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Analysis of Benzoic Acid in Fruit Juice and Some Soft Drinks in Benghazi Market by UV-Spectrophotometric Method

Hawa S. Elferjani[1,*], Fatma A. Almattardi[2], Najwa H. Ansir[3]

Abstract

The utilization of preservative substances is extensive in various industries, with particular prominence in the food industry. In this study, we investigated the estimate of benzoic acid as a preservative substance, which is widely used to preserve juices and carbonated beverages. Fifteen samples were collected from some markets in Benghazi. The spectrophotometer was utilized to take measurements at a wavelength of 228 nm. The pH value was measured using a glass electrode, and the pH values of some samples were compared to those of some natural fruits. It was observed that there was a decrease in the pH value compared to natural fruits, indicating the presence of acidic quantities that caused the decrease in pH. The results show that the concentration of benzoic acid in all tested samples did not exceed the recommended limit by the World Food, Agriculture and Health Organizations, which was 1000 mg/kg. The highest value was 216.159 mg/kg.

Keywords: Fruit juice, benzoic acid, glass electrode, spectrophotometer

INTRODUCTION

Preservatives are sed to increase food and juice's shelf life, hence the spread of chemical preservative industries worldwide. Preservatives are substances that are consumed to prevent food spoilage from microorganisms like bacteria and fungi [1–3].

Furthermore, preservatives have an elemental role during food storage and transportation because they preserve food for a long time, in addition to reducing commercial losses for the food industry due to food and drink spoilage and unwanted effects on food quality [4, 5].

Antimicrobial agents such as lactic acid, benzoic acid, and sorbic acid are the most commonly used preservatives due to their low cost, high efficiency, and antimicrobial properties. Generally, organic acids are used as preservers in beverages [6].

The oldest and most widely used preservatives for preserving fruit beverages, fruit products, bakery products, and margarine are those such as benzoic acid. Benzoic acid is widespread used in beverages as an antifungal agent, which is found naturally in plants like cranberries, raspberries, plums, prunes, cloves, and cinnamon (7). It was

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extracted and discovered to have effective antifungal properties, be tasteless in foods, and be simple to manufacture. The growth of mold, yeast, and specific bacteria can be inhibited by benzoic acid, which is available for direct consumption or in the form of sodium, potassium, or calcium salts. It is recognized by the E-numbers E210, E211, E212, and E213 [8,9].

Gas chromatography [12], spectrophotometry [13,8], and voltammetric techniques [14] are among the analytical techniques are used for determining food additives in various food products. Analytical determination of these preservatives is essential not only for quality assurance purposes but also for consumer protection and interest [3, 10, 11],

MATERIALS AND METHOD

Instrument

Concentrations of Benzoic acid was determined by U.V -visible single beam spectrophotometer CECIL spectrophotometer 1000S. This instrument was used to measure the absorbance by using quartz cells.

- A potentiometer can be utilized for measuring the pH of fruit juice samples. The calibration of potentiometer was done by different buffer solutions (4, 7, and 10)
  Analytical Balance
  Reagents and chemicals
- 0.1M HCl
- Preparation of Standard Solution. Stock standard solution containing 1000 mg/ L (ppm) benzoic acid was prepared by dissolving 1 g benzoic acid in one litter deionized water.
- The process of preparing a benzoic acid solution involves transferring 10mL of the 1000 ppm solution into a 100mL volumetric flask, then adding deionized water to the flask until it reaches the marking on the flask.
- Dilute this stock solution to get the solutions contains 2, 4, 6, 8, and 10 mg/L then add 10 ml 0.1 M hydrochloric acid and the volume to completed to 50 ml in volumetric flask with deionized water

Sample Preparation

1. 20 mL from fruit Juice were transferred to 250-mL beakers (soft drinks must be warmed to expel carbon dioxide gas).
2. The samples were filtered through a filter paper to remove any particles.
3. 2 mL from the filtrate was transferred quantitively to 50ml volumetric flask and diluted to mark using deionized water.
4. The absorbance of the standard solutions and samples were measured by U.V. visible spectrophotometer at 228 nm

RESULTS AND DISCUSSION

Estimation of λmax of Benzoic Acid

Maximum absorption, for benzoic acid was measured at a concentration of 10 ppm, and the Scan of Benzoic acid in the wavelength form range of 225 nm – 230 nm gave maximum absorbance at 228 nm (λmax), as illustrated in and Figure (1).

