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# Spectrophotometric Determination Of Sodium Benzoate in Some Energy Drinks With Different Brands

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# التحديد الطيفي لبنزوات الصوديوم في بعض مشروبات الطاقة من ماركات مختلفة

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**Abstract:**
Energy drinks are widely consumed by teenagers and young adults to enhance focus and energy. However, excessive consumption may lead to negative health effects, especially when they contain preservatives like sodium benzoate. In this study, the concentration of sodium benzoate was determined in four imported energy drink samples available in Asb'ah markets. The analysis was conducted using a UV spectrophotometric method, which proved to be both simple and accurate. The concentration of sodium benzoate in the samples ranged from 1361 to 1424.55 mg/L. The results indicated that all tested samples contained sodium benzoate levels within the upper safety limits established by the FDA.

**Keywords:** Energy Drink, Sodium Benzoate, Food Preservatives, UV–Visible Spectrophotometry.

**الملخص**
تستهلك مشروبات الطاقة على نطاق واسع من قبل المراهقين والشباب وذلك بهدف زيادة التركيز الانتباه والطاقة، ومع ذلك فإن الاستهلاك المفرط لها قد يؤدي الى أثار صحية سلبية خاصة أنها تحتوي على مواد حافظة مثل بنزوات الصوديوم. في هذه الدراسة، تم تحديد تركيز بنزوات الصوديوم في أربع عيينات من مشروبات الطاقة المستوردة والمتوفرة في أسواق مدينة ألأصابعة، باستخدام طريقة التحليل بالأشعة فوق البنفسجية والتي أثبتت فاعليتها من حيث الدقة والسهولة. تراوح تركيز بنزوات الصوديوم في العينات بين 1361و 1424.55 ملجم/لتر. أظهرت النتائج أن جميع العينات تحتوي على كميات من بنزوات الصوديوم اعلى من الحدود المسموح بها من قبل إدارة الغذاء والدواء الأمريكية.

**كلمات المفتاحية:** المواد الحافظة، مطيافية الأشعة الفوق البنفسجية مشروبات الطاقة، بنزوات الصوديوم.

## Introduction

Food preservatives are substances added to food products to prevent decomposition caused by adverse chemical changes or microbial activity. These preservatives are generally categorized into natural and chemical preservatives. Chemical preservatives are widely utilized in processed foods to inhibit the growth of bacteria, yeasts, and other microorganisms that contribute to food spoilage (Sabir et al., 2016). Their primary function is to extend the shelf life of food products while maintaining their quality and flavor over an extended period (Indrajit, 2011). The most commonly used preservatives in many types of foods are benzoic and sorbic acids, as well as nitrates and nitrites (B. Akbar et al., 2013; Ahmet Kucukcetine, 2008). Among chemical preservatives, sodium benzoate is one of the most

commonly used. Sodium benzoate is the sodium salt of benzoic acid (Elmanfe, 2020). It has the chemical formula $C_7H_5O_2Na$, is an odorless compound, and is soluble in both water and ethanol (Lennerz B.S. et al., 2015).

Sodium benzoate is particularly effective in preserving acidic foods and beverages, such as pickles, salads, fruit juices, and soft drinks, as it performs optimally within a pH range of 2 to 4 (Gordana et al., 2012). Although sodium benzoate is considered non-toxic when used within the permissible limits established by the Food and Drug Administration (FDA) (100 ppm) (Rwida A. Alsqir et al., 2022), excessive consumption has been associated with several adverse health effects, including hyperactivity in children, gastrointestinal disturbances, headaches, and skin rashes (Eguntade, 2022). Furthermore, when sodium benzoate interacts with ascorbic acid (Vitamin C), it can undergo a chemical transformation into benzene. This reaction is further accelerated by exposure to heat and light, increasing the potential health risks associated with its presence in food and beverages (Silva & Lidon, 2016). To regulate its consumption, the Food and Agriculture Organization (FAO) and the World Health Organization (WHO) Expert Committee on Food Additives have established a recommended daily intake of benzoic acid at 0–5 mg per kilogram of body weight (Wen et al., 2007).

Several analytical techniques have been developed for the determination of sodium benzoate in food samples, such as High-Performance Liquid Chromatography (HPLC) (Dr. Lakshmi, 2019), Gas Chromatography (N. Tungkijanansin, 2022), Capillary Electrophoresis (J. Feng et al., 2021), Spectrophotometry (Elmanfe, 2020; Eguntade, 2022), Enzymatic Assays (V. dos Santosa, 2013), Immunoassays (X. Li et al., 2018), and Voltammetric Techniques (Soad Shibani Jaida, 2025). The most common analytical method for the determination of benzoate salt is UV–Visible Spectrophotometry. This method is rapid, selective, sensitive, and simple to use, and has been validated in comparison with other methods (Elmanfe, 2020).

