مجلة جامعة الزاوية للعلوم الطبيعية
University of Zawia Journal of Natural Sciences *(UZJNS)*
https://journals.zu.edu.ly/index.php/UZJNS ISSN: 3078-4999

# Measuring the Concentration of Preservative Benzoic Acid of Tomato Paste Samples by Spectrophotometer Analyzer

**Mohamed A Gabbasa [a,c,*], Badria A Salem [b], Maryam M Alajami [b]**

[a] *Department of Chemical Engineering, Zawia Higher Institute of Science and Technology, Zawia, Libya*
[b] *Department of Chemistry, Faculty of Sciences, Almeregib University, Al-khoms, Libya*
[c] *Department of Chemical Engineering, Faculty of Engineering, Universiti Kebangsaan Malaysia, 43600 Bangi, Selangor, Malaysia*
**Corresponding author:*
E-mail address: Gabbasa80@gmail.com

Received 17 Feb 2025 | Accepted 11 Mar 2025 | Available online 15 Mar 2025 | DOI: 10.26629/uzjns.2025.04

**A B S T R A C T**

The principle main goal of any human that Obtain good food. The safety of any food item is the basis of its quality and its containment of guaranteed concentrations of additives. Canned food has preservatives added to prevent spoilage. Benzoic acid is added to tomato paste as a preservative, and the concentration of the preservative must be within the permissible range to ensure the health of the consumer. This article aims to measure and evaluate the concentration of the preservative (Benzoic acid) in Fifteen (15) samples of Tomato Paste (Triplicate for each sample) collected From the Libyan markets and then analyzed by using a UV-visible spectrophotometer analyzer. The results were fairly close, as follows, the lowest value and highest value for the concentrations of the preservative in the samples were 14 and 15 which amounted between 65.50 mg/kg and 449.70 mg/kg respectively, were the values of RSD less than 5 % For all studied samples. However, the concentrations of the preservative in all samples were within the permissible limits WHO as less than 1000 mg/kg. The article concluded that the optimum benzoic acid concentration to be in marketed food preservatives is between 70–500 mg/kg. And the benzoic concentration in selected food products determined were in the range, the study found that all the selected samples were qualified and safe.

***Keywords:*** *Benzoic Acid, Concentration, Tomato Paste, Spectrophotometer Analyzer.*

## قياس تركيز حمض البنزويك الحافظ لعينات معجون الطماطم بواسطة جهاز التحليل الطيفي

محمد عبد المجيد قباصة [a,c,*] ، بدرية عبد السلام سالم [b] ، مريم محمود العجمي [b]

[a] قسم الهندسة الكيميائية ، المعهد العالي للعلوم والتقنية الزاوية ، الزاوية ، ليبيا
[b] قسم الكيمياء ، كلية العلوم، جامعة المرقب ، الخمس، الخمس، ليبيا
[c] قسم الهندسة الكيميائية ، كلية الهندسة ، الجامعة الوطنية الماليزية ، 43600 بانقي، سلانقو، ماليزيا

**الملخص**

أن الهدف الرئيسي لأي إنسان هو الحصول على الغذاء الجيد. إن سلامة أي مادة غذائية هي أساس جودتها واحتوائها على تركيزات مضمونة من المواد المضافة. يتم إضافة مواد حافظة إلى الأغذية المعلبة لمنع التلف. يضاف حمض البنزويك إلى معجون الطماطم كمادة حافظة، ومن المهم أن يكون تركيز المادة الحافظة ضمن النطاق المسموح به لضمان صحة المستهلك. تهدف هذه الدراسة إلى قياس وتقييم تركيز المادة الحافظة (حمض البنزويك) في خمسة عشر (15) عينة من معجون الطماطم (ثلاث نسخ لكل عينة) تم جمعها من الأسواق الليبية، ثم تم تحليلها باستخدام جهاز تحليل الطيف المرئي فوق البنفسجي. كانت النتائج متقاربة إلى حد ما، على النحو التالي، كانت أقل قيمة وأعلى قيمة لتركيزات المادة الحافظة في العينات 14 و 15 والتي بلغت بين 65.50 ملغم / كجم و 449.70 ملغم / كجم على التوالي، وكانت قيم **RSD** أقل من 5٪ لجميع العينات المدروسة. ومع ذلك، كانت تركيزات المادة الحافظة في جميع العينات في الحدود المسموح بها من قبل منظمة الصحة العالمية والتي تقل عن 1000 ملغم/كجم. وخلصت المقالة إلى أن التركيز الأمثل لحمض البنزويك في المواد الحافظة الغذائية المتداولة في السوق يتراوح بين 70-500 ملغم / كجم. وقد تم تحديد تركيز البنزويك في المنتجات الغذائية المختارة ضمن النطاق، ووجدت نتائج الدراسة أن جميع العينات المختارة مؤهلة وآمنة.

