**Alqalam Journal of Medical and Applied Sciences**. 2025;8(3):2068-2071
https://doi.org/10.54361/ajmas.2583113

*Original article*

# Determination of Benzoate Sodium Level in Some Fruit Juice and Soft Drink Brands in Derna Markets by UV- Spectrophotometric Method

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**Abstract**
In the food and beverage industry, sodium benzoate is widely used due to its antimicrobial effectiveness. This study aimed to determine the concentration levels of sodium benzoate in various 20 commercially available beverages in Derna, Libya, using a rapid and simple UV spectrophotometer. The effectiveness of the method appeared to have good accuracy, with a mean recovery of 89.8% to 114% for benzoate. The samples studied were classified into two categories: fruit juice and soft drinks. The results showed that sodium benzoate concentrations in juice samples ranged from 31.64–145 ppm, while soft drink samples exhibited higher concentrations ranging from 18.07–173.34 ppm. The lowest concentration was recorded in the Alain-Diet (Benghazi-Libya) (18.07 ppm), whereas the highest was found in the frizbi (Turkey) (173.34 ppm). All measured levels were within the acceptable limits established by international standards, including those of the World Health Organization (WHO), confirming that all tested products are safe for human consumption.
**Keywords**: *Sodium Benzoate, UV-* Vis Spectrophotometer, Fruit Juice, Soft Drink.

## Introduction

With the increasing demand for ready-made industrial foods, food preservation has become a fundamental aspect of modern food technology; various methods are developed to ensure product quality without losing its nutritional value and ensuring its safety. Therefore, preservatives are added to prevent or delay changes in taste, aroma, and nutritional value. This is by preventing acidification, fermentation, and microbial contamination resulting from microorganisms, enzymes, or physical factors [1,2]. Because sodium benzoate is low-cost and has high antimicrobial efficacy [3,4], its effectiveness and water solubility make it one of the most preferred synthetic preservatives worldwide and used as a preservative for many commercial beverages, especially highly acidic beverages, such as fruit juices and soft drinks, also for jams and condiments [5].
Sodium benzoate is highly soluble in water. As a salt of benzoic acid, it functions optimally in acidic conditions (pH 2.5 – 4.0), where it effectively inhibits the growth of bacteria, molds, and yeasts [1, 6]. Sodium benzoate was classified under E211. Under certain conditions, sodium benzoate is converted into benzoic acid (E210), as a "Generally Recognized as Safe" (GRAS) preservative by the U.S. Food and Drug Administration (FDA). It destroys the internal proton of microbial cells, making it effective as an antibacterial and antifungal. Due to its poor solubility in water, benzoic acid was not used directly. The maximum admissible concentration is about 0.1% [7,8]. The acceptable daily intake (ADI) for the preservative ranges from 0 - 5 mg/Kg body weight, and the lethal dose (LD50) according to the European Food Safety Authority (EFSA) is 2000 mg/Kg [9]
There are concerns about the side effects of excessive sodium benzoate consumption, especially when combined with other ingredients such as ascorbic acid, which may cause benzene formation, a known carcinogen [6]. Furthermore, sodium benzoate has been associated in some studies with oxidative stress, DNA damage, potential genotoxic effects, hyperactivity in children, impaired liver and kidney function, and reproductive toxicity [1]. For consumer protection and quality control, accurate determination of sodium benzoate in beverages and food products is crucial [10]. There are different techniques for the analysis of benzoates in food products, such as gas chromatography, thin-layer chromatography, ultraviolet spectroscopy, and high-performance liquid chromatography (HPLC) [11,12]. The present research was aimed at determining the levels of the preservative sodium benzoate in some brands of beverages available in the Libyan market. One of the most practical and reliable methods for this purpose is ultraviolet-visible spectroscopy, which enables the determination of benzoic acid concentration through calibration curves and absorbance measurements [3,13] and comparison of results to national and international regulatory standards.

