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ECOTOXICOLOGICAL ASSESSMENT OF SOME ORANGE JUICES MARKETED IN ROMANIA

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ABSTRACT

This paper presents a comparative ecotoxicological study, performed on several orange juices sold in Romania and on a freshly orange juice prepared from the fruit. For each juice sample, quality parameters such as pH, carbohydrate content, dry matter and humidity were analyzed. The presence of the food additive ascorbic acid (vitamin C) was also studied. The obtained results revealed the similarities and differences between the natural juice and the studied commercial juices.

KEYWORDS: commercial orange juice, fresh orange juice, vitamin C, glucides

1. Introduction

Ecotoxicology is the frontier science between ecology and toxicology and studies the effect of toxic substances on ecological systems. Human can be seen as an element of ecological systems and not isolated from them, because there are organic relationships between man and his living environment [2]. Therefore, this paper presents an ecotoxicological study on the effect of commercial orange juices on human health. Orange juice is the most popular fruit juice worldwide for its nutritional content, attractive color and refreshing sweet and sour taste, but also for its biologically active compounds, such as Vitamin C [11]. This juice has been shown to be effective in neutralizing free radicals [8] and to reduce the oxidative effects of DNA in blood cells [3].

Preservation of this juice and other foods can be done at low temperature, but only for a short time. To prolong shelf life, chemical preservatives for food are used in the manufacture of bottled orange juices [4], although excessive consumption of these chemical preservatives can be dangerous to human health [10]. Also, artificial colors and synthetic sweeteners are added to commercial juice, in addition to natural fruit juice, to make it more attractive, tastier. Some of the additives are beneficial for health and others are dangerous [1]. In this paper, a comparative study was conducted between a freshly prepared orange juice from fruits (which is generically called "fresh") and two distinct brands of juices that are sold in the form of pulp juices. For an overview of the composition of the 3 types of studied juices, the presence of added sweeteners (sugar content), vitamin C content (and implicily the Ascorbic acid additive in commercial juices), humidity, dry matter and pH, were analyzed.
The choice for the study of these parameters is justified by their effects on the organism. Vitamin C is the most important water-soluble antioxidant nutrient and contributes greatly to the antioxidant defense against the oxidative stress. Chemically, Vitamin C is the Ascorbic Acid. Vitamin C is the most common vitamin in nature. It forms a redox system with dehydroascorbic acid, which regulates the non-enzymatic transport of hydrogen [5]. Avitaminosis leads to gingivitis, anemia, scurvy [9]. However, the stability of Vitamin C in fruits and vegetables is related to the degree of exposure to oxygen and storage temperature, and a long storage time, at a high temperature, have a negative impact on this vitamin [14]. Another parameter studied is represented by the carbohydrates (glucides) added in industrialized products, such as sweeteners or sugars. Refined (or processed) sugar provides a quick and easy source of energy, but does not contain other nutrients, such as vitamins and minerals [6].

Consumption of sugary drinks, especially soft drinks, can be a key contributor to the epidemic of overweight and obesity, due to its high sugar content, low satiety and incomplete compensation for total energy [7].

Fig. 1 Preparation of the natural orange juice (SN)

Fig. 2 Label of the commercial juice SC1

Fig. 3 Label of the commercial juice SC2

2. Materials and working methods

The orange juices that are the subject of this study are: freshly prepared natural orange juice, marked with SN, prepared by grinding (fig. 1) and two commercial juices, marked with SC1 and SC2, whose composition is shown in the labels in fig. 2 and fig. 3. The quality parameters and the food additives studied in the composition of orange juices are:

- pH, by electrometric method (fig. 4);
- glucide content, by refractometric method (fig. 5);
- dry matter content and humidity, by gravimetric method (fig. 6);
- Vitamin C content, by volumetric oxidation-reduction method, by prior preparation of an extract with HCl (fig. 7), and determination in the presence of KI 2% and starch as indicator, followed by titration with KIO_3 n/250 until the color turns blue (fig. 8);

Fig. 4 Determination of pH in the studied juices

Fig. 5 Determination of glucides in the studied orange juices

3. Results and discussions

The results after determining the pH values for the 3 samples of orange juice are shown in the diagram in fig. 10. Due to the presence of organic acid, naturally, orange juices are usually acidic.