***الكلمات المفتاحية:*** *حمض البنزويك، التركيز، معجون الطماطم، محلل الطيف الضوئي.*

## 1. Introduction

The preservatives are chemical 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 reactions of substances [2]. Whereas, food preservatives have become an increasingly important practice in modern food sciences with the high increase in the production of processed and convenience foods [3]. In this time, several forms of chemical preservatives are currently in use in the food and beverage industries such as benzoates, vitamins, fruit extracts, sodium salts, etc. All of these are categorized under the group of antimicrobial preservatives [4]. The benzoate sodium benzoate is a common preservative added to commercially available foods and beverages. Therefore, sodium benzoate is the sodium salt of benzoic acid and works very well in an acidic medium [5]. It is recommended as a preservative for many food products consumed by humans at an optimum level of 0.10%. The specific international limits values in food are 0.10% to 0.50% according to the WHO in most of the countries in the world. A study was carried out to determine the preservatives, sodium benzoate and potassium sorbate in approximately 100 or more types of tomato paste by spectrophotometry and High-Performance Liquid Chromatography (HPLC) methods in some countries. The results showed that SB and PS were not detected in tomato paste types, due to the consumption of these preservatives of significant carcinogenic risk, more care in monitoring these preservatives of with significant carcinogenic risk, there should be also more care in monitoring these substances by the food health authorities [4,5]. The most of estimated benzoate and sorbate in tomato paste by HPLC. Therefore, the results showed that 75% of 45 samples were positive for benzoate in the range of 73.2-20.9 mg/kg only one sample contained sorbate, which represented 25% of tomato paste in the Iranian markets indicating that some of the producing factories did not follow the quality and global health standards [6].

Some researchers as determined Sodium benzoate and potassium sorbate by HPLC in different samples from Syrian markets including tomato paste, the results showed the presence of benzoate and sorbate concentrations within the permissible limits [7,8]. Moreover, benzoic acid is an important preservative with antimicrobial activity, which is industrially synthesized and added not only to food, but also to cosmetics, hygiene, and pharmaceutical products. In some research conducted by [9] to measure the concentration of benzoic acid and heavy metals in some foods, it was noted from the results that the concentration of benzoic acid in all samples is within the recommended limits from the World Health Organization [9,10].

The main objective of this article is to measure and assess the concentration of the preservative Benzoic Acid in Fifteens (15) samples of Tomato Paste collected from the Libyan markets and then analyzed by using a UV-visible spectrophotometer analyzer (Triplicate for each sample), make sure that sample according within the international permissible limits.

## 2. Materials and methods

### 2.1. Sample collections

The tomato pasta cans sample was 15 samples collected from different Libyan markets during the end year of 2024. Fifteen types of tomato paste imported brands and origin countries all of them during the expiring dates were collected and analyzed as shown in Table 1.