## Materials and Methods

### *Sample Collection*

Twenty beverage samples were collected randomly from markets in Derna, Libya. The samples were selected based on products that declared the presence of sodium benzoate preservatives on their labels. The samples included nine fruit juices and twelve soft drinks. The fruit juice samples were coded F1–F9, and the soft drink samples S1–S11. All samples were freshly analyzed.


***Received****: 25-07-2025 -* ***Accepted****: 22-09-2025 -* ***Published****: 30-09-2025*

https://doi.org/10.54361/ajmas.2583113

### *Chemicals and Reagents*

Laboratory chemicals and reagents used in this study were analytical grade. Hydrochloric acid was purchased from BDH (VWR International, UK), petroleum ether was purchased from Riedel-de Haen (Germany), and sodium benzoate was purchased from Cosmic Chemical (India).

### *Apparatus and instruments*

A UV-Vis spectrophotometer (JENWAY 6305, England) was used for all absorbance measurements. Using a 1 cm quartz cell.

### *Standard Preparation*

The UV method used was as described in the ISO nos. 5518 and 6560 procedures [14, 15]. For the calibration, 100.0 mg of sodium benzoate was dissolved in a 100.0 mL volumetric flask. Dilution of the stock solutions was made with distilled water to yield 60, 50, 40, 30, 20, and 10 mg/L of sodium benzoate standard solution. Then, 5 mL each of the working standard solutions prepared was extracted with 0.4 mL of 6 M hydrochloric acid and 45 mL of petroleum ether. The absorbance of the standard samples was detected at 227 nm for sodium benzoate.

### *Sample Preparation*

The samples were extracted using the method reported by Reddy et al. with slight modification [16]. The samples were prepared by adding 0.4 ml of 6 M hydrochloric acid to 5.0 ml of the sample without dilution and extracting with 45 ml of petroleum ether. The absorbance of the samples was detected at 227 nm for sodium benzoate.

## Results

In this study, the concentration of sodium benzoate in samples of fruit juices and soft drinks was determined using the ultraviolet spectroscopic method. The method was first validated regarding linearity, precision, and accuracy. The graph of six points of absorption versus concentration was drawn (Fig. 1), the linear regression equation was y = 0.011x + 0.0912 with a correlation coefficient of 0.9768. RSD for three replicate determinations (intraday) was good, and it can be concluded that the stability of the samples was appropriate. Mean recoveries for benzoate were found to be 89.8–114%. This indicates that the method shows good accuracy for the determination of Sodium benzoate (Table 1).

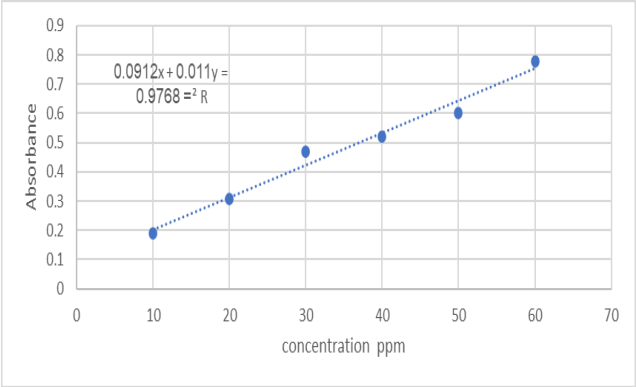


***Figure 1. Calibration curve for Sodium benzoate at 227nm***

***Table 1. The precision and accuracy of the UV method for sodium benzoate with three replicate determinations***

| Sodium Benzoate Concentration (ppm) | Calculated Sodium Benzoate concentration (mean± SD) | Absorbance Standard Average | Relative standard deviation | Recovery (%) |
|---|---|---|---|---|
| 10 | 8.98±0.00 | 0.19 | 0 | 89.8 |
| 20 | 19.7±0.01 | 0.308 | 3.2 | 98.8 |
| 30 | 34.4± 0.01 | 0.47 | 2.1 | 114 |
| 40 | 38.95±0.03 | 0.52 | 5.7 | 97.4 |
| 50 | 46.2±0.08 | 0.60 | 1.6 | 92.5 |
| 60 | 62.4±0.01 | 0.778 | 2.5 | 104.1 |


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Results of the analysis of fruit juice and soft drinks samples are demonstrated in (Tables 2-3). The analysis was performed 3 times for each sample, and their mean were reported in the tables.

