ASIAN JOURNAL OF PHARMACEUTICAL AND CLINICAL RESEARCH

INNOVARE ACADEMIC SCIENCES
Knowledge to Innovation

Vol 17, Issue 1, 2024

Online - 2455-3891
Print - 0974-2441

Research Article

DETERMINATION AND ESTIMATION OF PRESERVATIVES IN PACKAGED FOOD

SIREESHA KALVA*, SAI GANESH P

Department of Pharmacology, Sri Venkateshwara College of Pharmacy, Osmania University, Hyderabad, Telangana, India.
***Corresponding author: Sireesha Kalva; Email: sireesha.kalva@gmail.com**

Received: 25 April 2023, Revised and Accepted: 31 July 2023

ABSTRACT

Objectives: Packaged food and beverages are consumed all over the world for their nutritional value, durability, their quenching properties, stimulating effect, and for their medicinal value. Food additives are substances that are added to food or animal feed during processing or storage. They include antioxidants, preservatives, coloring and flavoring agents, and anti-infective agents. This study focuses on the determination of the content levels of sodium benzoate in different samples of commercially available food products in the local market.

Methods: Food products selected are Sting Energy Drink, Listerine Cool Mint Mouthwash, Kissan Fresh Tomato Ketchup, and Dabur Homemade Imli Sauce. Identification tests for the presence of benzoic and its salts in food products were conducted. A standard graph for benzoic acid at different concentrations is drawn. The concentrations of benzoic acid in selected food products were determined and evaluated by rapid and simple ultraviolet spectrophotometric methods.

Results: The results obtained from this study indicated that the quantity of benzoic acid in analyzed food samples was in the range of 18.3–160.5 µg/mL.

Conclusion: The optimum benzoic acid concentration to be in marketed food preservatives is 20–700 µg/mL. As the benzoic concentration in selected food products determined were in range, we found that all the selected samples are safe to use.

Keywords: Ultraviolet spectrometer, Food preservatives, Benzoic acid.

 DOI: http://dx.doi.org/10.22159/ajpcr.2024v17i1.48182. Journal homepage: https://innovareacademics.in/journals/index.php/ajpcr

INTRODUCTION

Food preservatives are used from the ancient times. Preservatives are substances, which are used to prevent food spoilage from microorganisms [1]. These preservatives are added to stop or delay nutritional losses due to microbiological, enzymatic, or chemical changes of food [2]. Food preservatives have become an increasingly important practice in modern food technology with the increase in the production of processed and convenience foods [3]. Conventionally, food preservation has three goals; the preservation of appearance, the preservation of nutritional characteristics, and prolongation of time that the food can be stored. Hence, food preservatives inhibit the growth of microorganisms such as yeast, molds, and bacteria and prevent the spoilage by different anti-oxidative reactions to maintain the quality, texture, consistency, color, alkalinity, or acidity [4,5].

Several forms of chemical preservatives are being currently in use in the food and beverage industries such as benzoates, sorbates, vitamins, fruit extracts, sodium salts, etc. [6,7]. Benzoates (E210–219), Sorbates (E200–E209), Nitrates (E240–E259), and Sulphites (E220–E229) are categorized under the group of antimicrobial preservatives [8].

Sodium benzoate is a common preservative added to commercially available foods and beverages. Sodium benzoate is the sodium salt of benzoic acid and works well in an acidic medium [9,10]. It is recommended as a preservative for a number of food products consumed by humans at an optimum level of 0.1% [11,12]. The recommended limits in food are 0.1 to 0.5% for different countries [11,13].

Some species of micro-organisms are resistant to chemical preservatives as well as sorbic acid and benzoic acid and they tolerate acid environment and low value of water activity [14].

Benzoic acid (C_6H_5COOH), is a colorless, crystalline solid, and the simplest aromatic carboxylic acid. The name derived from gum benzoin, which was for a long time the only source for benzoic acid. The weak acid and its salts are used as a food preservative [15].

Benzoic acid was discovered in the 16th century [16]. Benzoic acid also possesses anti-fungal abilities which used for a long time in the preservation of benzoate-containing fruits [17].