This study aims to analyze the presence of sodium benzoate in some commercially available energy drinks in Asbi'ah City using the UV–Visible spectrophotometry method. The obtained results will be compared with the permissible limits to evaluate their compliance with safety standards.

## MATERIAL AND METHODS

### Samples Collection

Collection of energy drink samples were carried out in a market located in Asbi'ah city. four samples of different brands were selected based on their availability and popularity among most consumers. The energy drink samples collected are listed in Table 1.

**Table 1.** Energy Drink Sample used to Determine Sodium Benzoat with Different Brands.

| Sample code | Brand | Canister Sized | origin |
|---|---|---|---|
| 1 | Power Horse | 250 | Austria |
| 2 | Future Club (F.C) | 250 | Turkey |
| 3 | Mɑnste r(M) | 500 | Poland |
| 4 | Izem | 250 | Algeria |

### Materials and Equipmen

The apparatus utilized in this study includes a separation funnel, volumetric flasks, stirring rod, spatula, watch glass, filter paper, and volumetric pipettes. The chemical reagents employed comprise benzoic acid, sodium chloride, hydrochloric acid (1:3), chloroform, methanol, and distilled water.

### Selection of Wavelength

The wavelength selection was carried out by recording the UV absorption spectrum of a 100-ppm sodium benzoate solution, using methanol as the solvent. The spectrum was scanned over the range of 350 to 200 nm utilizing a UV-Visible spectrophotometer. The results revealed that sodium benzoate exhibited a maximum absorbance (λmax) at 225 nm, as illustrated in Figure 1.

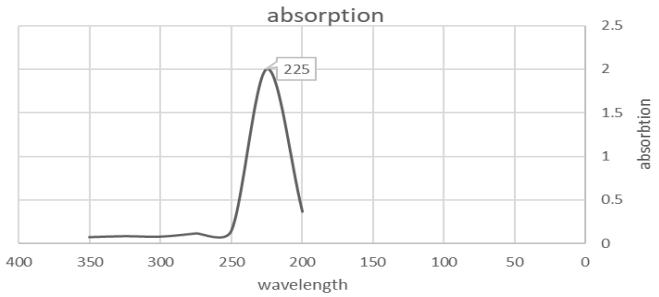


**Figure 1:** UV spectrum of sodium benzoate.

**Sample Preparation**

A 20 mL sample from each energy drink was degassed and filtered. Sodium chloride was then added until the solution was saturated. After that, the mixture was made basic by adding 2 mL of a 10% sodium hydroxide solution. The solution was transferred into a 100 mL volumetric flask, and saturated sodium chloride was added to bring the solution to the mark. The solution was shaken and allowed to stand for one hour. Afterward, the solution was acidified by adding 4 mL of hydrochloric acid, filtered, and transferred to a 250 mL separation funnel. The solution was extracted with chloroform (10-10-10-20 mL). To avoid contamination by mineral acids, the chloroform layer was washed with distilled water. The organic layer was separated and evaporated. After cooling, the residue of benzoic acid was dissolved in 5 mL methanol and stored in the refrigerator at 4°C (ABEBA, 2021; Shamaail A. Saewan, 2017).

**Preparation of Standard Solutions**

A standard stock solution of 100 ppm was prepared by dissolving 1 g of sodium benzoate in 100 mL of methanol. Diluted working standard solutions were then prepared in concentrations of 10, 20, 30, and 40 ppm.

**Instrument**

Absorbance measurements were carried out using a double-beam spectrophotometer, model SPECORD-210 plus, with a 1 cm matched cell. The analysis of the energy drink samples was carried out in the laboratory of the Chemistry Department at Asbi'ah College, Gharyan University.

**Table 2.** UV Absorbance of Standard Sodium Benzoate Solutions.

| Concentration of benzoic acid | Absorbance at 250 nm |
|---|---|
| 10 | 0.1327 |
| 20 | 0.2156 |
| 30 | 0.3287 |
| 40 | 0.4067 |

