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ON THE OCCURRENCE OF POTASSIUM SORBATE (E202) IN CERTAIN FOOD AND BEVERAGE PRODUCTS

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Abstract

Potassium sorbate (E202) is one of the food additives approved by the European Union to be used as preserving agent with antibacterial and antifungal actions in certain food groups, such as the ones investigated in this study: jams, jellies, marmalades (apricot jam) and aromatized alcoholic beverage (ciders). Six commercial products (three from each group) were investigated through spectrophotocolorimetric methods to identify and quantify the usage of the potassium sorbate. The inclusion level of E-202 in the first food category (apricot jam) was 28.4-47.2% lower than the maximum allowed inclusion level (MAIL) in product (100 mg potassium sorbate/100 g jam). The estimated daily intake through a portion of jam (100 g) represented 6.7-7.4% of the maximal allowed daily intake (MADI) in children and 3.1-4.0% in adults, respectively. The potassium sorbate concentration in Apple cider product was 51-52% below the MAIL (20 mg additive/100 ml), while the consumption of one portion of such beverage (660 ml, equivalent of two bottles) would lead to an intake of 3.93-4.84%, compared to MADI, in adults. Although the potassium sorbate has lower toxicity, compared to other commonly used antiseptic food additives (sodium nitrite and sodium benzoate), it still represents a risk factor in certain consumers known with immunity issues, because is a factor involved in the onset of certain allergic reactions localized in the upper respiratory and digestive tracts, as well as in certain contact dermatitis (cutaneous eruptions, itching etc.). Therefore, the cumulative consumption of the foods containing the E202-potassium sorbate should be avoided.

Key words*: potassium sorbate, apricot jam, apple cider, maximum allowed daily intake.*

INTRODUCTION

The spectacular development of food industry, in terms of manufacturing quantities, varieties of types of foods and length of distribution logistic chains rendered an increased role of food additives in the processing industry, because they provide safety in usage and long shelf life. The natural ingredients, used in the past both for spicing, coloring and preserving were replaced by synthetic substances, easier and cheaper to produce, store, use and also more stable at different treatments (Banu, 2010).

Food additives are known to preserve products quality and safety throughout a longer period of time, improve products taste, ensures the control of acidity and alkalinity of products, maintain the texture, flavor and color of food. It is not to be neglected that the usage of food additives plays a serious role in influencing consumers' choices and preferences, especially of those related to sensorial features. Among the additives most used to preserve food, benzoic acids and its salts, sorbic acid and its salts, as well as sodium and potassium nitrites and nitrates are the most used ones (Ciobanu, 2003).

Sorbic acid and the potassium sorbate are part of an additives group playing antiseptic role in food preserving, therefore protecting consumers against microbiological hazards that could be transmitted through food. However, according to certain studies (Cho et al., 2000) such additives could be incriminated in developing side effects in laboratory animals used as animal model in certain studies simulating the response of the human consumers to food preserved in such manner. The main undesired effects occur in upper respiratory ways due to nasal epithelia squamation, to microvascular inflammation, to pronounced edema.

Potassium sorbate generated genotoxic effects in some in-vitro studies on human lymphocytes: chromosomal aberrations and interchromatidic mutations, DNA disaggregation and decrease of cell division speed. Such effects could be involved in the carcinogenic processes, mostly when the additive exerts its