Benzoic acid and its salts are used as food preservatives, represented by the E-numbers E210, E211, E212, and E213. It is either added directly or created from reactions with its sodium, potassium, or calcium salts.

Typical levels of use of benzoic acid as a preservative are between 0.005% and 0.1% and the permissible limits are laid down in international food law [18,19].

Benzoic acid may cause diarrhoea and abdominal pain. Benzoate can be transformed by decarboxylation into toxic benzene, especially in combination with Vitamin C, and then become a compound of high toxicity, mutagenicity, and teratogenicity [20]. There are also reports that sodium benzoate has a weak genotoxic effect. Moreover, it was shown to increase the DNA damage in human lymphocyte in vitro. The compound reduces the mitotic rate [21]. Mutagenic and genotoxic effects were also demonstrated in another study on lymphocytes [22]. This compound caused micronucleus formation and chromosome breakage. In addition, the research shows that sodium benzoate generates oxidative stress and has an adverse effect on the immune system, liver, kidneys, and fertility.

The analytical determination of these preservatives is not only important for quality assurance purposes but also for consumer interest and protection. In our study, a rapid and simple method is developed, based on other methods recommended by other researchers with

some modifications, to determine benzoic acid in beverages and soft drinks or other foods. The analyses were developed and validated by ultraviolet-visible (UV-vis) spectrophotometer.

METHODS

Instrumentation

UV-vis spectrophotometric method was selected based on the previous studies. Spectrophotometric measurements of benzoic acid were carried out by means of UV-vis spectrophotometer, using 1 cm quartz cell. The absorption bands of benzoic acid solutions were recorded over the wavelength 200–400 nm.

Preparation of calibration graph

Stock standards (4.0 mg/mL benzoic acid): 400.0 mg each of benzoic acid is weighed into a 100 mL volumetric flask.50 mL 70% ethanol is added and dissolved, and diluted to volume with 70% ethanol. The stock solution is diluted to 25, 50, 75, 100, 125, and 150 µg/mL in 70% ethanol, and calibration curves were prepared.

The absorbance of each solution was measured at absorption value that was then plotted against concentration and calibration curve was generated.

Sample collection

The food samples selected were Sting Energy Drink, Listerine Cool Mint Mouthwash, Kissan Fresh Tomato Ketchup, and Dabur Homemade Imli Sauce contain benzoic acid as a preservative which is indicated on the label. The samples were procured from the local supermarket. The samples were tested for the presence of benzoic acid by ferric chloride test.

Ferric chloride test

Food product was acidified with hydrochloric acid and extracted with diethyl ether. The solvent is evaporated on a hot water bath and the last traces of solvent were removed under a current of air. The residue was dissolved in few mL of hot water. Few drops 0.5% ferric chloride solution was added. Salmon color precipitate of ferric benzoate indicated the presence of benzoic acid.

Procedure

The sample was mixed thoroughly and 100 g of the sample was transferred into a 250 mL volumetric flask using saturated sodium chloride solution. Solution was made alkaline to litmus paper with 10% sodium hydroxide solution. Made up to volume with saturated sodium chloride solution. Shaked thoroughly and kept aside for 2 h. The sample was filtered and diluted appropriately. Diluted filtrate was used for determination.

RESULTS AND DISCUSION

Benzoic acid is used as food preservative in the food products such as carbonated beverages, pickles, sauces, and jellies.

The absorption spectrum of benzoic acid standard solution indicated that the acidic form for their food preservatives was characterized by a simple ultraviolet absorption band at λmax 271 nm. It was observed that the increase in concentration of benzoic acid over the range of 25–150 µg/mL is accompanied by a proportional enhancement in the monitored absorption intensity.

The linear calibration curve obtained from the solutions analysis is presented in Fig. 2. It showed a good linear relationship between the absorbance and concentrations of the standard solutions. From the standard graph, the R square value obtained is 0.9715.

The results obtained are, this work suggests that the selected samples Listerine Cool Mint Mouthwash, Sting Energy Drink, Kissan Fresh Tomato Ketchup, and Dabur Homemade Imli Sauce have benzoic acid levels 160.5, 148.7, 18.3, 73.9 µg/mL respectively which are in the permissible limits. The highest benzoic acid levels were observed in Listerine Cool Mint Mouthwash and lowest in Kissan Fresh Tomato Ketchup.