**Table 1.** Tomato paste samples as country of manufacture product

| Sample No. | Code of Sample | Country of Manufacture Product |
|---|---|---|
| **01** | TP 01 | European Union |
| **02** | TP 02 | European Union |
| **03** | TP 03 | Cyprus |
| **04** | TP 04 | Cyprus |
| **05** | TP 05 | Turkey |
| **06** | TP 06 | Turkey |
| **07** | TP 07 | Tunisia |
| **08** | TP 08 | Tunisia |
| **09** | TP 09 | Libya |
| **10** | TP 10 | Libya |
| **11** | TP 11 | Algeria |
| **12** | TP 12 | Algeria |
| **13** | TP 13 | Italia |
| **14** | TP 14 | Italia |
| **15** | TP 15 | Egypt |

### 2.2. Materials and devices

The analyses were conducted (Triplicate for each sample) using UV/Visible spectrophotometer type (UV-6300 PC UV/Visible Spectrophotometer) as shown in Figure 1, model Helios Alpha, produced by

Europe Western and Northern company, attached to a computer and printer, working within the wavelength range of 200 nm to 1000 nm, and cells of light path length quartz. From the correlation absorbance with the calibration graph obtained using standard benzoic acid solution, the amount of benzoic acid was determined [10,11].

**Figure 1.** UV-6300-PC UV/Visible Spectrophotometer

### 2.3. Experimental procedure

#### 2.3.1.Preparation of standard solutions

Prepare a solution of benzoic acid in ether containing 20, 40, 60, 80, and 100 mg/l. Determine the absorbance of these solutions in a spectrophotometer between points 268.5 nm and 276.5 nm. [12.13,14]. For each concentration average absorbance at band 276.5 nm subtract from absorbance at 268.5 nm. Plot a difference against the concentration to get the standard curve. Prepare samples by mixing each sample thoroughly. Then transfer 10 gm to the separator funnel and dilute to 200 ml with saturated sodium chloride solution. Acidity of solution with hydrochloric acid mixed well, prepare a solution of benzoic acid in ether containing 20, 40, 60, 80, and 100 mg/l [15,16].

An accurately weighed 50 mg of benzoic acid was transferred into a 50 ml volumetric flask, added ether to dissolve it and made up the final volume with ether (1000 ppm). A 5 ml of stock solution was taken in a 50 ml volumetric flask and made up to mark with ether (100 ppm) in Stock 1 [17,18]. From stock 1, A 5 ml was taken in a 10 ml volumetric flask and made up to mark with ether (50 ppm), which was scanned in the range of 265 nm to 280 nm. From the stock solution, appropriate dilutions were made to obtain the final concentration of 20, 40, 60, 80, and 100 ppm and absorbance was determined at 272 nm [19,20,21]. A calibration curve was plotted by taking concentration on the X-axis and absorbance at the Y-axis as shown in Figure 2.

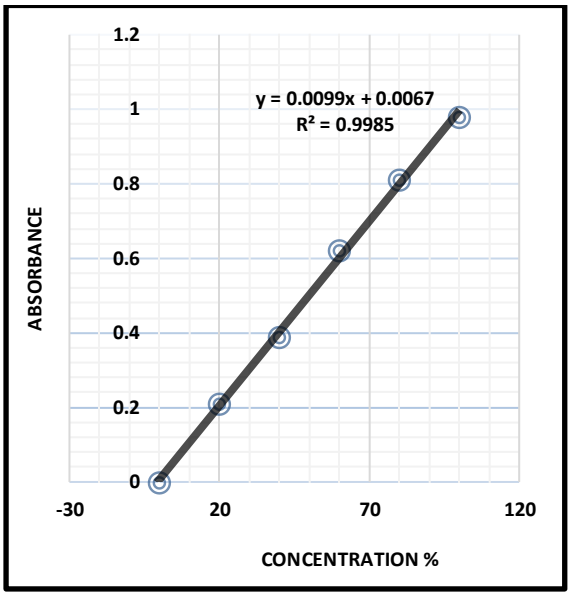


**Figure 2.** Calibration curve for benzoic acid solution

#### 2.3.2. Method preparation

Preparing 10 gm from each sample was collected whereas, each sample was separators and diluted to 200 ml with saturated sodium chloride solution. The solution was made acidic to litmus with HCL mixed well. The prepared solution was extracted with each 30, 40, 50, 60, and 70 ml portions of diethyl ether, and shaken well to ensure complete extraction. The aqueous phase was drained and discarded. The combined ether extracts were washed with 40 and 50 ml portions of HCL [21,22]. The ether solution was extracted with 20, 30, 40, 50, and 60 ml portions of ammonium hydroxide, ether layer was discarded. Combined ammonium hydroxide extract was neutralized with hydrochloric acid and 1.0 ml in excess was added. The acidified solution was extracted with 30, 40, 50, 60, and 70 ml of ether. The combined ether extract was diluted to 100 ml with ether [23,24].

