

STUDY ON THE USAGE OF SODIUM BENZOATE (E 211) IN TWO FOOD CATEGORIES

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Abstract

Six products belonging in two food categories (soups and broths, as well as fish and seafood smoked, dried, fermented and/or marinated) have been investigated in laboratory via spectrophotocolorimetry to identify and quantify the usage of sodium benzoate as food additive with antiseptic-preservative purpose. The inclusion level of E-211 in the first group (instant soup) was 28.4-47.2% less than the maximum admitted inclusion level (AIL) (50 mg additive/100g product, while the calculated daily intake through eating a portion of reconstituted soup (250 ml) reached 44.0-59.7% out of the maximal admitted daily intake (MADI) for children and 20.3-32.6% of the MADI for adults. The concentration detected in the marinated fish was 27.3-42.1% lower than the AIL for this food category (200 mg/100 g). Calculus of the daily intake for a serving portion of marinate fish (env. 75 g) reached 57.9-72.7% of the MADI for children and 26.7-39.7% for adult consumers. Although the inclusion rates were below the maximal admitted limits, if we cumulate the potential intake of the sodium benzoate from other food sources preferred by children (sweet treats and sodas), the daily intake dose for this additive present becomes alarming and could endanger the health and development of young age consumers. Therefore, we recommend proceeding with increased caution in supervising their nutritional habits.

Key words: sodium benzoate, inclusion level, daily intake, instant soup, marinated fish

INTRODUCTION

The idea of this study started from the fact that the lifestyle of nowadays generations, especially in developed countries, is based on cutting the time invested in household activities and on maximizing and optimizing the time spent in the professional or social interaction environments to which the individual belongs. Therefore, the way in which daily nutritional routine of an adult person or/and of the younger ones is organized has been changed. The proportion of industrially processed food increased, disfavoring the participation of those traditionally prepared or cooked in the daily food ration [9]. Consequently, the quantity of food additives, expressed as daily ingested doze by a single person in absolute or cumulated values, increased, compared with the situation occurred a few decades ago [10]. Moreover, the intake of food additives in modern

processed food was correlated with the emotional distress of the consumers [7].

Among the other categories of food additives, the antiseptic ones or the so-called preservatives, are chemical substances that stop the development and the action of certain microorganisms (bacteriostatic action) or even destroy them (bactericide action) [8], in straight dependence with their inclusion rate and with the contaminating microorganism type and virulence [11]. The food products investigated within this study belonged to two groups in whose composition the benzoic acid and its salts can be included. The additives in this group, coded by the E numbers E210-E213 in the Codex Alimentarius catalogue [5], are known for inducing some adverse effects in consumers' health. The oral and/or dermal exposure to benzoic acid and to sodium benzoate could produce rash, asthma, rhinitis or even anaphylactic shock in certain highly sensitive persons. The symptoms appear immediately after exposure and disappear in a few hours if low dosage was consumed. In high doses, provided consecutively throughout 5 days (env. 2500 mg/day), severe symptoms

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The manuscript was received: 09.10.2017
Accepted for publication: 30.10.2017

occur, such as nausea, headaches, weakness, oral mucosa burns and esophagus mucosa burns [4, 12]. The benzoic acid could induce development issues, insomnia and behavioral disorders in laboratory animals used as animal models in human pharmacology modeling experiments [6]. The sodium benzoate could temporarily inhibit the digestive enzymes and could contribute in depleting the hepatic level of glycine. This preservative must be avoided by consumers presenting special medical conditions (fever, asthma or acute rash eruption) [3].

Experimental data, issued from laboratory analysis on the investigated products, served to estimate the daily ingested intake for sodium benzoate, in relation with the food category, with the consumer type (age, gender, body weight). All the data was interpreted in relation with the on-force regulations on the usage of sodium benzoate as antiseptic (preservative) food additive.

MATERIAL AND METHOD

There have been studied two groups of food, in whose composition the usage of sodium benzoate as antiseptic additive is allowed at certain legal levels: "Soups and broths" (maximum inclusion level of 500 mg/kg or 50 mg/100 g edible portion) and "Fish and seafood smoked, dried, fermented and/or marinated" (maximum inclusion level of 2000 mg/kg or 200 mg per 100 g edible portion). Out of the first category (soups and broths), three brands of concentrated soups, commonly known as "Instant chicken noodle soup", have been investigated (coded Soup A, Soup B, Soup C). Out of the second category, three commercial products of "Marinated herring with vegetables" type have been investigated (coded Marinade A, Marinade B, Marinade C).

The analytical method was derived from the A.O.A.C. 960.38 and 980.17 methods [1, 2] and has as principle the Beer's laws.

