Determination of Benzoate Level in Canned Pickles and Pickled Cucumbers in Food Producing Factories in Markazi Province and those that their Products were Sold in Arak City, Iran

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ABSTRACT

Background: Anecdotal information has suggested that sodium benzoate is used with more than permissible doses during production steps of food products especially pickles and pickled cucumbers in food producing factories in Markazi province and other food producing factories . The present study was done to evaluate factual concentration of sodium benzoate in these products.

Methods: In this study**,** 8 samples from canned pickled cucumbers and 10 samples from canned pickles were randomly gathered from food production factories in Markazi province between March and September 2010. Also, 25 samples from canned pickled cucumbers and 15 samples from canned pickles and 7 samples of bulk cargo pickled cucumbers were collected from the other provinces in Arak city. Sodium benzoate level was determined in the samples using UV-VIS spectrophotometry method. The determined values were analyzed by N-par test using SPSS software version 16.0.

Results: Sodium benzoate level was near zero in the samples of canned pickles and pickled cucumbers from producing factories. This was 200-400 PPM in 7 samples from bulk cargo pickled cucumbers which was higher than permissible dose. There was not a statistically significant difference between mean benzoate level of canned pickles and pickled cucumbers produced in Markazi providence factories and other food factories. Benzoate level was significantly higher than permissible dose in bulk cargo pickled cucumbers.

Conclusion: Food products from production factories do not have higher than permissible level of sodium benzoate; however, this is higher in bulk cargo pickled cucumbers. Hence, stricter control on bulk cargo pickled cucumber products is recommended.

Keywords: Arak, Bulk Cargo, Pickled Cucumbers, Pickles, Preservative, Sodium Benzoate.

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INTRODUCTION

Sugar, salt, and drying methods were used for protection of food products by human, before the invention of refrigerator and other modern methods for food preservation; however, not all foods can be preserved through these methods. As a result, preservatives were introduced with anti-microbial activities. They have an important role in healthy maintenance of food products. Raw foods have a relatively low shelf-life due to biochemical and

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microbial interactions. Preservatives are used to lengthen the shelf-life of foods and promote their robust status. They can delay or stop disintegration down to microorganisms. They not only delay spoilage caused by bacteria, molds, and yeasts but also prevent toxin formation, especially by bacteria and molds (1).

Preservatives such as benzoates, sorbates, propionates, sulphur dioxides, sulphites, parabones, sodium nitrites, sodium nitrates, natamycine, and nicine are widely used, especially in production of cheese, meet products, fruit-based products, and various beverages. Nature of preservative to be used is determined by the type of food product and prior estimation about the degree of spoilage; for instance, salt and nitrites is regularly used for meat products, sulphur dioxide is utilized for fruit-based products, sorbic acid is used for drinks, and benzoate is utilized for soured products and ketchup.

Benzoic acid ($C_7H_6O_2$) with molecular weight of 122.12 is an inorganic acid which is widely used in food preservation. It appears as white spike-shaped crystals at room temperature. It is present in apple, strawberry, and butter naturally. Its utility depends on environmental pH and it stops microbial growth more efficiently at pH 2.5-4 (2). Benzoic acid itself has low solubility in aqueous phase; therefore, its sodium salt is usually used which is, then, converted to benzoic acid. Its ability to pass across cell membranes is raised in salt form (PKa=4.19) since its unionized form increases.

Benzoic acid and sodium benzoate are utilized for preservation of fruit juices, apple syrup, soured food, carbonated drinks, cooked flour products, salad sauces, margarine, ketchup, fruit salads, jams, and jellies. Iranian National Standards have interdicted the use of any preservatives, coloring agents, and flavor modifying agents to salted cucumber products, except sorbate salts (3). Permissible dose of benzoate in food products by FDA is less than 0.1%. Various experiments done on animals and human have revealed some undesirable effects due to prolonged use of benzoate which include changes in serum parameters, increased relative liver and kidney weight, changes in hepatic histopathology, and disorders related to the central nervous system damage (convulsion) (4, 5). In addition, benzoic acid may produce allergic reactions in human (6); even asthma and urticaria are reported in human after benzoate use(7, 8).

