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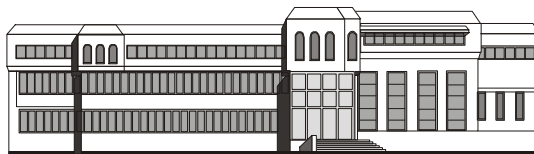
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ORGANISER AND PUBLISHER

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Cara Dušana 34, 32000 Čačak
e-mail: afdekanat@kg.ac.rs
www.kg.ac.rs



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2. University of Belgrade, Faculty of Agriculture, Belgrade, Serbia;
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20. University Goce Delcev, Faculty of agriculture, Štip, North Macedonia;
21. University of Montenegro, Biotechnical faculty Podgorica, Podgorica, Montenegro.

Food additives in fruit juices and carbonated soft drinks

Students: Stefani Matevska, Sara Dolevska, Sara Dimevska

IIIrd Year, Bachelor Study

Mentor: Prof. Dr Mila Arapcheska

University "St. Kliment Ohridski" - Bitola; Faculty of Biotechnical Sciences, Partizanska bb, Bitola 700, Republic of North Macedonia,

e-mail: stefani_dh@live.com

Abstract: Juices are drinks made from the extraction or pressing of the natural liquid contained in fruit and vegetables. It can also refer to liquids that are flavored with concentrate or other food sources. Additives are substances that are not normally consumed as food and are not normally used as a characteristic food ingredient, whether it has or is not a nutritional value and which is deliberately added to the food for technological purposes. The purpose of this research was to make an overview of the presence of additives in fruit juices and carbonated soft drinks. In this research, were included 48 products grouped into four groups: carbonated juices, nectars, drinks and juices. The data of the additives used for the production of juices were obtained from the declarations of the products. The obtained results of this research have shown that most of additives are present in carbonated juices compared with other groups of juices. Most of additives used for production of juices are according national role for food safety, and are safe for human health.

Key words: additives, fruit juices, carbonated soft drinks, food safety

Introduction

Juices are drinks made from extraction of a natural fluid contained in fruits and vegetables. It may also refer to liquids that are flavored with concentrate or other food sources. Juice is usually consumed as a drink or used as an ingredient or aroma for other beverages such as smoothies. Juice appeared as a popular choice for drinks since the development of pasteurization methods allowed its preservation without the use of fermentation (used in wine production), (Ward 2011).

According raw material and technology of production fruit juices can be: clear (with a higher percentage of water) and dense (with a smaller percentage of

water). Non-carbonated juices are usually fruit juices, and carbonated juices contain industrially added carbon dioxide. During technology of production of carbonated juices, usually are added additives for color and flavor.

According EU legislation the only ingredients allowed for fruit juices and concentrated fruit juices are vitamins, minerals, pulp and lemon juice. In however, there are no added sugars, no dyes, no preservatives (Journal Officiel de l'Union européenne, 2012).

Additives are substances that are not normally consumed as food and are not characteristic food ingredient, despite if they have or not have nutritional value. They are intentionally added to the food for technological purposes in the production, processing, preparation, packaging, transport or storage of food, and can reasonably be expected to be present in it (Rulebook on additives used in food production, Official Gazette RNM, No. 31/2012).

Additives can be grouped into: natural additives, additives of plant origin, additives of animal origin, mineral additives and artificial / synthetic additives.

Additives are added for many purposes such as changing the appearance (colors), changing the taste (sweeteners, flavors), preservatives - which extend the shelf life, emulsifiers, gelling agents, antioxidants, vitamins, minerals, fatty acids and other supplements.

There are a lot of additives that are present in the juices. Each of them has its purpose for which it is added and the effects of their addition can be different.

Material and methods

The main objective of this research was to make an overview of the presence of additives in fruit juices and carbonated soft drinks.

In this research, were included 48 products present on the local markets. According raw material and technology used for their production, samples were grouped into four groups: carbonated juices, nectars, drinks and juices. The data of the additives used for the production of analyzed samples juices were obtained from the declarations of the products.

Results and discussion

A food additive is any substance added to food primarily for preservation purposes and the consumer demands for a variety of safe and tasty, convenient and colorful foods. Additives and preservatives have been used for a very long time and contributed significantly to product development by the food industry.