Calibration Curve

After identifying the highest level of absorption of benzoic acid (228 nm) using a spectrophotometer, a calibration curve was constructed using benzoic acid standards. Serial dilutions of concentrations ranging from 2ppm to 10ppm (2, 4, 6, 8, and 10) were prepared. The experimental conditions were optimized, resulting in a strong linear correlation, as depicted in the figure (Figure 2).

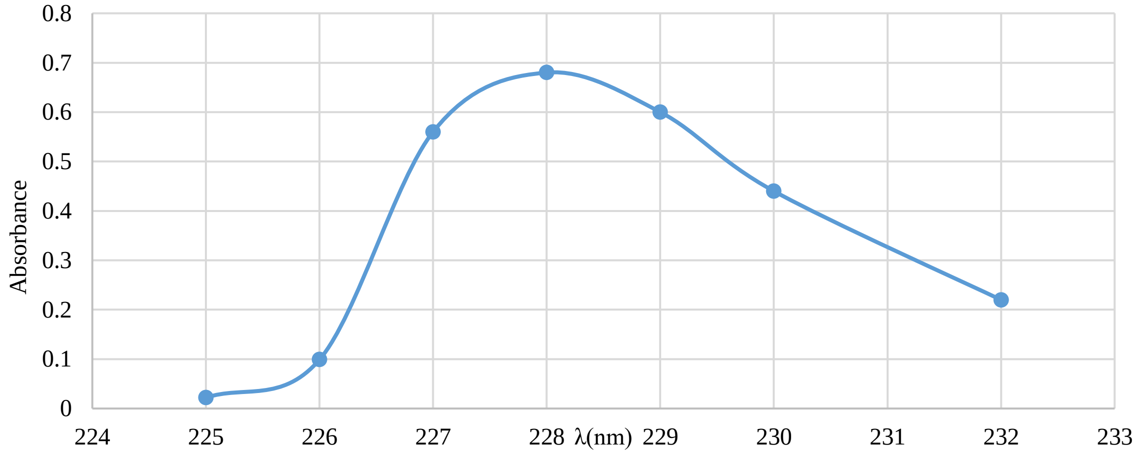

Figure 1. λ Max for Benzoic acid.

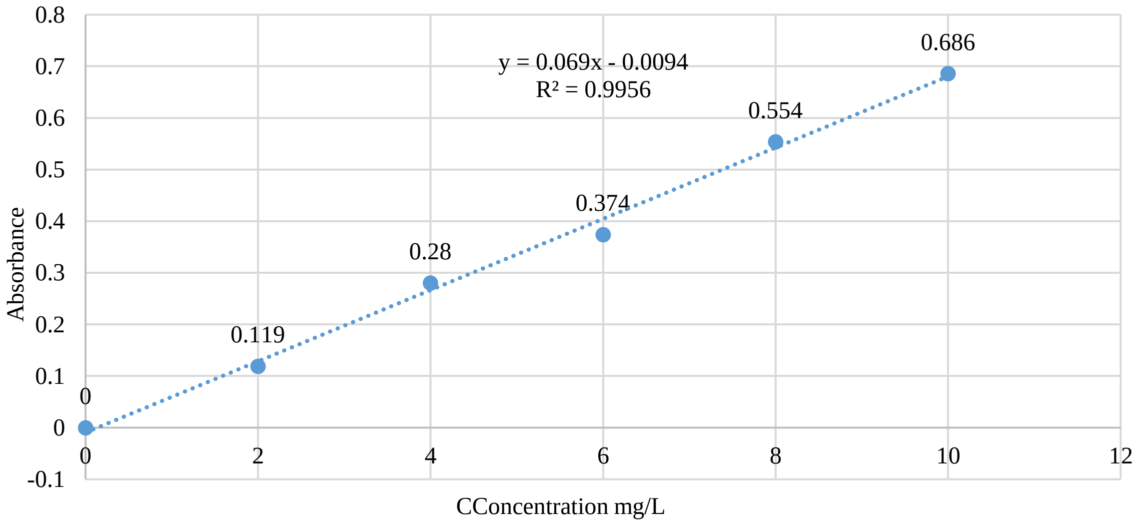

Figure 2. Calibration Curve of Standard Benzoic acid at 280nm.