Equipment: UV-VIS VWR UV-6300PC (double beam, reading wavelength spectrum: 190-1100±0.3 nm); quartz cuvettes; laboratory glassware (flasks of 150 ml, 100 ml balloons, 0.5, 1 and 10 ml pipettes).

Reagents: sodium benzoate 0.2% solution; bi-distilled and ultra-purified water.

Calibration curves: 6 successive diluted solutions of sodium benzoate are prepared (1; 2; 3; 4; 5; 6 ml sodium benzoate 0.2% solution added in 100 ml bi-distilled and ultra-purified water). Out of each dilution, there were taken 5 ml and were added to the measuring cuvettes. The blank sample cuvette is filled with 5 ml bi-distilled and ultra-purified water only. The successively diluted solutions, as well as the blank sample, were read in spectrophotometer between 200-300 nm wavelengths. The values read at 225 nm (wavelength at which the sodium benzoate exerts absorbance of the photonic beam) were subtracted from the value read for the blank sample, resulting the quantitative values corresponding to 0.1-0.6 mg sodium benzoate.

Working procedure: 20 g (mashed) or 20 ml for each food product have been sampled and introduced into a 100 ml balloon. There were added 80 ml bi-distilled and ultra-purified water to reach the whole balloon capacity. The balloons were steered then quantitatively filtered in 150 ml flasks. From the filtrate, 5 ml have been taken and pipetted into the measuring cuvettes. Those were scanned at 200-300 nm wavelengths, observing the peak readings for 225 nm. The readings were expressed as deviations from blank sample reading. Hence every cuvette contains a dilution equivalent of 1 g or 1 ml sample, each point of 0.1 mg on the calibration curve represents 0.01% sodium benzoate. Ten reading replicates have been run for each analyzed product.

The acquired data have been statistically interpreted, computing the main statistical descriptors (mean, standard mean error and variation coefficient). The means have been compared with the maximum tolerated limits of sodium benzoate inclusion in food and relative differences were also calculated. Starting from the average obtained values, the ADI (average daily intake) of E-211 were calculated, in relation with the legal allowance and with the type of consumer (child - 30 kg body weight, adult woman - 55 kg body weight, adult man - 65 kg body weight). When ADI was calculated, the size of consumed portions was considered in accordance with every product specificity and consumption habits: 250 ml, reconstituted liquid phase for

the soups, eaten once a day; 75 g of marinated herring, approximately 3 pieces of fish trunk consumed during the same meal.

RESULTS AND DISCUSSIONS

The data on the occurrence and concentration of sodium benzoate in the analyzed instant soups are presented in table 1. In the situation of Soup A samples, the analytical values varied within the 34 - 38 mg sodium benzoate /100g, resulting a mean of 35.8 ± 0.39 mg/100g, which represented 71.60% of the maximal inclusion level (50 mg E-211/100 g product). In the other analyzed products, there were identified levels of 25-28 mg/100g Soup B, resulting an average content of 26.40 ± 0.32 mg sodium benzoate/100 g, respectively values of 29-31 mg/100g soup C, with an average of 30.20 ± 0.37 mg sodium

benzoate /100 g Soup C (52.80-60.40% out of the maximal inclusion level).

In order to estimate the daily intake of sodium benzoate, the eatable soup portion volume was considered of 250 ml, reconstituted from powder concentrate and hot water. The results are presented in table 2 and fig. 1. It resulted that compared with the maximal allowed intake level (5 mg E-211/kg body weight), a child eating such a soup portion will ingest a daily dose of 2.200 mg/kg BW – 2.983 mg/kg BW, which means 44-59.7% of the maximal allowed daily intake. If such a product would be eaten by adults, we estimated a daily intake of 1.2 mg/kg BW – 1.627 mg/BW in women, respectively of 1.015-1.377 mg/kg BW in men, resulting proportions of 24.00-32.55% of the maximal allowed daily intake in women and 20.31-27.54% in men.

Table 1 Average values of the sodium benzoate contents in the three food products in the "Soups and broths" category

| Analyzed product | Analytical value (mg/100 g) \bar{x} | Mean standard error $\pm s_x$ | Variation coefficient v% | Legal Inclusion threshold (mg/100 g) | % vs. legal threshold |
|------------------|--|----------------------------------|-----------------------------|--------------------------------------|-----------------------|
| Soup A | 35.80 | 0.39 | 3.45 | 50 | 71.60 |
| Soup B | 26.40 | 0.32 | 3.84 | 50 | 52.80 |
| Soup C | 30.20 | 0.25 | 2.59 | 50 | 60.40 |