***Table 2. Concentration of Sodium benzoate in fruit juice samples***

| Code | Brand name | Origin | Concentration of Sodium Benzoate in the sample (mean± SD) |
|---|---|---|---|
| F1 | Helow Alrabee | Tobruk-Libya | 71.07±0.0123 |
| F2 | Sabrina (almond drink) | Ajilat- Libya | 117 ±0.019 |
| F3 | Amwaj | Libya | 36.009± 0.0026 |
| F4 | Annad | Libya | 84.98 ±0.0231 |
| F5 | Sabrina (limonada) | Ajilat- Libya | 145± 0.0075 |
| F6 | Ranch | Saudi Arabia | 71.07±0.0234 |
| F7 | Viva | North Macedonia | 52.89±0.232 |
| F8 | Wadian | Egypt | 53.70±0.0240 |
| F9 | Aseel | United Arab Emirates | 31.64±0.0015 |

***Table 3. Concentration of sodium benzoate in a soft drinks sample***

| Code | Brand name | Origin | Concentration of sodium Benzoate in the sample (mean± SD) |
|---|---|---|---|
| S1 | Frizbi | Turkey | 173.34±0.001 |
| S2 | Schweppes | Egypt | 98.25±0.01 |
| S3 | Alain | Benghazi-Libya | 18.70±0.0076 |
| S4 | Alain (Diet) | Benghazi-Libya | 18.07±0.0083 |
| S5 | Shani | Tripoli-Libya | 103.25±0.002 |
| S6 | Freez | Lebanon | 22.17±0.01 |
| S7 | Silver | Libya | 66.52±0.01 |
| S8 | Sprite | Libya | 67.30±0.0015 |
| S9 | Waw | Saudi Arabia | 58.52±0.005 |
| S10 | Bitter soda | Egypt | 85.43±0.015 |
| S11 | Seven up | Tripoli-Libya | 29.35±0.020 |

## Discussion

This study showed that all the samples contained sodium benzoate, and the sodium benzoate concentrations ranged between 31.64– 145 ppm in the fruit juice (Table 2). The determination of the sodium benzoate in carbonated soft drinks revealed a concentration range of 18.07 – 173.34 ppm (Table 3). Our results show that all fruit juice and soft drink brands that contain sodium benzoate are within acceptable limits. Among the frizbi (Turkey) contains the highest amount of sodium benzoate, while Alain-Diet (Benghazi-Libya) was the lowest. Several studies, have been conducted to estimate the concentration of sodium benzoate in samples of various juices and soft drinks in the Libyan market. The UV–Visible spectrophotometry method was used to determine the concentration. These studies measured benzoate in samples of energy drinks available in Al-Asabaa markets [17].

Also, fifteen samples were tested from different markets in Benghazi. [3]. The UV-Visible spectrophotometer was also utilized to establish sodium benzoate concentrations in both imported and locally made soft drinks in the city of Al-Bayda. It is worth noting that the concentration of sodium benzoate was measured without any extraction or separation of the benzoate from the samples, after filtration and dilution [18]. We found that previous studies are consistent with the current study, as most samples fall within the acceptable limits set by international standards, including those of the World Health Organization.

## Conclusion

Fruit juices and soft drinks contain good levels of sodium benzoate that do not exceed the permissible limits. The highest concentration of sodium benzoate was found in the Frizbi-Turkey sample (the imported sample). The UV–Visible spectrophotometry method used in this study was very accurate. We recommend that other researchers conduct further studies to determine sodium benzoate and other additives in larger samples of commercial products from different brands to complement our study.

***Conflict of interest.*** Nil

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***Received****: 25-07-2025 -* ***Accepted****: 22-09-2025 -* ***Published****: 30-09-2025*

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***Received****: 25-07-2025 -* ***Accepted****: 22-09-2025 -* ***Published****: 30-09-2025*