By using regression statistics the validation of the results (Figure 2). The calibration curve by serial dilutions of concentrations (2, 4, 6, 8, and 10 ppm) was linear, correlation coefficient (R^2) (0.9957) , while correlation factor (r) was (0.9978) and the% average recovery (93.18 %).

The minimum level at which the analyte could be detected was established to determine the limit of detection (LOD), which was found to be 1.01 mg/L using the 3s/m definition. Furthermore, the limit of quantification (LOQ) was determined as the lowest concentration that can be accurately and precisely measured, and it was found to be 3.080 mg/L. Molar absorptivity is a critical characteristic for determining the accuracy and sensitivity of a method. To assess molar absorptivity, it is measured at various concentrations at a wavelength of 228nm. Based on the results, the average molar absorptivity value was determined to be 8037.532 M-1 cm-1 L.

pH Measurement

The taste and quality of most fruits are influenced by their pH values, sugar content, and flavor volatiles, as stated in references [15,16]. Typically, the pH values of edible fruits fall between 3-5, although genetic variation for fruit acidity has been observed in various fruit crops, as reported in references [17,18].

By using pH meter and calibration of glass electrode, pH of samples were measured before measuring the absorbance to ensure the pH values. pH values are shown in Table 1, from our measuring of pH we noted that there were decreasing in pH values from the natural values this may be due to the presence of added acid (benzoic acid)the comparison shown in the Figure (3).

Table 1. pH values of fruit juice comparison with some pH of fresh fruit

S.N.	Sample	pH for fruit Juice	pH for Fresh Fruit [19]
1	F.J 1	2.61	4.15
2	F.J2	2.88	4.15
3	F.J3	2.89	4.15
4	F.J4	2.76	3.75
5	F.J5	2.96	-
6	F.J6	3.16	-
7	F.J7	2.55	-
8	F.J8	3.16	-
9	F.J9	2.74	4.6
10	F.J10	3.29	5.2
11	F.J11	2.90	-
12	F.J12	2.91	-
13	F.J13	3.14	2.93
14	F.J14	2.74	3.75
15	F.J15	4.30	-

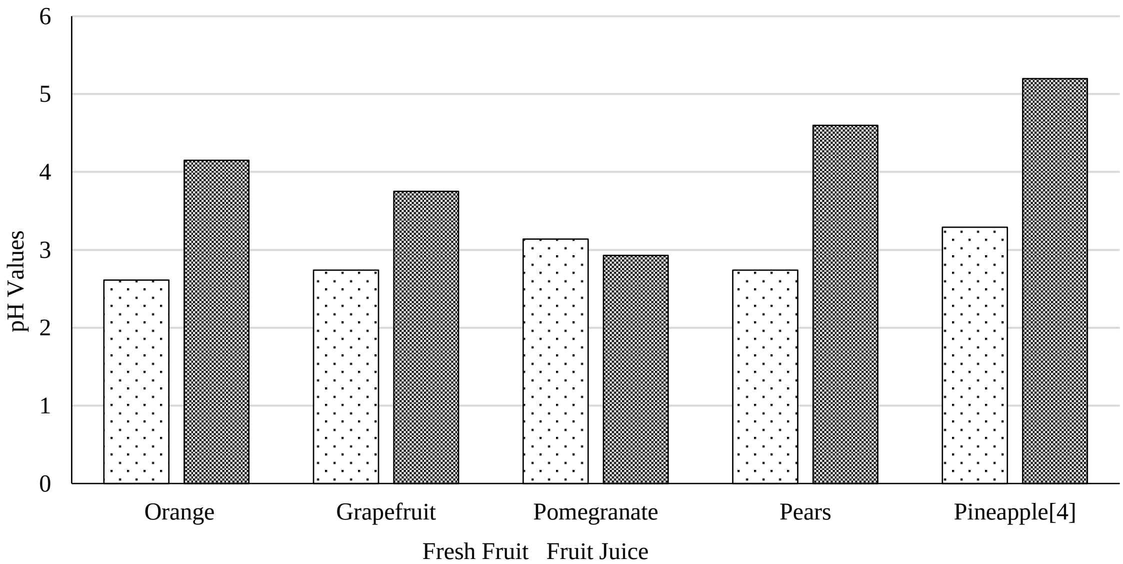

Figure 3. Comparison of pH values between fresh fruit and fruit juice.