The present study was conducted to evaluate sodium benzoate level in canned pickles and pickled cucumbers which are produced in Markazi province and used in Arak city. If the levels were high, more stringent intercessions and supervisions should be made on related producers.

MATERIALS AND METHODS

The present study was performed between March and September 2010. One of the researchers referred to related food factories and took random samples from their products. Also, some random samples were collected from bulk cargo pickled cucumbers sold in food stores. The samples were transferred to laboratory without delay.

The samples were categorized into canned pickles and pickled cucumbers in food producing factories in Markazi province and the other food producing factories which their productions were sold in Arak city. Overall, 33 samples from canned pickled cucumbers and 25 samples from canned pickles were collected, including 8 samples from canned pickled cucumbers produced in Markazi province, 25 samples produced in the other food producing factories, 10 samples from canned pickles produced in Markazi province, and 15 samples produced in the other food producing factories. Moreover, 7 samples of bulk cargo pickled cucumbers

were collected from the other provinces which their productions were sold in Arak city.

Various methods such as thin layer chromatography (TLC), gas chromatography (GC), capillary electrophoresis, spectrophotometry, and high performance liquid chromatography (HPLC) were applied to determine benzoate levels in food products in reported studies. We utilized UV-VIS spectrophotometry for determination of Sodium Benzoate level in the studied samples.

After filtration of the samples, extraction of them was performed by petroleum ether solvent in the presence of hydrochloric acid 0.6 N. UV-VIS spectrophotometer from Varian Co, UK, was used for the analysis. UV absorption at wavelength of 228 nanometers was determined and the relevant calibration curve was drawn. The results were analyzed by N-par test using SPSS software version 16.0.

RESULTS

To validate the analyzing method, it was performed with standard samples containing 2 and 4 mg/l sodium benzoate. The results showed the validity and the precision of the method (Table 1).

RSD was less than 4% and it can be concluded the stability of the samples was appropriate in less than 3 days waiting analysis. As it is shown in Table 2, analyzing the method of the study has had satisfactory repeatability.

Table 1. Results of analysis on standard samples of sodium benzoate

Sodium Benzoate concentration (mg/l)	Calculated Sodium Benzoate concentration (mean± SD)	Relative standard deviation
2	2.1±0.05	2.7
4	4.1±0.05	3.7
6	6.1±0.05	2.5

Table 2. Repeatability of benzoate analysis with standard samples of sodium benzoate

Prepared concentration of Benzoate in water	Calculated Sodium Benzoate concentration (mean± SD)	Relative standard deviation
2	2±0.05	2.8
4	4±0.1	2.5

Results of analysis of canned pickles and pickled cucumbers produced in food producing factories in Markazi province and the other food producing factories which their productions were sold in Arak city are demonstrated in Tables 3-5. The analysis was performed 3 times for each sample and their mean were reported in the tables.Descriptive statistical variables for benzoate concentration in the samples are shown in Table 6.

Table 3. Sodium benzoate levels (in PPM) in samples of canned pickled cucumbers produced in food producing factories *

Sample code	X1	X2	X3	X4	X5	X6	X7	X8	X9	X10
Benzoate concentration	2.5	3	3.5	3	3.5	2	3.6	2	2.5	3.7
Sample code	**X11**	**X12**	**X13**	**X14**	**X15**	**X16**	**X17**	**X18**	**X19**	**X20**
Benzoate concentration	3	4	4.4	1.5	2	3.6	1.5	3.5	2.5	3.3
Sample code	**X21**	**X22**	**X23**	**X24**	**X25**	**X26**	**X27**	**X28**	**X29**	**X30**
Benzoate concentration	3.2	2	3.4	3.5	2	2.2	1.9	2.8	3	3.1
Sample code	**X31**	**X32**	**X33**							
Benzoate concentration	3.3	2.6	3							

*: Mean concentration was 3 PPM.