Other roles include imparting desired color, odor or a specific flavor to food. Food additives may have a natural origin in the sense that they may be found existing naturally forming part of the indigenous components of the food, or they

may be synthetic replicas of substances found naturally in foodstuffs. They may also be entirely artificial, which implies that they are synthetically produced and are not copies of any compounds found in nature. There are a number of additives and preservatives commonly used in foods including antioxidants, acids, acid regulators and salts, emulsifiers, coloring agents, minerals and vitamins, stabilizers, thickeners, gelling agents, sweeteners and preservatives. These different food additives play different roles in foods depending on their intended purpose. For instance, emulsifiers tend to give food a good texture as well as good homogeneity such that they make it possible for immiscible items such as water and oils to mix well without any separation (Suman et al. 2009).

Stabilizers, thickeners and gelling agents provide strong texture and smoothness as well as an increase in viscosity (Quemener et al. 2000). Sweeteners are important as flavors, although there are other types of sweetener flavors which perform an important function in the diets of consumers with health problems such as diabetes (Hutteau et al. 1998). Nutritive additives such as minerals, vitamins, essential amino acids, etc., are added to particular food products where they are missing (Nayak and Nair 2003) or in food stuffs specifically intended for specific group, for example milk for babies (Ikem et al. 2002). Other additives such as antioxidants are needed for the prevention of fat and oil rancidity in baked foods by inhibiting the effects of oxygen on foods and also preventing the loss of flavor, there by maintaining food palatability and wholesomeness. Acids and acidic regulators such as citric acid, vinegar and lactic acid are food additives for control of food pH (levels of acidity or alkalinity) and they play an important role in the sharpening of flavors (Populinetal.2007), as preservative (Brul and Coote, 1999) and as antioxidants. Some acids and acid regulators tend to release acids only when they are subjected to a heat treatment such as with some bakery products (e.g. acids produced by the leavening agents react with baking soda to make the bakery products rise during the baking process). Coloring and color retention agents are added to foods to appease the eye of the consumer or beholder. They are also intended to maintain the color of food in cases where it may fade (MacDougall, 1999). Generally speaking, the desire for a particular quality of food has resulted in the introduction of numerous additives with wide applications in different cultures and civilizations. Currently, many different types of food additives have been commercialized and are finding their way on to the markets worldwide (Baker, 2010).

Apart from thermal pasteurization, some chemical preservatives are also widely used for the extension of the shelf-life of fruit juices and beverages. Two of the most commonly used preservatives are potassium sorbate and sodium benzoate. However, consumer demand for natural origin, safe and environmental friendly food preservatives has been increasing since 1990s. Natural

antimicrobials such as bacteriocins, organic acids, essential oils and phenolic compounds have shown considerable promise for use in some food product (Rupasinghe and Yu, 2012)

In general, additives are added for many purposes such as changing the appearance (colors), changing the taste (sweeteners, flavors), preservatives - which extend the shelf life, emulsifiers, gelling agents, antioxidants, vitamins, minerals, fatty acids and other supplements.

The food industry use a wide range of products. In this research were included 48 products grouped in: carbonated juices (n=14), nectars (n=10), concentrated fruit juices (n=9) and soft drinks (n=15) (Figure 1).

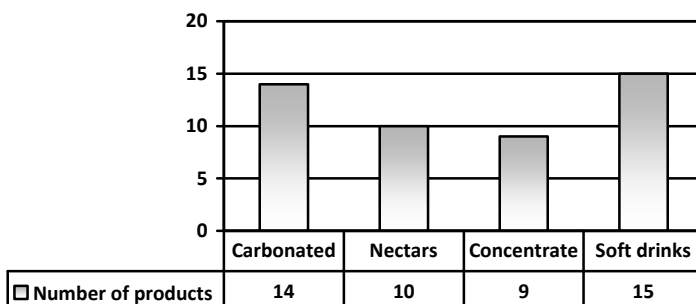


Figure 1. Distribution of products by categories

Non-thermal processing is a promising and useful approach for fruit juice and beverage preservation. The products based on these techniques show many advantages such as the retention of sensorial qualities and nutritional values over traditional thermal processing. However, among these non-thermal techniques, only high pressure processing has been adopted by the food industry so far.