The pH values of commercial juices are slightly lower than the pH of natural SN juice (3.80 pH units), i.e. 3.60 pH units for commercial juice 1 (SC1) and 3.55 pH units for commercial juice 2 (SC2).

The more acidic pH recorded in commercial juices may be due to the presence of added acidic additives, which the case of high consumption, can cause stomach acidity and erosion of tooth enamel [12]. The dry matter content, respectively the humidity of the three samples, are shown in fig. 10 and fig. 11. The higher values obtained for the dry matter, recorded in the case of natural juice, are due to the pulp of the fruit found in freshly prepared natural juice and the more aqueous consistency of the commercial juices. On the other hand, in order to be able to market orange juice in countries where this fruit cannot be grown, the juice is usually converted into concentrate immediately after the fruit has been harvested. In this way, the juice is reduced to 1/6 of the original volume, which facilitates its transport to factories around the world where water is added again, before the juice is marketed [13].

Figure 12 shows the glucide content of orange juices. The lower glucide content of fresh juice (8.2 ^{0}Brix, which means 8.2 g glucides/100 ml of juice) can be observed compared to commercial juices, where the higher values of 9.2 ^{0}Brix (SC1) and 10.1 ^{0}Brix (SC2) may be due to synthetic sweeteners, which are usually added to improve the taste and make the juice more attractive [1].

Fig. 6 Determination of humidity and dry matter, before (left) and after evaporation in the oven (right)

Fig. 7 Preparation of the extract from juices for the determination of Vitamin C

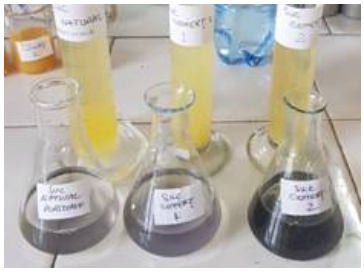

Fig. 8 Determination of the Vitamin C content in the studied orange juices

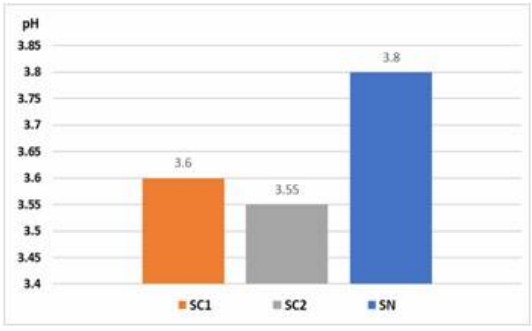

Fig. 9 pH values of the studied orange juices

However, the harmful effect of sugar and added sweeteners should be mentioned, as they can cause obesity to consumers, in case of a regular and a prolonged consumption [7].

The values of the Vitamin C content are shown in Figure 13. Fresh natural juice (SN) has a content of 0.096% Vitamin C, compared to the lower content of commercial juices, namely 0.064% in the case of SC1 and 0.080% in the case of SC2. Oranges, like other citrus fruits, are an excellent source of vitamin C for the body.

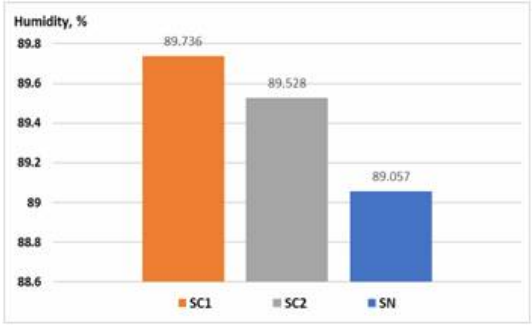

Fig. 10 Humidity content of the studied juices

Among the main benefits of Vitamin C, it should be mentioned its strong natural antioxidant character, which increases the resistance of the body to infections and eliminates proinflammatory free radicals from the blood [9]. The reduced differences in Vitamin C content, recorded for the three orange juices studied, can be explained by the addition of ascorbic acid in commercial juices. This additive is added due to the benefits for the body of the Vitamin C, due to the antioxidant character that helps prevent the oxidation of juices and also due to the possibility of storing them on the shelf for longer.