Table 4. Sodium benzoate levels (in PPM) in samples of canned pickles produced in food producing factories *

Sample code	**X1**	**X2**	**X3**	**X4**	**X5**	**X6**	**X7**	**X8**	**X9**	**X10**
Benzoate concentration	3.3	3	2.9	2.8	2.6	2.5	2.5	2.4	2.4	2.3
Sample code	**X11**	**X12**	**X13**	**X14**	**X15**	**X16**	**X17**	**X18**	**X19**	**X20**
Benzoate concentration	3.3	4	3.7	3.7	3.6	3.6	3.5	3.5	3.4	3.3
Sample code	**X21**	**X22**	**X23**	**X24**	**X25**					
Benzoate concentration	2.1	2.1	1.8	1.5	2.5					

*: Mean concentration was 2.9 PPM.

Table 5. Sodium benzoate levels (in PPM) in samples of bulk cargo pickled cucumbers *

Sample code	X1	X2	X3	X4	X5	X6	X7
Benzoate concentration	400	220	230	180	225	195	200

*: Mean concentration was 220 PPM.

Table 6. Statistical variables for benzoate concentration in the studied samples

Category of the sample	**Number of the samples**	**Mean concentration± SD**	**Relative standard deviation (SEM)**	**MIN**	**MAX**	**Permissive level**	**Number of T in One-sample T-test**	**P-Value**
Canned pickles produced in food producing factories	25	2.9±0.67	0.137	1.5	4	0	- 0.8	0.429
Canned pickled cucumbers produced in food producing factories	33	2.8±0.73	0.127	1.5	4.4	0	- 1.01	0.32
Bulk cargo pickled cucumbers	7	235±74.6	28.2	180	400	0	8.2	0.0001

DISCUSSION

Benzoate level was near zero in products of food producing factories, but its level in bulk cargo pickled cucumbers products was above the permissible level. In a study conducted in USA in 2000, benzoate level was measured using HPLC method in food products including fruit juices, sodas, ketchup, soy sauce, peanut butter, and cream cheese. The results varied between 0.015 and 0.1% (9). In another study performed in Saudi Arabia in 2005, benzoate level of 29 samples of beverages, fruit juices, drinks, and high energy drinks were measured via UV spectrophotometry (10). Benzoate level was 16 PPM which was within the permissible level of benzoate. Analyzing the method of analysis of the above studies differs from the current study; in that these studies focused on benzoate level as a typical food preservative. Differences between resultant Benzoate levels can be explained by type of the food products that were analyzed. The authors could not find similar studies on benzoate level in canned pickles in their search on common scientific databases. Moreover, benzoate

level in bulk cargo pickled cucumbers was observed in the present study. Results of the present study revealed correct apprehension of the authors about probability of high benzoate level in bulk cargo pickled cucumbers.

In most canned pickles or pickled cucumber products, some food additives and flavor modifiers is added to the products. Some of these additives have low levels of benzoate. This may partly justify the presence of benzoate in products in food producing factories. These substances are not used in bulk cargo pickled cucumber products and have no role in the existence of benzoate in such food products. Iranian National Standards have debarred any use of coloring agents, flavor modifying substances, and preservatives except sorbate salts in production of pickled cucumbers. Sorbate salts can be used in production of pickled cucumbers maximally 500 PPM for an 18 kg package (3). According to Iranian National Standards sodium benzoate cannot be added to food products including pickles and pickled cucumbers.

CONCLUSION

Results of the present study have demonstrated that approved food producing factories under study follow the standards; but it is not true for bulk cargo products. It is recommended that governmental authorities provide some arrangements for more supervision and control over bulk cargo food products. Public edification about risks of bulk cargo food products is reasonable as well. Also, suitable instruments should be set in laboratories of food control for more precise analysis of food products that should be tested.

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