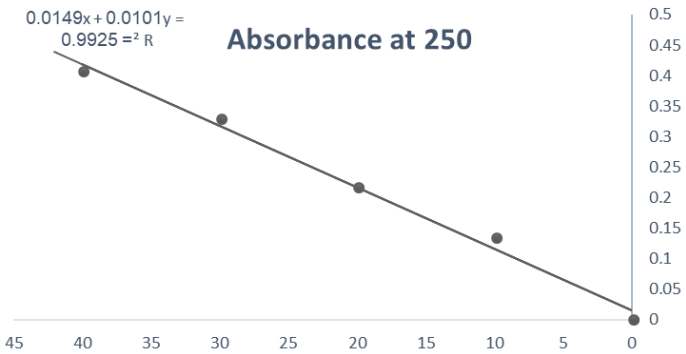


**Figure 2.** Calibration curve for sodium benzoate.

**Results and discussion**

The results are presented in Table 3, which illustrates the mean concentrations (in ppm) of benzoic acid detected in the analyzed energy drink samples. It was observed that all four samples contained varying concentrations of benzoic acid, with values ranging from 1361 ppm to 1424.55 ppm. These slight variations indicate differences in formulation or preservation practices among the tested products.

**Table 3.** Concentrations of sodium benzoate in energy drinks samples.

| Sample code | Absorb ion | Concenter ion | Concenter ion after dilution |
|---|---|---|---|
| 1 | 4.0613 | 272.42 | 1362.1 |
| 2 | 4.0713 | 273.10 | 1365.5 |
| 3 | 4.0580 | 272.20 | 1361 |
| 4 | 4.2478 | 284.91 | 1424.55 |

The results indicate that the sodium benzoate concentrations in all four analyzed energy drink samples exceeded the permissible regulatory limits, as depicted in Figure 3. A comparative evaluation with the study conducted by Sirwan et al. (2021) reveals that the concentration range in their samples,414.19 to 14.41 ppm (measured by HPLC) and 669.66 ppm to undetectable levels (measured by UV spectrophotometry), was significantly lower than the concentrations observed in our study. In fact, the benzoic acid levels identified in our samples were more than twice the maximum concentration

reported by Sirwan et al. (2021). Conversely, the findings of our study align more closely with those reported by Islam et al. (2016), who employed the HPLC method to determine benzoic acid levels ranging from 106 to 6261 ppm. Notably, four samples from their study conducted in Bangladesh exhibited concentrations between 1112 and 1340 ppm, which are comparable to or slightly lower than the levels observed in our current investigation. This consistency suggests a broader pattern of regulatory non-compliance within the sampled energy drinks. Nevertheless, the concentrations reported in our study remain below the extreme values of 5872 and 6261 ppm.

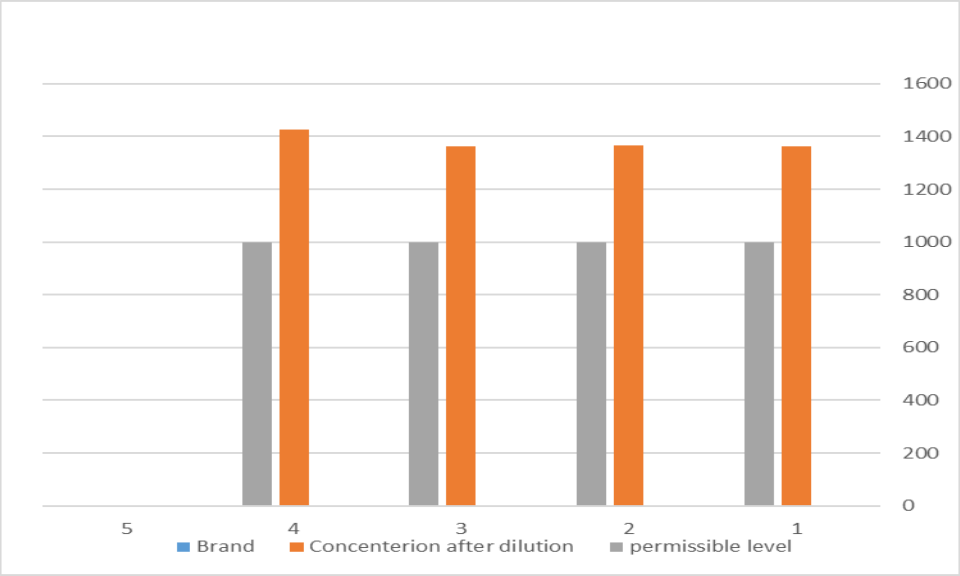


**Figure 2.** Concentrations of sodium benzoate in energy drinks samples compared with the permissible limits.

## Conclusion

Energy drinks contain high levels of sodium benzoate that exceed the permissible limits, which can result in negative health effects such as headaches, gastrointestinal disturbances, and hyperactivity. It is advised to consume these drinks in moderation and to be mindful of their sodium benzoate content. Additionally, further studies should be conducted with a broader sample of commercial products from various brands to obtain a comprehensive understanding of sodium benzoate levels in both local and imported products.

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