Similarly, the application of natural antimicrobial compounds in fruit juice and beverages is in the laboratory scale. But the potential benefits of these compounds would lead to a fast growth of scale-up and commercial application in food industry.

More practically, the combination of non-thermal techniques and natural antimicrobial compounds would be the future trends for fruit juice and beverages preservation, due to the proven records for effective inhibition of microorganisms and shelf-life extension of fruit juices and beverages (D'Amico et al., 2006)

The additives declared on analyzed samples of beverages are presented in Table 1.

Table 1. Declared additives in the analyzed samples

| Product group | Additives |
|---------------------------|--|
| Carbonated juices | Carbon dioxide Colors: E150d, E 160a acidity regulators: E296, E 330, E331, E 338 |
| Carbonated juices | sweeteners: E 950 E 951, E 952 preservative: E 202, E211 antioxidants: E 300 stabilizers: E 412, E 445, E 1450 thickener: E414 moisture retainer: E422 aromas (caffeine, quinine, lemon aroma, orange , and natural aromas) extracts (from citrus fruits, orange extract) |
| Nectars | vitamins C and E acidity regulators E330 antioxidant E 300 stabilizers: E 412, E414, E440 (a) aroma: raspberry colors: E160 (a) extracts (herbal extracts from hibiscus and black carrots and plant extract of hibiscus) |
| Concentrated fruit juices | Without the addition of sugars, without preservatives, without additives, contains natural sugars from the fruit itself. |
| Drinks | stabilizers: E440 (a), E466, E415, E414, E 445 colors: E 160a, E100, E150c acidity regulators: E304, E331, E 330, E414 vitamins: vitamin E and vitamin A sweetener: sucralose antioxidants: E 300, E 445 |

According to the performed researches and the obtained results, the presence of the following additives in the carbonated juices are determined: industrial added **carbon dioxide**, **colors** E150d (*Sulphite ammonia caramel*) and E 160a (*Alpha-carotene, Beta-carotene, Gamma-carotene*), **acidity regulators**: E296 (*Malic acid*), E 330 (*Citric Acid*), E331 (*Sodium Citrate*), E 338 (*Phosphoric acid*), **sweeteners**: E 950 *Acesulfame K*, E 951 *Aspartame*, E 952 *Cyclamic acid and its Na and Ca salts*, **preservative**: E 202 *Potassium Sorbate*, E211 *Sodium Benzoate*, **antioxidants**: E 300 *L-Ascorbic Acid (Vitamin C)*, **stabilizers**: E 412 *Guar Gum (Cluster Bean Gum)*, E 445 *Glycerol esters of wood rosins*, E 1450 *Starch sodium octenyl succinate*, **thickener**: E414 *Acacia (Gum Arabic)*, and **moisture retainer**: E422 *Glycerol*. Also, in this group were identified **aromas**

(caffeine, quinine, lemon aroma, orange , and natural aromas), **extracts** (from citrus fruits, orange extract).

In nectars were represented **vitamins** especially vitamin C and vitamin E, **acidity regulators** E330 (citric acid), **antioxidant** E 300 *L-Ascorbic Acid*, **stabilizers**: E 412 *Guar Gum*, E414 *Acacia (Gum Arabic)* E440 (a) *Pectin*, **aroma**: raspberry, **colors**: E160 (a) beta carotene and **extracts** (herbal extracts from hibiscus and black carrots and plant extract of hibiscus).

Concentrated fruit juices are without the addition of sugars, without preservatives, without additives. They contain natural sugar from the fruit itself.

Drinks contain **stabilizers**: E440 (a) *Pectin*, E466 *carboxymethylcellulose*, E415 *Xanthan Gum*, E414 *Acacia (Gum Arabic)*, E 445 *Glycerol esters of wood rosin*, **colors**: E 160a *Beta-carotene*, E100 *curcumine* and E150c - *Ammonia caramel*, **acidity regulators**: E304 *ascorbyl palmitate*, - E331- *Sodium citrate*, E 330 (*Citric Acid*), E414 *Acacia (Gum Arabic)* , E 445 *Glycerol esters of wood rosins*, **sweetener**: sucralose, **antioxidants**: E 300 *L-Ascorbic Acid*, and *Tocopherol* (vitamin E) and vitamin A.

