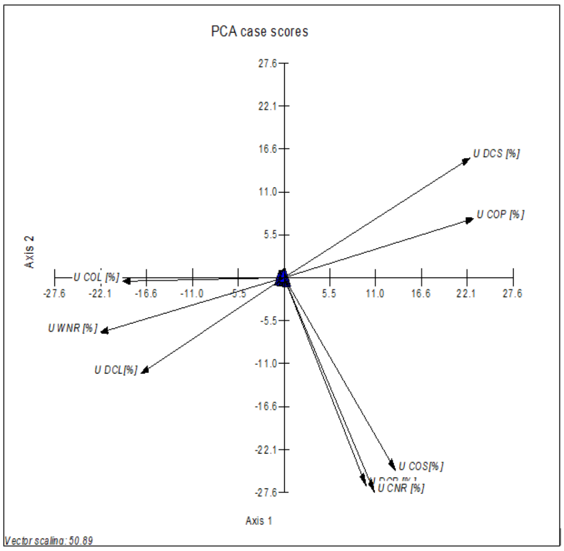

Figure 3. PCA data biplot representation

Legend:U COS[%] = moisture content of quince peel; U COP [%] = moisture content of quince pulp; U COL [%] = moisture content of quince leaf; U DCS [%] = moisture content of carrot peel; U DCP [%] = moisture content of carrot pulp; U DCL[%] = moisture content of carrot leaf; U CNR [%] = moisture content of chestnut kernel; U WNR [%] = moisture content of walnut kernel.

The biplot representation of data is grouping UDCS with UCOP (first quarter), UCOL with UWNR and UDCL (third quarter) and UCOS, UCNR and UDCP (fourth quarter). The groups are visible because PCA captures the variation that exists in the compound data. This information is of importance in choosing the materials to create new food products due to the fact that it is indicating what components might be used in combination to obtain food with similar properties, but using different raw materials.

Figure 4 presents the fingerprint of the analyzed fruit and vegetables samples using as marker moisture content.The biplot (figure 3) and fingerprint (figure 4) are helpful in interpreting relationships between the analyzed samples offering information about the potential of samples to create innovative food products.

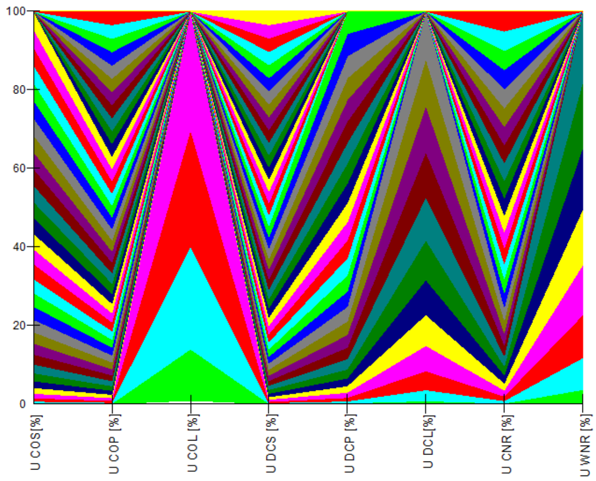

Figure 4. Fingerprint of samples based on moisture content

Legend:U COS[%] = moisture content of quince peel; U COP [%] = moisture content of quince pulp; U COL [%] = moisture content of quince leaf; U DCS [%] = moisture content of carrot peel; U DCP [%] = moisture content of carrot pulp; U DCL[%] = moisture content of carrot leaf; U CNR [%] = moisture content of chestnut kernel; U WNR [%] = moisture content of walnut kernel.

4. Conclusion

Determination of moisture content is very important for food scientists because it helps to predict the behavior of foods during processing and to identify new ways to create innovative, healthy and nutritious food products.

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Compliance with Ethics Requirements. Authors declare that they respect the journal’s ethics requirements. Authors declare that they have no conflict of interest and all procedures involving human / or animal subjects (if exist) respect the specific regulation and standards.

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