Quantity of benzoic acid in the Fruit Juices samples

Table (2) and Figure 4 show the calculated concentration of benzoic acid in various fruit juice from different Companies in different countries we noted that the

The provided data lists various samples with their respective concentrations in mg/L of benzoic acid

It was observed that the highest values of benzoic acid in juice samples were in samples 1and 4 (341.0145 and 413.4783, respectively), while the lowest values were found in samples 9, 12, (4.289855 and 6.898551 respectively).

Table 2. The total benzoic acid in Fruits juice.

Sample	Volume	A	mg/50	mg/L
F1	1	0.48	6.8203	341.0145
F2	1	0.43	6.0957	304.7826
F3	2	0.471	6.6899	167.2464
F4	1	0.58	8.2696	413.4783
F5	2	0.606	8.6464	216.1594
F6	2	0.398	5.6319	140.7971
F7	2	0.408	5.7768	144.4203
F8	5	0.249	3.4725	34.72464
F9	5	0.039	0.4290	4.289855
F10	2	0.058	0.7043	17.6087
F11	2	0.31	4.3565	108.913
F12	5	0.057	0.6899	6.898551
F13	5	0.176	2.4145	24.14493
F14	5	0.082	1.0522	10.52174
F14	2	0.163	2.2261	55.65217

Where F= fruit juice

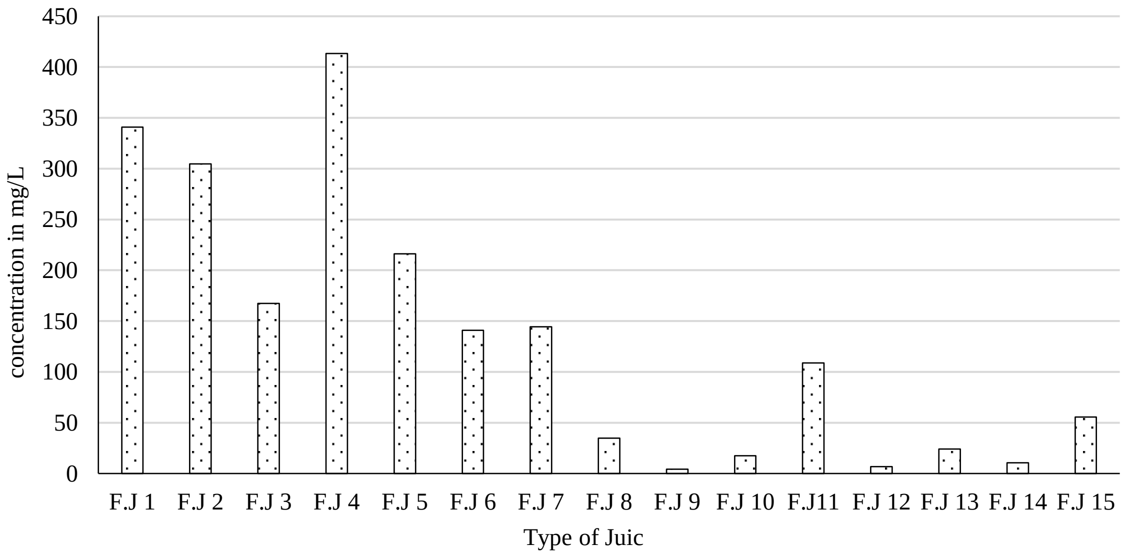

Figure 4. Illustrate the values of benzoic acid in fruit juice samples.

Benzoic acid can be found in natural sources such as plant-based foods (fruits, nuts, spices, and vegetables), animal and fungal tissues, and can also be produced by microorganisms during food processing or added as a food additive. Natural sources rich in benzoic acid include strawberries (up to 29 mg/kg), cayenne pepper, and mustard seeds (up to 10 mg/kg), as well as cloves, sage, thyme, and nutmeg (up to 50 mg/kg), and cinnamon (up to 335 mg/kg), according to (del Olmo et al., 2017). [21]

CONCLUSION

The results of the current study have shown variations in the levels of benzoic acid, which is known to pose a risk to human health Government authorities must take steps to enhance monitoring and control over food products to ensure their safety. Public awareness about the risks associated with different food products is also reasonable. Suitable instruments should be put in place in food control laboratories for more precise analysis of the food products that need to be tested.

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