Table 2 Estimation of the sodium benzoate (E-211) daily intake (mg/kg body weight) from the three products belonging to "Soups and broths" foods category

| Consumer category | Analyzed product | | |
|--|------------------|--------|--------|
| | Soup A | Soup B | Soup C |
| Maximal allowed intake | 5 | 5 | 5 |
| Child, 30 kg body weight | 2.983 | 2.200 | 2.517 |
| <i>% of daily maximum allowed intake</i> | 59.7 | 44.0 | 50.3 |
| Adult woman, 55 kg body weight | 1.627 | 1.200 | 1.373 |
| <i>% of daily maximum allowed intake</i> | 32.55 | 24.00 | 27.45 |
| Adult man, 65 kg body weight | 1.377 | 1.015 | 1.162 |
| <i>% of daily maximum allowed intake</i> | 27.54 | 20.31 | 23.23 |

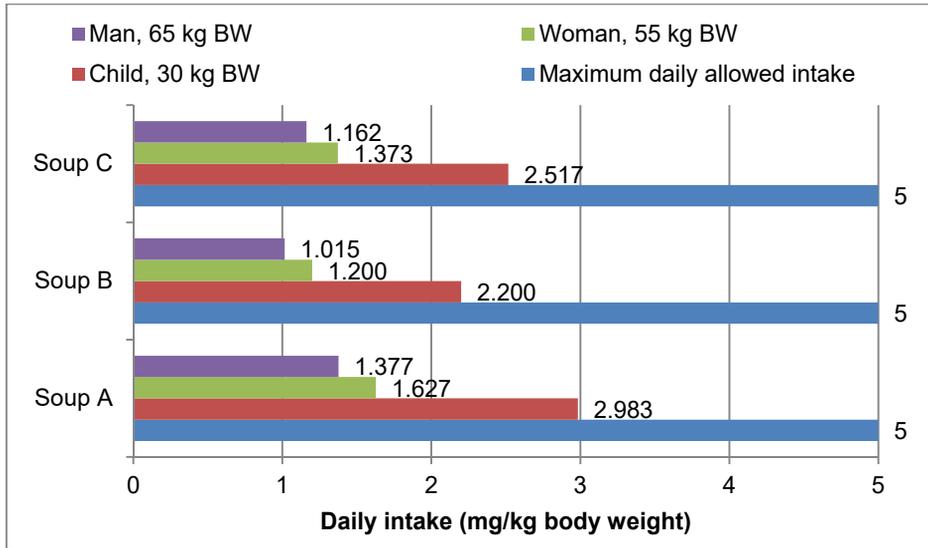


Fig. 1 Sodium benzoate daily intake (E-211) from products in food group "Soups and broths", depending on consumer category (BW = body weight)

Results of the analytical trials related to the fish marinated with vegetables are presented in table 3. Results of the analysis on the fish marinade content are presented in table 3.

Compared to the legal limit of E-211 inclusion for the food category "Fish, and seafood smoked, dried, fermented and/or marinated" (200 mg/100 g), the analytical values oscillated between 112-120 mg/100 g

in Marinade A samples, between 121-129 mg/100 g in Marinade B and between 142-149 mg/100 g in Marinade C samples. Detection of such concentrations led to various proportions of remanence in the three products, respectively of 57.9%, 67.7% and 72.7%, compared with the maximal admitted level (200 mg/100 g) (table 3).

Table 3 Average values of the sodium benzoate contents in the three food products in the "Fish and seafood smoked, dried, fermented and/or marinated" category

| Analyzed product | Analytical value (mg/100 g) \bar{x} | Mean standard error $\pm s_{\bar{x}}$ | Variation coefficient v% | Legal inclusion threshold (mg/100 g) | % vs. legal threshold |
|------------------|--|--|-----------------------------|--------------------------------------|-----------------------|
| Marinade A | 115.8 | 0.95 | 2.60 | 200 | 57.90 |
| Marinade B | 125.4 | 0.96 | 2.41 | 200 | 62.70 |
| Marinade C | 145.4 | 0.81 | 1.75 | 200 | 72.70 |

Starting from these values and considering the size of an eaten portions of marinated fish of 75 g per day (approximately 3 pieces of fish trunk), the daily intake of sodium benzoate has been calculated (table 4 and fig. 2).

If such products would be consumed by children weighing 30 kg, the daily intake would reach 2.895-3.635 mg sodium benzoate per kg body weight (57.9-72.7% of

the maximal allowed daily intake dosage, i.e. 5 mg preservative E-211/kg body weight). In adult consumers, the daily intake varied between 1.579-1.983 mg sodium benzoate/kg body weight in women (55 kg) or between 1.336-1.678 mg sodium benzoate/kg body weight in men (65 kg), resulting levels of 31.58-39.65% and 26.72-33.55% of the maximal allowed daily intake level in both analyzed genders (table 4).

