The Investigation of Benzoic Acid Amounts in Some Foodstuffs Consumed in Ankara Region

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Abstract: Benzoic acid and its salts are commonly used as a preservatives in food products. Excess amounts of benzoic acid can be harmful to human health. Therefore, the determination of benzoic acid is important in routine analysis of foods. The aim of this study was to determine amounts of benzoic acids in some foodstuffs and to evaluate whether these amounts were within the Turkish Food Codex (TFC) values or not.

For this purpose, total number of 80 samples consisting of 20 ketchup (A, B firms), 20 sauce (C, D firms) and 40 jam samples (E, F, G, H, I, J, K firms) were collected from supermarkets, Ankara Region. In this research, spectrophotometric method was used for the quantitative determination of benzoic acid in ketchup, sauce and jam samples. Mean amounts ($\bar{X}$ ± S.E) of benzoic acid in ketchup samples of A and B firm were found as 152.32±18.41 and 1008.21±30.74 mg/kg, respectively. Mean amounts ($\bar{X}$ ± S.E) of benzoic acid in sauce samples of C and D firm were determined as 990.85±26.00 and 1148.19±43.62 mg/kg, respectively. Also, mean amounts ($\bar{X}$ ± S.E) of benzoic acid were found as 435.27±26.07 mg/kg in 8 jam samples of E firm. Our data revealed that while mean amounts of benzoic acid of A and C firms were found within TFC values, benzoic acid amounts of B and D firms samples were higher than the TFC values. Furthermore, some jam samples of firm E was not found appropriate to TFC.

Keywords: Benzoic acid, food additives, food preservatives, food safety, spectrophotometric method.

INTRODUCTION

Benzoic acid and its salts are used as an antimicrobial preservatives in cosmetics, drug and food industry [1, 2]. These preservative compounds have been extensively used in the food industry as an important food preservatives in order to inhibit various bacteria, yeasts and molds [3, 4]. Particularly, it is the most effective to prevent deterioration in acidic foods [5]. Food preservatives are especially used in many food types including marmalades, gels, jams, desserts, meats, fish, ketchup, mayonnaise, dairy products, fruits, vegetables, non-alcoholic and fermented beverages [6]. Benzoic acid is ocurred naturally in plant and animal, thus, it is natural constituent of many foodstuffs. The quantity of benzoic acid in several foodstuffs does not exceed 40 mg/kg [7]. While these preservatives prevent or retard deterioration of foods due to microbiological, enzymatic or chemical changes during the shelf life, they are hazardous at higher than permitted safety levels [8]. After oral intake, benzoic acid and sodium benzoate are rapidly absorbed from the gastrointestinal tract and metabolized in the liver by conjugation with glycine, resulting in the formation of hippuric acid, which is rapidly excreted *via* the urine [7]. Oral, dermal or inhalation exposure of benzoic acid can cause urticaria, asthma, rhinitis, or anaphylactic shock. The symptoms appear shortly even at low doses and disappear within a few hours [9]. JECFA has evaluated and established an acceptable daily intake for benzoic acid, benzoate salt (calcium, potassium and sodium), benzaldehyde, benzyl acetate and benzyl alcohol as 0-5 mg/kg per body weight [10].

Use of excessive quantities of benzoic acid can cause hazardous effect to human health [11, 12]. Therefore, the development of appropriate and cost effective analysis methods of these preservatives is essential for food safety and public health [3, 11]. Maximum levels of benzoic acid and its salts in different foodstuffs are estimated as 50-2000 mg/kg according to the Turkish Food Codex (TFC) [13].

The aim of this study was to determine the benzoic acid amounts in ketchup, sauce and jam samples collected from Ankara region local markets and to evaluate whether benzoic acid amounts were within the Turkish Food Codex.

MATERIALS AND METHODS

Sample Collection

In this study, total of 80 food samples including ketchup, jam, sauces were collected from supermarkets located in Ankara, Turkey. Widely consumed foods in the Turkey such as jams, ketchups

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and sauces were selected for the analysis. The food samples that had different serial numbers were used. For sampling procedure, having a different serial number and production date is important in terms of realizing the persistence of quality at the production process. Generally, it is difficult to find same food brand with different serial number and production date at the same supermarket. Samples stored under appropriate conditions before the analysis. The package of samples were opened just before the analysis.

Method of Analysis

The extraction and determination procedure for analysis of samples were based on the method described by AOAC [14, 15]. The analysis was carried out by Beckman DU650 Spectrophotometer. Benzoic acid standard were purchased from Merck Chemical. All reagents used were of analytical grade.