## 3. Result and discussion

Sodium benzoate is used as a preservative for most canned foods, including tomato paste. From the calibration curve in Figure 2, a linear direct relationship was observed between the concentration of standard solutions and absorption. The ($R^2$) square value obtained was exactly 0.9985. The result values of the analysis of benzoic acid have been presented in Table 2. The values range between

65.50 mg/kg to 449.70 mg/kg, the highest value of 449.70±0.30 mg/kg was in sample 15 and the lowest value of 65.5±0.50 mg/kg was in sample 14 for tomato paste.

In Table 3. Shows results of a large discrepancy reaches a maximum of 449.70 mg/kg in the samples fifteens This discrepancy appears in Figure 3., The reason for the presence of benzoic acid is that it is added as a preservative to tomato paste. However, the results of benzoic acid are lower than the values of permissible limits according to the standard international specifications [25]. Indeed, overall, the obtained values result in the occurrence of all values less than the permissible limits according to the standard international specifications as less than 1000 mg/kg.

The results indicate that the benzoic acid values are all within the WHO permissible range [25,26]. However, samples like samples 5, 13, and 15 are higher than other samples, but these values are not higher than the permissible limits. That is because, some of the samples with high values as samples 5, 13, and 15 had high acidity (PH) values the other hand, some of the manufacturing products do not follow the international specifications for cover and coating of the uses metal containers material of the samples of tomato paste. Therefore, some of the company uses metal containers, which are filled from the inside with cadmium-containing substances to prevent rusting. Over time, the metal packaging becomes susceptible to whole contamination with tomato paste.

**Table 2.** Result values of benzoic acid are presented as mean ± standard deviation for 15 samples of tomato paste

| Code of Sample | SD (Mg/Kg) | Mean± SD (Mg/Kg) n=3 | *RDS % |
|---|---|---|---|
| **TP 01** | 116.04 | 116.04±0.08 | 1.16% |
| **TP 02** | 105.01 | 105.01±0.03 | 1.05% |
| **TP 03** | 232.32 | 232.32±0.96 | 2.32% |
| **TP 04** | 95.60 | 95.60±0.90 | 0.96% |
| **TP 05** | 315.40 | 315.40±0.08 | 3.15% |
| **TP 06** | 90.22 | 90.22±0.00 | 0.90% |
| **TP 07** | 220.13 | 220.13±0.60 | 2.21% |
| **TP 08** | 168.41 | 168.41±0.80 | 1.68% |
| **TP 09** | 211.67 | 211.67±0.10 | 2.12% |
| **TP 10** | 88.89 | 88.89±0.50 | 0.88% |
| **TP 11** | 102.10 | 102.10±0.40 | 1.02% |
| **TP 12** | 86.56 | 86.56±0.60 | 3.13% |
| **TP 13** | 312.03 | 312.03±0.70 | 0.86% |
| **TP 14** | 65.50 | 65.50±0.50 | 0.65% |
| **TP 15** | 449.70 | 449.70±0.30 | 4.49% |
| **WHO** | 0.00* | 1000.00 ±0.00 | 0.00% |

(*): Maximum Permissible Limits.
(*RSD): Relative Standard Deviation.

**Table 3.** Min and Max for benzoic acid concentration for tomato paste samples

| Tomato Paste Samples | Min Mean ± SD (Mg/Kg) | Mix Mean ± SD (Mg/Kg) | International Standard Specification (Mg/Kg) |
|---|---|---|---|
| **Code of sample** | TP 14 | TP 15 | WHO |
| **Results values (mg/kg)** | 65.50±0.50 | 449.70±0.30 | < 1000.00 |