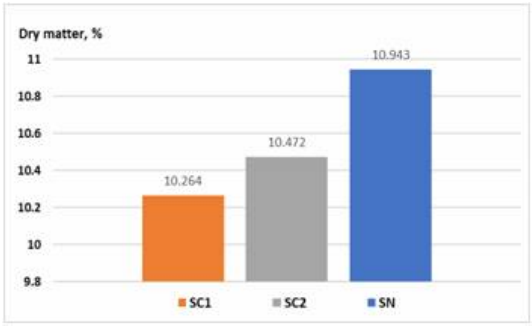

Fig. 11 Dry matter content of the studied juices

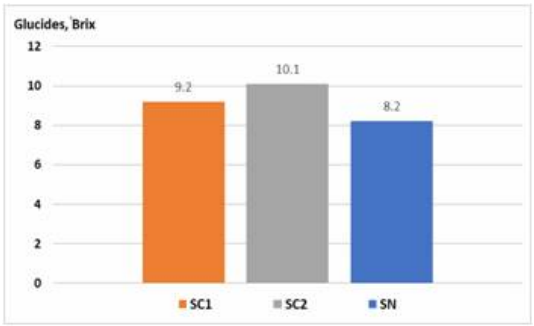

Fig. 12 The glucides content in the studied juices

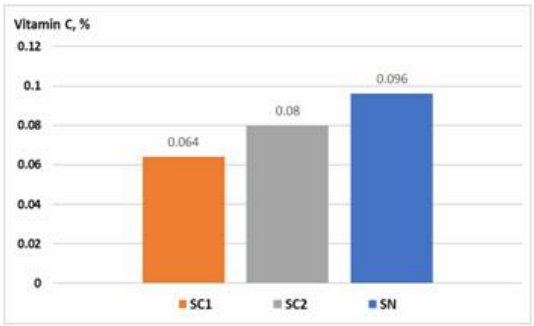

Fig. 13 The vitamin C content in the studied juices

4. Conclusions

1. In this paper, an ecotoxicological study of some orange juices sold in Romania was performed. A number of quality parameters were determined such as: pH, humidity and dry matter, glucide and the Vitamin C content;
2. After the pH analysis, it was observed that all three samples have an acidic pH, in the case of

commercial orange juices the values being lower, of 3.60 upH (SC1) and 3.55 upH (SC2), which may be due the presence of acid additives in these juices;

3. The dry matter content showed higher values in the case of natural juice, as it contains the total amount of pulp of the fruit. The value recorded for freshly prepared juice was of 10.94%, and for commercial juices SC1 and SC2 the values of 10.47% and of 10.26%, respectively, were obtained. The differences are small because the commercial juices also have a certain fruit pulp content, according to the information given by the producer;
4. Regarding the presence of glucides in the studied orange juices, a lower content was observed in the fresh juice (8.2 g glucides/100 ml juice) compared to the commercial juices, where the values were higher, of 9.2 g glucides/100 ml juice (SC1) and of 10.1 g glucides/100 ml juice (SC2). These values may be due to synthetic sweeteners, which are usually added to improve the taste and make commercial juices more attractive.
5. The fresh natural juice (SN) had a content of 0.096% Vitamin C, compared to the lower content of the commercial juices, of 0.064% in the case of SC1 and of 0.080% in the case of SC2. The reduced differences in Vitamin C content, recorded for the three studied orange juices (natural juice has only 0.032% more vitamin C than SC1 and 0.016% more than SC2), can be explained by the addition of the Ascorbic Acid in the commercial juices. This additive is added both due to the benefits for the body of Vitamin C, due to the antioxidant character that helps prevent the oxidation of juices and also due to the possibility of storing them on the shelf for longer.
6. From the nutritional point of view, the studied juices are comparable, so that any of them can be recommended for consumption. However, a number of food additives, mainly preservatives and antioxidants, are added into the commercial juices (according to the labels). Although these additives are in acceptable doses and are permitted by the World Health Organization and governments, in the case of a frequent and prolonged consumption, they may cause side effects. Therefore, from the ecotoxicological point of view and in the benefit of human health, it is always recommended to choose the natural juice at the expense of the commercial ones.

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