action onto the immune system cells (Mamur et al., 2010).
According to other authors (Luck and Jager, 1995) the chronic consumption of food containing sorbates and benzoates or sorbic acid and benzoic acid could induce the occurrence of generalized inflammatory status, visible through clinic signs such as dermatitis (itching), respiratory difficulties of asthma type and even anaphylactic shock in consumers with allergic issues to food additives. The consumption of foods belonging to dressings and sauces, very rich in antiseptic additives like sorbic acid and its salts with potassium and sodium induced peri-oral dermatitis – like effects (itching, edema, redness) in pre-scholar children (Maritim and Universitäts medzin, 2010). However, other authors underlined that an absolute correlation between the intake of foods preserved with sorbic acid and its salts and the side effects like local inflammatory responses could not be formulated. However, when systemic responses like toxicity syndromes occur, the sorbates act in synergy with other food preservatives (eg. nitrites) (Walker, 1990).
Heating and high temperature storage could induce genotoxicity and cell-transforming capacities of the food containing sorbic acid and its salts with sodium and potassium, especially when these additives are used in mixture with nitrites (Piper and Piper, 2017).
In accordance with the F.A.O. Codex Alimentarius (FAO, 2011) and the EU regulations (European Comission, 2011, 2012), the sorbic acid and its salts could be used in several food categories, with specified maximal inclusion limits. For instance, the potassium sorbate (E202, the subject of this study) could be used up to: 200 mg / liter in wines, cider, acidulated fermented beverages made of fruits, mead, beverages with less than 15% alcohol; 300 mg / liter in nonalcoholic aromatized beverages (dairy products excluded); 1000 mg / kg in fillings for ravioli and other similar products, dried fruits, sauces based on fruits and vegetables, jams, jellies and marmalades, olives and derivate, cheese and cheese with added food products, dehydrated egg products kept refrigerated or frozen; 2000 mg/kg in melted cheese, pre-packed sliced bread. Also, the Maximal Allowed Daily Intake of potassium sorbate (E202) was limited to 25 mg/kg body weight.

MATERIALS AND METHODS

The purpose of this study was to investigate two categories of food in which the usage of E-202 – Potassium sorbate is allowed: (a) jams, jellies, marmalades and (b) wines, cider and other fruits fermented acidulated beverages, mead.
Three commercial products were chosen from each category and coded jam A, jam B, jam C (apricot jam), respectively cider A, cider B, cider C (apple cider), because the purpose of the study was to test only the occurrence and quantify the concentration of E202, regardless the brand..
The used analytical method was in accordance with the AOAC 960.38 protocol (benzoic acid and its salt/preservatives assessments in Beverages and Beverage Materials/Beverages containing small amounts of alcohol, Beverages and Beverage Materials/Soft Drinks, Fruits and Fruit Products/Jelly, Vegetables/Catsup, Fruits and Fruit Products/Jam), applied on a UV-VIS VWR UV-6300PC double beam spectrophotometer. After the calibration of the curve, using an aqueous solution of 0.2% potassium sorbate, there were run 20 readings per investigated sample at the wavelength of 250 nm.
The acquired values were statistically processed to obtain the main statistical descriptors (mean, standard deviation, standard mean error, coefficient of variation). The data was afterwards compared with the maximal admitted inclusion limit (MAIL) for each food category and with the maximal allowed daily intake (MADI) for each consumer category (child of 30 kg body weight, adult woman of 55 kg, adult man of 65 kg). The size of the daily consumed portions was estimated accordingly to the consumption behaviors: apricot jam, 10 teaspoons = env. 100 g (consumed by both children and adults); apple cider: 2 bottles of 330 ml = 660 ml (consumed by adults only).

RESULTS AND DISCUSSIONS

The analytical results for the apricot jam product are presented in Table 1 and Figure 1.

It could be noticed that the limits of potassium sorbate inclusion were not exceeded, compared with the rate legally regulated (100 mg E-202/100 g product).
Thus, in the first analyzed product – Jam A, the analytical values varied between 54-56 mg potassium sorbate/100 g, resulting a mean of 55.40±0.18 mg potassium sorbate/100 g jam, thus 55.4% of the legal limit.