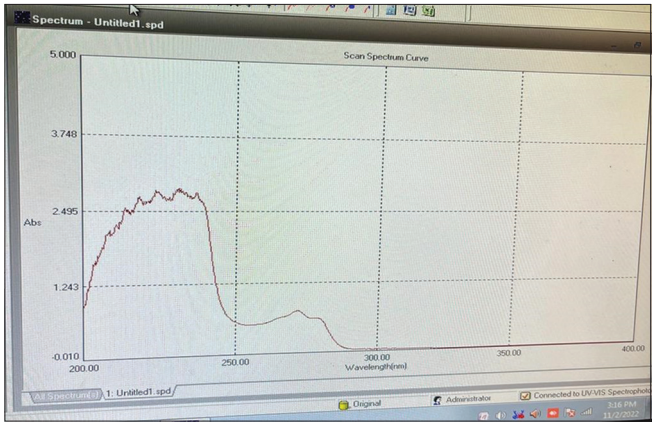

Fig. 1: Ultraviolet spectrum of benzoic acid at different concentrations

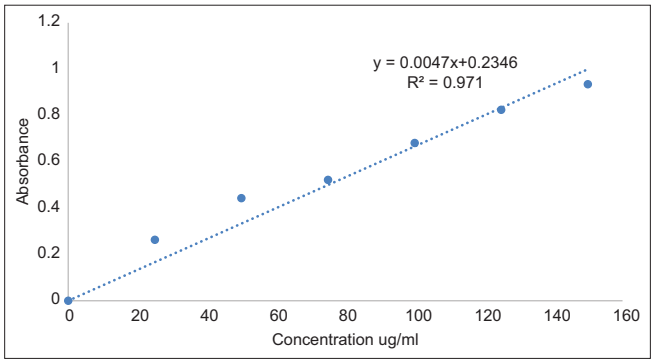

Fig. 2: Standard graph of benzoic acid in ethanol

Table 1 : Absorbance values for benzoic acid at different concentrations

Concentrations (µg/mL)	Absorbance
25	0.263
50	0.443
75	0.522
100	0.681
125	0.824
150	0.935

Table 2: Concentration of benzoic acid in selected food samples

Food samples	Absorbance	Concentration (µg/mL)
Listerine Cool Mint Mouthwash	0.989	160.5
Sting Energy Drink	0.754	148.7
Dabur Homemade Imli Sauce	0.582	73.9
Kissan Fresh Tomato Ketchup	0.321	18.3

The concentration of benzoic acid in Listerine Cool Mint Mouth wash determined was 160.5 µg/mL. The concentration of benzoic acid in Sting Energy Drink determined was 148.7 µg/mL. The concentration of benzoic acid in Dabur Homemade Imli Sauce determined was 73.9 µg/mL. The concentration of benzoic acid in Kissan Fresh Tomato Ketchup determined was 18.3 µg/mL.

Benzoate is used largely in the soft drink industry as preservative due to the amount of high fructose corn syrup in many carbonated beverages. The mechanism starts with the absorption of benzoic acid into the cell. If the intracellular pH changes to 5 or lower, the anaerobic

fermentation of glucose through phosphofructokinase is decreased by 95%. The efficacy of benzoic acid and benzoate is thus dependent on pH of the food. Acidic food and beverages such as fruit juice (citric acid), sparkling drinks (carbon dioxide), soft drinks (phosphoric acid), pickles (vinegar), or other acidified food are preserved with benzoic acid and benzoates. The food manufacturer should give special attention during their formulation for healthy preservatives as a combination of different preservatives has been known to improve not only the shelf life of the product but also enhance the quality and health benefits.

CONCLUSION

Although there are certain risk in using preservatives but its importance and contributions to packaged food industry cannot be overlooked. A lot researches are needed to be done to find out the nature and harmless preservatives. The optimum benzoic acid concentration to be in marketed food products is about 20–700 μg/mL. The benzoic acid content in the selected food samples analyzed in this study is in the range of 18.3–160.5 μg/mL in the allowable limits according to the standards and specifications of the World Health Organization.