Table 4 Estimation of the sodium benzoate (E-211) daily intake (mg/kg body weight) from the three products belonging to "Fish and seafood smoked, dried, fermented and/or marinated" foods category

| Consumer category | Analyzed product | | |
|--|------------------|------------|------------|
| | Marinade A | Marinade B | Marinade C |
| Maximal allowed intake | 5 | 5 | 5 |
| Child, 30 kg body weight | 2.895 | 3.135 | 3.635 |
| <i>% of daily maximum allowed intake</i> | 57.9 | 62.7 | 72.7 |
| Adult woman, 55 kg body weight | 1.579 | 1.710 | 1.983 |
| <i>% of daily maximum allowed intake</i> | 31.58 | 34.20 | 39.65 |
| Adult man, 65 kg body weight | 1.336 | 1.447 | 1.678 |
| <i>% of daily maximum allowed intake</i> | 26.72 | 28.94 | 33.55 |

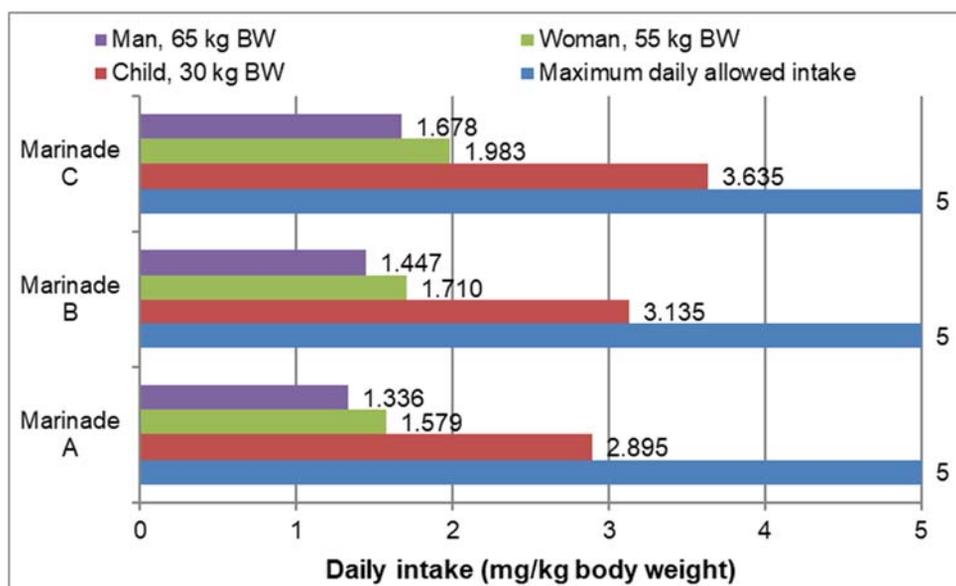


Fig. 2 Sodium benzoate daily intake (E-211) from products in food group "Fish and seafood smoked, dried, fermented and/or marinated", depending on consumer category (BW = body weight)

Although in the investigated foods, the intake proportions, compared to the maximal allowed daily intake were lower, if one child would consume a portion from both products in the same day, the real daily intake would exceed the maximal allowed intake limit (+16.7...+17.6%). In adult consumer, the daily cumulative intake of sodium benzoate from the two food categories would reach 50-75% of the daily maximal admitted intake level.

In both consumption scenarios, there must be proceeded with caution when children nutritional habits are considered, due to the cumulative intake of such food additives and, in particular, of sodium

benzoate, from many other food categories. It is known that E-211 is also used in sweet treats and fizzy drinks, frequently consumed by toddlers, schoolers and teenagers.

CONCLUSIONS

The inclusion rate of sodium benzoate in the products from the "Soups and broths" category was 28.4-47.2% lower than the Maximal allowed inclusion level (50 mg/100g). The daily intake due to the consumption of 250 ml reconstituted soup reached 44.0-59.7% of the maximal allowed daily intake in children and 20.3-32.6% in adult consumers.

The E 211 concentration in Fish marinade samples was 27.3-42.1% below the maximum inclusion rate for such food (200 mg/100 g). Estimation of daily intake through a portion of marinated fish (75 g) indicated a level of 57.9-72.7% of the maximal tolerated intake in children and 26.7-39.7% in adults.

Based on the achieved results, may we recommend increased caution in the nutritional choices that are made for children, especially for toddlers, preschoolers and schoolers due to the risk of cumulative intake of food preserving additives (benzoates and nitrites). It is known that there are common food consumption patterns and preferences in children of such ages for products rich in antiseptic-preserving additives (fast-food products, sweets, snacks and sodas).

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