In general, performed research have shown that analyzed samples of beverages contained: sweeteners, colors, preservatives, acids and substances that increase acidity of the products, emulsifiers, stabilizers, thickener, moisture retainer, aromas, extracts and vitamins.

Sweeteners are substances that are used to give a sweet taste of food or table sweeteners. Colors are substances that add or refresh the color of food and include natural food ingredients and natural sources that are not usually consumed as food and are not used as characteristic food ingredients. Colors are preparations derived from foods or other nutrients made from physical or chemical extraction resulting in selective extraction of pigments in relation to nutrients or aromatic constituents.

Preservatives are substances that extend the shelf life of the food through protection against spoilage caused by microorganisms and / or protection against the growth of pathogenic microorganisms. Antioxidants are substances that prolong the shelf life of food and protect it from degradation caused by oxidation such as fatty acidity and color changes. Acids are substances that increase acidity of the products and / or add sour taste. Acidic regulators are substances that alter or control the acidity or alkalinity of the food product.

Emulsifiers are substances that allow the formation or maintenance of a homogeneous mixture of two or more immiscible phases in the product. Stabilizers are substances that enable maintenance of the physical and chemical state of the food product. These include those substances which allow the maintenance of homogeneous dispersion of two or more substances that can't be mixed in the foodstuff, substances to stabilize, maintain or intensify the existing color of the foodstuff and substances that increase the binding capacity of food.

According to obtained results the presence of most common used additives in analyzed samples beverages was different among groups.

Table 2. Presence of additives in different groups of analyzed products

| Additive | Carbonated juices (n=14) | Nectars (n=10) | Concentrated fruit juices (n=9) | Soft drinks (n=15) |
|--------------------------|---|---------------------------|--|-------------------------------|
| Carbon dioxide | 14 | 0 | 0 | 0 |
| Colors | 11 | 1 | 0 | 15 |
| Regulators of acidity | 14 | 9 | 0 | 1 |
| Aromas | 14 | 0 | 0 | 15 |
| Sweeteners | 2 | 0 | 0 | 1 |
| Stabilizers | 5 | 0 | 0 | 4 |
| Preservatives | 8 | 0 | 0 | 0 |
| Antioxidants | 6 | 1 | 0 | 6 |
| Thickeners | 2 | 0 | 0 | 0 |
| Moisture retainer | 1 | 0 | 0 | 0 |

Today, the frequently asked question is whether food additives are safe. It can be argued that additives are safe for human health due to the evaluation process being carried out at this time. Before setting the additives in use, they must pass the test procedure, followed by a recommendation on the quantity and method of use, and they must be toxicologically evaluated (tested). Additives would also not pose a risk to human health if they are used in quantum satis.

According to literature data toxicological and physiological effects of additives are monitored and evaluated so that there is a continuous monitoring of their effect on human health. Some of food additives such as colors, can cause allergic reactions, asthma while others are associated with serious health problems. defects. The national Rulebook for food safety (Official Gazette RNM, No. 31/2012) requires all ingredients to be listed on the food label, but additives are often listed as "spices" or "aromas" without specificity, which makes it impossible for consumers to know exactly what they are consuming. On the other hand according to literature data there are numerous additives that must be listed on the packaging, as they can cause serious health problems.

Conclusion

Juices provide energy and well-being. Some are full of vitamins and antioxidants, which slow down aging and inhibit the occurrence of various diseases.

Because of different raw materials and technology processes there are some differences between juices, nectars and drinks. There are several divisions of juices, one of which is division on fruit juices: clear (with a higher percentage of water) and dense (with a smaller percentage of water). Non-carbonated juices are usually concentrated fruit juices.

The concentrated juices contain 100% fruit part, while the nectars contain lower fruit part, and its content is determined by rulebook. The sugar or acidity regulators are not added in concentrated juices.

The addition of sugar and citric acid is allowed in nectars, and they are added for taste improvement. All nectars are enriched with vitamin C, and some with a complex of other vitamins.