Analysis of Benzoic Acid

Food samples were homogenized by stirring manually. Briefly, 3 g of sample was diluted with 50 ml of saturated NaCl and transffered to the separating funnel. Then, the sample was extracted with 20 mL, 17.5 mL and 10 mL portions of diethyl ether, respectively. Ether layer was collected in conical flask. The extract was washed three times with 15 mL HCl (1+1000) and discarded the acid with aqueus portion of the extract. The remaining solution is complete to 50 mL with ether. The absorbance is measured at 267.6, 276.6 and 272.6 nm wavelenght by spectrophometer. Standards of benzoic acid were measured in the same way. The calibration curve was characterized *via* series of dilutions containing different levels (10-120 mg/L) of benzoic acid.

Statistical Analysis

Student's t-test and One-Sample t-test were conducted for the statistical comparisons [16].

RESULTS AND DISCUSSION

The spectrophotometric method is oftenly used for determination of single compound such as only benzoic acid. The mean recovery was 98.68% in jam samples. The analysis was conducted in duplicate for each sample. The concerning values are shown in Table **1**. The results of the analysis were evaluated within the Turkish Food Codex values. Benzoic acid mean levels of ketchup samples of A and B firms were determined as 152.32±18.41 mg/kg and 1008.21±30.74 mg/kg, respectively. The differences between the mean level of benzoic acid in ketchup samples of firm A and the TFC values (1000 mg/kg) were statistically significant ($p<0.001$). There was a statistically significant ($p<0.01$) differences between the mean level of benzoic acid in sauce samples of firm D and the TFC values (1000 mg/kg). Benzoic acid levels of sauces samples of firms C and D were found as 990.85±26.00 and 1148.19±43.62 mg/kg, respectively. Average benzoic acid level of eight jam samples (Firm E) was determined as 435.27±26.07 mg/kg. The difference of the benzoic acid levels within the ketchup samples was found statistically significant ($p<0.001$). Although benzoic acid should not be used as a food additives in jams according to TFC, in this study eight jam samples of firm E contain benzoic acid.

Yentür and Bayhan [17] determined the mean level of benzoic acid as 0.516±0.065 and 0.479±0.046 g/kg, respectively in ketchup and jam samples. Yentür *et al.* [15] also indicated benzoic acid levels in jam samples of different firms as 303.4±20.9 and 320.1±26.9 mg/kg. However, benzoic acid mean levels to be 858.8±49.7 mg/kg and 730.9±87.6 mg/kg in ketchup samples of firms A and B, respectively. Koyuncu and Uylaşer [18] determined mean levels of benzoic acid as 0-866 mg/kg and 0-375 mg/kg respectively in ketchup and jam samples. These levels in ketchup and jam samples were found to be similar to our results. In our research, benzoic acid was not found in other jam samples.

Table 1: Statistical Analysis for Levels of Benzoic Acid in Ketchup and Sauce Samples (X±S.E in mg/kg)

Firm	N	X±S.E	Min.	Max.	t
A	10	152.32±18.41	69.41	248.73	***
B	10	1008.21±30.74	873.43	1139.51	-
C	10	990.85±26.00	850.29	1145.29	-
D	10	1148.19±43.62	815.59	1307.25	**

p> 0.05(the difference between the mean level of benzoic acid in samples and the TFC values; 1000 mg/kg).
**:p< 0.01(the difference between the mean level of benzoic acid in samples and the TFC values; 1000 mg/kg).
***: p<0.001 (the difference between the mean level of benzoic acid in samples and the TFC values; 1000 mg/kg).

Saad *et al.* [19] identified benzoic acid levels as not detection amount - 1260 mg/kg samples from a total of 67 different food samples in Malaysia. Ferreira *et al.* [20] reported benzoic acid levels as 413±10.4 - 1501±4.2 mg/kg in jam samples from a total of 11 samples in Portugal. Mota *et al.* [21] analysed 87 food samples and reported benzoic acid levels as not detection amount - 639±16 mg/kg in jam samples in Portugal. Tfouni and Toledo [5] have analysed 40 food samples in Brazil for benzoic acid and one sample was reported to have higher benzoic acid level than the acceptable levels of the Brazil regulation.

Benzoic acid and its salts are important to provide the persistence of food quality. However, high levels of benzoic acid and its salts could cause to be risk to human health. The amounts of preservatives allowed for different foods are controlled by legal regulations. Monitoring the levels of benzoic acid or benzoates in foods and their permitted levels is important for public health and food safety.

As a result, the levels of ketchup and sauce samples of B and D firms, respectively were found to be higher than Turkish Food Codex value (1000 mg/kg). Although use of benzoic acid as a food additives in jams is not allowed by TFC, benzoic acid was determined in some traditional jam samples. These values are especially affect the children and immunesupressive people. Therefore, for food safety, necessity of analytically monitoring and controlling of benzoic acid in widespread consumed foods is observed.

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