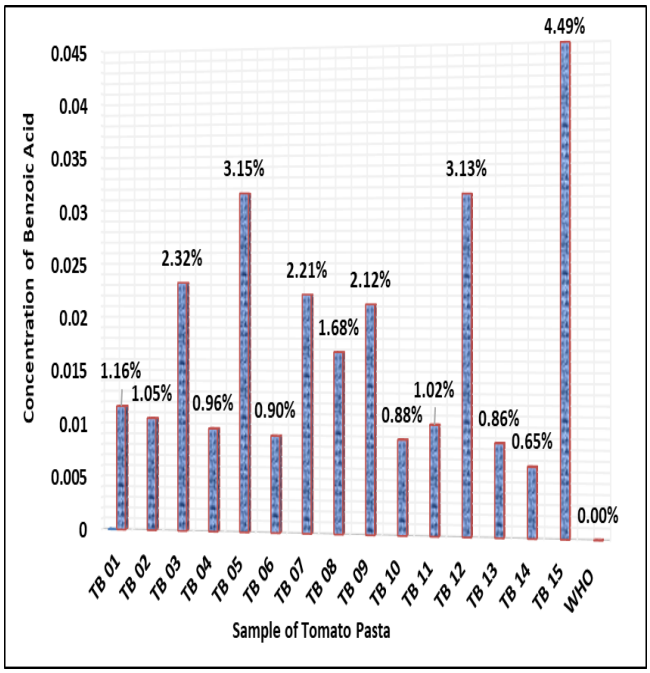


**Figure 3.** Concentration of benzoic acid in tomato pasta samples

## 4. Conclusion

Due to the high consumption of tomato paste by Libyans, the quality control of this product has become very important. Therefore, it is necessary to manage the continuous monitoring of sodium benzoate amount in Canned tomato paste. Although there is a certain risk in using preservatives the very importance of our raw materials and contributions to the packaged food industry cannot be ignored or overlooked. Much research needs to be done to find out the nature and harmless preservatives in our food. We summarized that in article used a UV-visible spectrophotometer for the detection of benzoic acid in Fifteen samples of tomato paste. All

the results values of measuring preservative concentration in tomato paste samples were within permissible limits of the World Health Organization. The optimum benzoic acid concentration to be in marketed food products is less than 1000 mg/kg and is still an acceptable value in this article, we concluded that all of the samples of tomato pasta are between (70-500 mg/kg). The benzoic acid content in the selected food samples analyzed in this study is in the range of 65.50 mg/kg and 449.70 mg/kg in the acceptable limits according to the standards and specifications of the World Health Organization.

## 5. Recommendation

During our research we recommended that should be, using natural preservatives instead of manufactured ones. Also, we recommend that tomato paste manufacturing and packaging companies add quantities of preservatives within the permissible limits, and adhere to the specifications for Libyan and international health standards preservatives to get accurate data, by using more sophisticated analytical techniques.

**Acknowledgement**

The authors would like to thank the Libyan Medical Research Center of Zawia - Libyan Authority for Scientific Research - Tripoli, Libya for her great full support in completing this research.

## References

[1] Amirpour M., Arman A., Yollmeh A., Azam M., and Morad Z. sodium benzoate and potassium sorbate preservatives in food stuffs in Iran . journal food additives and contaminants, 8(2), 8-142, 2015.

[2] Antakli S., Alhmed A., and Badinjk B. simultaneous determination of sodium benzoate and potassium sorbate preservatives in foodstuffs using high performance liquid chromatography. journal of chemistry, 22(4), 3275-3282, 2010.

[3] Abdalla. F. Determination of benzoic acid concentration in tomato paste. M.SC, chemistry. University of Niles, Khartoum, Sudan. October 2020.

[4] Chalesshtori F., Arian A., and Chaleshtori R. Assessment of sodium benzoate and potassium sorbate preservatives in some produce in Kashan, Iran with estimation of human health risk. journal food and chemical toxicology 12(6),634-638, 2018.

[5] Merve K., Burcu C., and Hayda O. Investigation of sorbic acid and benzoic acid amount some food exposed for sale in Istanbul. journal of food engineering research, 2:2, 43-58, 2016.

[6] Patricia Haricarova, et al. Different behavior of food-related benzoic acids toward iron and copper. Journal of Food Chemistry, 462:2025, 1-11, 2025.