CONFLICTS OF INTEREST

There are no conflicts of interest by the authors.

AUTHORS FUNDING

No funding was provided for this project.

REFERENCES

1. Norkulova K, Iskandarov Z, Safarov J, Jumayev B. Research dryer for drying agricultural products. J Food Ind Microbiol 2016;2:111.
2. Han JH, Floros JD. Modeling the growth inhibition kinetics of baker's yeast by potassium sorbate using statistical approaches. J Food Sci 1998;63:12-4. doi: 10.1111/j.1365-2621.1998.tb15664.x
3. Saad B, Bari MF, Saleh MI, Ahmad K, Talib MK. Simultaneous determination of preservatives (benzoic acid, sorbic acid, methylparaben and propylparaben) in foodstuffs using high-performance liquid chromatography. J Chromatogr A 2005;1073:393-7. doi: 10.1016/j.chroma.2004.10.105, PMID 15909546
4. World Health Organization (WHO). Principles for the Safety Assessment of Food Additives and Contaminants in Food (Environmental Health Criteria). Geneva: World Health. Organization; 1987.
5. Tuormaa TE. The adverse effects of food additives on health: A review of the literature with special emphasis on childhood hyperactivity. J Orthomol Med 1994;9:225-43.
6. Doughari JH, Alabi G, Elmahmood AM. Effect of some chemical preservatives on the shelf life of Sobo drink. Afr J Microbiol Res 2007;2:37-41.
7. Sharma S. Food preservatives and their harmful effects. Int J Sci Res Pub 2015;5:1-2.
8. Abdulmumeen HA Risikat AN, Sururah AR. Food: Its preservatives, additives and its applications. Int J Chem Biochem Sci 2012;1:36-47.
9. Jones JM. Food Safety. St. Paul, Minnesota: Eagan Press; 1992.
10. Brause AR. Detection of juice adulteration. J Assoc Food Drug 1993;57:6-25.
11. Chipley JR. Sodium benzoate and benzoic acid. In: Branen AL, Davidson PM, editors. Antimicrobials in Foods. New York: M. Dekker; 2005. p. 11-48. doi: 10.1201/9781420028737.ch2
12. Baldwin EA, Nisperos-Carriedo MO, Baker RA. Use of edible coatings to preserve quality of lightly (and slightly) processed products. Crit Rev Food Sci Nutr 1995;35:509-24. doi: 10.1080/10408399509527713, PMID 8777016
13. European Commission. European Union Directive 95/2/CE from 20.02.1995 on Food Additives, Colorants and Sweeteners. Brussels: European Commission; 1995.
14. Battey AS, Duffy S, Schaffner DW. Modelling mould spoilage in cold-filled ready to drink beverages by *Aspergillus niger* and *Pencillium spinulosum*. Food Microbiol 2001;18:521-9. doi: 10.1006/fmic.2001.0438
15. Gibson CM. Benzoic Acid. WikiDoc; 2012.
16. Neumuller OA. Rompps Chemie-Lexikon. 6th ed. Stuttgart: Frankh'sche Verlagshandlung; 1988.
17. Salkowski E. Über die antiseptische Wirkung Berl Klin. Wochenschr. 1875;12:297-8.
18. GSFA Online Food Additive Group. Details: Benzoates; 2006.
19. European Parliament and Council Directive No 95.2/EC of 20 February 1995 on Food Additives Other than Colours and Sweeteners; 1995.
20. Piper JD, Piper PW. Benzoate and sorbate salts: A systematic review of the potential hazards of these invaluable preservatives and the expanding spectrum of clinical uses for sodium benzoate. Compr Rev Food Sci Food Saf 2017;16:868-80. doi: 10.1111/1541-4337.12284, PMID 33371618
21. Zengin N, Yüzbaşıoğlu D, Unal F, Yılmaz S, Aksoy H. The evaluation of genotoxicocity of two food preservatives: Sodium benzoate and potassium benzoate. Food Chem Toxicol 2011;49:763-9. doi: 10.1016/j.fct.2010.11.040, PMID 21130826
22. Pongasavee M. Effect of sodium benzoate preservative on micronucleus induction, dismutase gene mutation in lymphocytes. BioMed Res Int 2015;2015:1033-512.