Table 1. Average values of potassium sorbate (E-202) content in the three foods analysed from the group jams, jellies, marmalades

Product	Analytical values			MAIL* (mg/100 g)	% of MAIL
	$\bar{X}$	$\pm s_{\bar{x}}$	CV%		
Jam A	55.40	0.18	1.48	100	55.40
Jam B	50.60	0.23	2.07	100	50.60
Jam C	54.20	0.17	1.42	100	54.20

* MAIL = maximal allowed inclusion level (mg/100 g product)

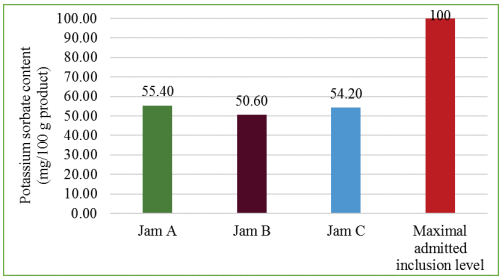

Figure 1. Potassium sorbate inclusion in the analysed samples from jams, jellies and marmalades category

The jams produced by other companies presented lower levels of potassium sorbate in product B (50.60±0.51 mg/100 g) or close ones, in product C (54.20±0.37 mg/100 g), hence the inclusion rates between 50.6-54.2%, comparing to the legal limit.
Starting from an estimated consumed portion of 100 g / day (equivalent of circa 10 teaspoons), the data related to the daily intake dose were obtained, referring to the three consumers' categories (children and both genders adults) (Table 2 and Figure 2).
In children weighing 30 kg, daily ingested dose is between 1.687 and 1.847 mg potassium sorbate per kg body weight, intake that represented 6.7-7.4% of the Maximal Admitted Daily Intake (25 mg E202/kg body weight). In adults, these doses were even lower, reaching 0.920-1.007 mg E-202/kg body weight in women (3.68-4.03% of the MADI), respectively 0.778-0.852 mg potassium sorbate/kg body weight in men (3.11-3.41% of the MADI regulated for the studied additive).

Table 2. Calculation of daily ingested dose of potassium sorbate (E-202) through the three food products from the category jams, jellies and marmalades

Daily ingested dose, related to consumer type	Product		
	Jam A	Jam B	Jam C
Maximal allowed daily intake (MADI) (mg potassium sorbate/kg body weight)	25	25	25
Child, 30 kg body weight(mg potassium sorbate/kg body weight)	1.847	1.687	1.807
% of MADI	7.4	6.7	7.2
Adult, woman, 55 kg body weight(mg potassium sorbate/kg body weight)	1.007	0.920	0.985
% of MADI	4.03	3.68	3.94
Adult, man, 65 kg body weight(mg potassium sorbate/kg body weight)	0.852	0.778	0.834
% of MADI	3.41	3.11	3.34

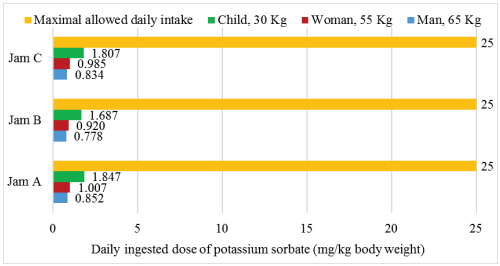

Figure 2. Daily ingestion of potassium sorbate through the consumption of 100 g portion of apricot jam

Although the intake through the apricot jam was quite low when compared to the MADI, the cumulative intake must be taken into account, especially in children alimentary patterns, knowing that E202 is also allowed to be included in several foods and beverages (flavored nonalcoholic beverages, pasta filling, sauces, olives, cheeses, egg products, sliced pre-packed bread etc.).
The second studied group of products is designed exclusively for adults, knowing the cider contains environ 4-5% alcohol. The results related to the usage of potassium sorbate in the three analyzed commercial products are presented in table 3 and figure 3.

Table 3. Average values of potassium sorbate (E-202) content in the three products analysed from the group wines, cider, acidulated fermented beverages made of fruits, mead

Product	Analytical values			MAIL* (mg/ 100 ml)	% of MAIL
	$\bar{X}$	$\pm s_{\bar{x}}$	CV%		
Cider A	9.80	0.17	7.83	20	49.00
Cider B	9.60	0.11	5.24	20	48.00
Cider C	9.80	0.09	4.19	20	49.00

* MAIL = maximal allowed inclusion level (mg/100 ml product)

In the Cider A product, the analytical values felt within the 9-11 mg/100 ml interval,

resulting an average potassium sorbate content of 9.80±0.37 mg/100 ml, reaching thus 49% of the Maximal Allowed Intake Level (20 mg potassium sorbate/100 ml). For the other studied cider brands, the potassium sorbate content measured in laboratory was found between 9.60±0.24 mg/100 ml and 9.80±0.20 mg/100 ml, that meant 48-49% of the regulated MAIL.