[7] Peyman Ghajarbeygi, et al. Assessment of Sodium Benzoate and Potassium Sorbate Preservatives and Artificial Color in Bulk Tomato Paste Samples in Qazvin, Iran. Journal of Chemical Health Risks. 12(3), 501-507, 2022.

[8] Shaamial S., and Sawsan Al-Hilfi. Estimating the percentage of benzoic acid and heavy metals in some fresh and processed foods in the markets of Basra city, Syrian Journal of Agricultural Research 4(2), 64-73, 2017.

[9] Uysal E., Akcadag F., Tokman N. proficiency testing for determination of metals in tomato paste. journal of chemical metrology, 8(1),13-26, 2014.

[10] Tfouni S., Toledo M. Determination of benzoic and sorbic acids in Brazilian food. Food Control. 13(2), 117-123, 2002.

[11] Dong C., Mei Y., Chen L. Simultaneous determination of sorbic and benzoic acids in food dressing by headspace solid-phase microextraction and gas chromatography. J Chromatogr A. 1117(1), 109-114, 2006.

[12] Ferreira I. M., Mendes E., Brito P., Ferreira M.A. Simultaneous determination of benzoic and sorbic acids in quince jam by HPLC. Food Res Int. 33(2), 113-117, 2002.

[13] Khosroukhavar R., Sadeghzadeh N., Amini M., Ghazi-Khansari M., Hajiaghaee R., Ejtemaei Mehr S. Simultaneous determination of preservatives (sodium benzoate and potassium sorbate) in soft drinks and herbal extracts using high-performance liquid chromatography (HPLC). J Med Plants. 9(35), 80-87, 2010.

[14] Juhlin L. Recurrent urticaria: clinical investigation of 330patients. Brit. J. Dermatol. 104(3), 369–381, 1981.

[15] Faraji M., Rahbarzare F. Simultaneous determination of four preservatives in food stuffs by high performance liquid chromatography. Nut Food Sci Res. 3(2),43-50, 2016.

[16] 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, 49: 763-35, 2011.

[17] Delavar M., Ahmadi A. R., Kazemifar A. M., Abdollahi M. 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. Iran J. Toxicol. 6(18), 686-690, 2012.

[18] Yildiz A., Erdogan S., Saydut A., Hamamci C. High-performance liquid chromatography analysis and assessment of benzoic acid in yogurt, ayran, and cheese in Turkey. Food Anal Methods. 5(3), 591-595, 2012.

[19] Mahboubifar M., Sobhani Z., Dehghanzadeh G., Javidnia K. A comparison between UV/spectrophotometer and high-performance liquid chromatography method for the analysis of sodium benzoate and potassium sorbate in food products. Food Anal Methods. 4(2), 150-154, 2011.

[20] Piper J. D. Piper P. W. 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, 16: 80-86, 2017.

[21] Esfandiari Z. N., Hosseini H. Examination of the Antimicrobial Preservatives of Benzoic Acid and Sodium Benzoate in Different Food Products in Iran: A Review of the Current Evidence. J. Health Syst Res. 13(1), 1-9, 2017.

[22] Pongasavee M. Effect of sodium benzoate preservative on micronucleus induction, dismutase gene mutation in lymphocytes. BioMed Res Int, 1033-512, 2015.

[23] Arijit Chatterjee. Quantitative Estimation and Comparative Study of Sodium Benzoate in Local Tomato Sauce by UV Spectrophotometric Method. International Journal of Research in Engineering and Science, 10(12),48-53, 2022.

[24] Beezhold B. L., Johnston C.S., Nochta K.A. Sodium benzoate–rich beverage consumption is associated with increased reporting of ADHD symptoms in college students: A pilot investigation. J Atten Disord. 18(3), 23-24, 2014.

[25] World Health Organization, Expert Committee on Food Additives, World Health Organization & Food and Agriculture Organization of the United Nations. Toxicological evaluation of certain food additives with a review of general principles and of specifications: seventeenth report of the Joint FAO/WHO Expert Committee on Food Additives, Geneva, 25 June 1974.

[26] World Health Organization, report of the Exposure to cadmium: a major public health concern. www.who.int/ipcs/features/pdf. Accessed 10 Oct 2011.