Soft drinks have the lowest content of fruit compared to other juices, but they are great refreshments during the summer season. They can also be made from plant extracts other than fruit.

The obtained results of this research have shown that among analyzed samples, most of additives are present in carbonated juices. Most of additives used for production of juices are according national role for food safety, and are safe for human health.

Before setting the additives in use, they must pass the test procedure and they must be toxicologically evaluated, which is followed by a recommendation on the quantity and method of their use.

Despite the fact that food additives are extensively investigated before they are allowed to be added to foods, scientific investigation is known to have its own limitations, which may probably explain the continued reports of adverse effects on an individual basis. Also, additives would not pose a risk to human health if they are used in quantum satis.

References

- Baker S.R. (2010): Maximizing the use of food emulsifiers. MSc thesis, Kansas State University, Manhattan, Kansas, USA.
- Brul S., Coote P. (1999): Preservative agents in foods: Mode of action and microbial resistance mechanisms. *International Journal of Food Microbiology* 50: 1–17.
- Chemistry of Food Additives and Preservatives, First Edition. Titus A. M. Msagati. C 7 2013 John Wiley & Sons, Ltd. Published 2013 by John Wiley & Sons, Ltd.
- D'Amico D.J., Silk T.M., Wu J., Guo M. (2006): Inactivation of microorganisms in milk and apple cider treated with ultrasound. *J Food Prot*, 69(3): 556-563.
- Vasantha Rupasinghe P.H., Li Juan Yu Nova Scotia Agricultural College Canada Emerging Preservation Methods for Fruit Juices and Beverages.

- Hutteau F., Mathlouthi M., Portmad M.O., Kilcast D. (1998): Physicochemical and psychophysical characteristics of binary mixtures of bulk and intense sweeteners. *Food Chemistry*, 63(1): 9–16.
- Ikem A. Nwankwoala A., Odueyungbo S., Nyavor K., Egiebor N. (2002): Levels of 26 elements in infant formula from USA, UK, and Nigeria by microwave digestion and ICP–OES. *Food Chemistry*, 77: 439–447.
- Kregiel D. (2015): Health Safety of Soft Drinks: Contents, Containers, and Microorganisms. *BioMed Research Volume 2015*, Article ID 128697 <http://dx.doi.org/10.1155/2015/128697>.
- MacDougall D.B. (1999): *Coloring of Food, Drugs, and Cosmetics*. Marcel Dekker, Inc., New York, Basel, USA.
- Nayak B., Nair K.M. (2003): In vitro bioavailability of iron from wheat flour fortified with ascorbic acid, EDTA and sodium hexametaphosphate, with or without iron. *Food Chemistry*, 80: 545–550.
- Parlement européen, Conseil Européen. Directive européenne 2012/12/UE du 19 avril 2012: *Journal Officiel de l'Union européenne* 2012.
- Populin T., Moret S., Truant S., Conte L.S. (2007): A survey on the presence of free glutamic acid in foodstuffs, with and without added monosodium glutamate. *Food Chemistry*, 104: 1712–1717.
- Plaisir, nutrition et santé (Le livre blanc du jus de fruits).
- Rulebook on additives used in food production - Official Gazette of the Republic of North Macedonia, No 31; 2012.
- Quemener B., Marot C., Mouillet L., Da Riz V., Diris J. (2000): Quantitative analysis of hydrocolloids in food systems by methanolysis coupled to reverse HPLC. Part 1. Gelling carrageenans. *Food Hydrocolloids*, 14: 9–17.
- Rupasinghe H.P.V, Yu L.J. (2012): Emerging Preservation Methods for Fruit Juices and Beverages, *Food Additive*, Yehia El-Samragy, IntechOpen, DOI: 10.5772/32148.
- Suman M., Silva G., Catellani D., Bersellini U., Caffarra V., Careri M. (2009): Determination of food emulsifiers in commercial additives and food products by liquid chromatography/atmospheric-pressure chemical ionization mass spectrometry. *Journal of Chromatography A*, 1216: 3758–3766.
- Ward R.A. (2015): "A Brief History of Fruit and Vegetable Juice Regulation in the United States", 12-27. <https://www.intechopen.com/books/food-additive/emerging-preservation-methods-3-for-fruit-juices-and-beverages>

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