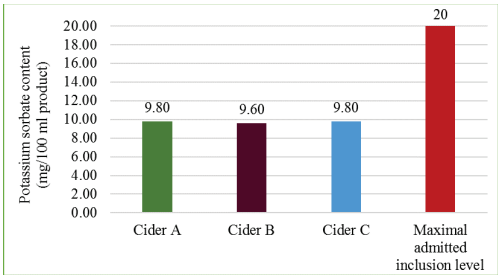

Figure 3. Potassium sorbate inclusion in the analysed samples from wines, cider, acidulated fermented beverages made of fruits, mead category

In order to estimate the daily intake dose of potassium sorbate (Table 4 and Figure 4), the consumption portion was considered to be 660 ml (2 bottles of 330 ml), knowing that apple cider is rather drunk as refresher beverage than like an alcoholic beverage itself.

Table 4. Calculation of daily ingested dose of potassium sorbate (E-202) through the three products from the category wines, cider, acidulated fermented beverages made of fruits, mead

Daily ingested dose, related to consumer type	Product		
	Cider A	Cider B	Cider C
Maximal allowed daily intake (MADI) (mg potassium sorbate/kg body weight)	25	25	25
Adult, woman, 55 kg body weight(mg potassium sorbate/kg body weight)	1.187	1.162	1.211
% of MADI	4.75	4.65	4.84
Adult, man, 65 kg body weight(mg potassium sorbate/kg body weight)	1.004	0.984	1.025
% of MADI	4.02	3.93	4.10

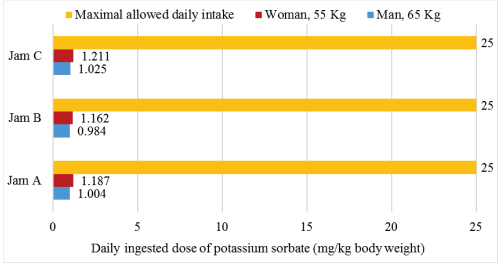

Figure 4. Daily ingestion of potassium sorbate through the consumption of 660 ml portion of apple cider

Thus, for the considered consumption rate (660 ml cider), the calculated values of the daily intake dose oscillated between 1.162 and 1.211 mg potassium sorbate/kg body weight in women, respectively between 0.984-1.025 mg potassium sorbate/kg body weight in men.
In comparison with the MADI regulated for the studied additive, the daily intake doses represented 4.65-4.84% in women and 3.93-4.10% in men consumers. Although the potassium sorbate has a lower systemic toxicity in humans, comparing with other antiseptic additives frequently used in food and beverages (sodium nitrite and sodium benzoate), it should be remembered that it is still a risk factor in triggering certain allergic reactions localized in the respiratory tracts as well as in certain contact dermatitis (skin rushes, itching etc.).

CONCLUSIONS

The potassium sorbate level of inclusion in the apricot jam was 45.8-49.4% lower than the maximal admitted level (100 mg E202/100g product).
The daily ingested dose through a portion of apricot jam (100 g) represented 6.7-7.4% comparing to the maximal admitted daily intake in children, respectively 3.1-4.0% in adults.
The measured concentration of potassium sorbate in apple ciders was 51-52% below the maximal admitted inclusion level (20 mg E202/100 ml).
Consuming a portion of apple cider (660 ml) resulted in reaching 3.93-4.84% of the maximal tolerated daily intake in adults.
All levels felt within the legal limits. However, it must be noticed that in certain products, the labeling was not honest, as all products contained the investigated additive in certain concentrations and only a few producers mentioned it as ingredient in their product.

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