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SPECTROPHOTOMETRIC DETERMINATION OF SODIUM BENZOATE IN SOME SOFT DRINKS COLLECTED FROM SOME LOCAL MARKETS IN EL-BIEDA CITY - LIBYA

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Abstract:-

Sodium benzoate is often used as a preservative of food and beverages. The aim of this work is to determine the content levels of sodium benzoate in different samples of soft drinks commercially available in local markets in El-Beida city-Libya by rapid and simple UV spectrophotometric methods. Samples under study was divided into two part: Libyan products and imported. The results obtained from this study indicated that the quantity levels of sodium benzoate in the analyzed samples were in the range of 131.9269 – 278.8285 ppm for the Libyan products samples. Whereas its concentrations in the imported samples were in the range of 230.7044 - 357.3124 ppm. The minimum sodium benzoate level was observed in the Sabaa/Benghazi- Libya sample (131.9269 ppm), while the Mirinda/Dubai - United Arab Emirates sample showed the highest sodium benzoate content (357.3124 ppm). The sodium benzoate content in all the samples analyzed in this study are below the allowable limits according to international standards and specifications of the World Health Organization (WHO).

Keywords: - *Soft Drinks, Food Additives, Sodium Benzoate, WHO and UV-Vis Spectrophotometer*.

INTRODUCTION

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 antiinfective agents. Most food additives have little or no nutritional value [(1)]. Food preservatives have become an increasingly important practice in modern food technology with the increase in the production of processed and convenience foods [(2)]. These preservatives are added to stop or delay nutritional losses due to microbiological, enzymatic or chemical changes of foods and to prolong shelf life and quality of foods [(3, 4)]. Preservation is aimed at achieving the self-life EPH - International Journal of Applied Science | ISSN: 2208-2182prolongation of foods. Present tendencies are based on the employment of certain methods which ensure qualitatively products, less preserved, with no additives, with nutritional value, but also safe from the microbiological point of view [(5, 6)]. Preservatives are defined as substances able to inhibit, stop or delay the growth of microorganisms or any deterioration of aliments due to microorganisms [(5, 7)].

Sodium benzoate is a common preservative added to commercially available foods and beverages. Once dissolved in a polar solution, sodium benzoate dissociates into sodium ions and benzoic acid. Sodium benzoate is the sodium salt of benzoic acid and works well in acidic media to inhibit yeasts, molds, and bacterial growth. It is used in a variety of products, such as cosmetics and pharmaceuticals, but more commonly in foods like soda and fruit juice to preserve freshness [(8, 9)]. Benzoic acid is an effective antimicrobial agent for the purpose of preservation. However, sodium benzoate is more effective and preferred because it is approximately 200 times more soluble than benzoic acid [(10-12)]. Sodium benzoate is a very stable solid material, soluble in water at room temperature. It has antimicrobial activity against bacteria, fungi and yeasts, and shows most activity at pH below 4.5. It is recommended as a preservative for a number of food products consumed by humans at an optimum level of 0.1 % [(11, 13)]. The recommended limits in foods are 0.1 to 0.5 % for different countries [(11, 14)]. Some studies were aimed to have investigate effects of Sodium benzoate on the blood parameters [(15)].

Soft drinks bottled at low temperatures have high values of the water activity, which allow microbial growth; the pH, the sugar content and the ad of preservatives prevent the microorganism's growth in soft drinks. Some species of moulds *Aspergillus niger* and *Penicillum spinulosum* are resistant to chemical preservatives, as well as the sorbic acid and the benzoic acid and they can tolerate acid environments and low values of the water activity [(16)].

The soft drink industry is the largest user of benzoate as a preservative due to the amount of high fructose corn syrup in many carbonated beverages. Soft drinks account for the largest human consumption of benzoate in the USA, Australia/New Zealand, France, and the United Kingdom [(10)]. Although soft drinks do not normally spoil due to their acidity and carbonation, preservatives are required to prevent changes during long-term storage [(17)].

The analytical determination of these preservatives is not only important for quality assurance purposes but also for consumer interest and protection. Several analytical techniques for the determination of food additives in various foodstuff products can be found in the literature: High Performance Liquid Chromatography (HPLC) [(18)], capillary electrophoresis [(19, 20)], spectrophotometry [(21, 22)] and voltammetric techniques [(23,24)]. In our study, a rapid and simple method is developed, based on other methods recommended by other researchers with some modifications, in order to determine sodium benzoate in beverages and soft drinks or other 68 fluids. The method used is more rapid and simple compared with other methods [(22)]. The analyses were developed and validated by UV-Visible spectrophotmeter.

MATERIAL AND METHODS

Instrumentation:

UV-Vis spectrophotometric method was selected based on previous studies [(22)]. Spectrophotometric measurements of sodium benzoate were carried out by means of a UV-VIS Spectrophotometer (BECKMAN COULTER DU 800), using 1 cm quartz cell. The absorption bands of the aqueous sodium benzoate solutions were recorded over the wavelength 200-400 nm. Preparation of calibration graph:

The absorbance of each standard solution was measured at absorption maximum of 221 nm using quartz cuvette (1 cm). The absorbance values were then plotted against concentrations to generate a standard calibration curve. The figure (1) show the spectrum of sodium benzoate of different concentrations (9 - 36 ppm) at 221 nm.

Table (1) shows the relationship between each concentration of sodium benzoate and its absorption value. This relationship can also be observed in Figure (1) at 221nm

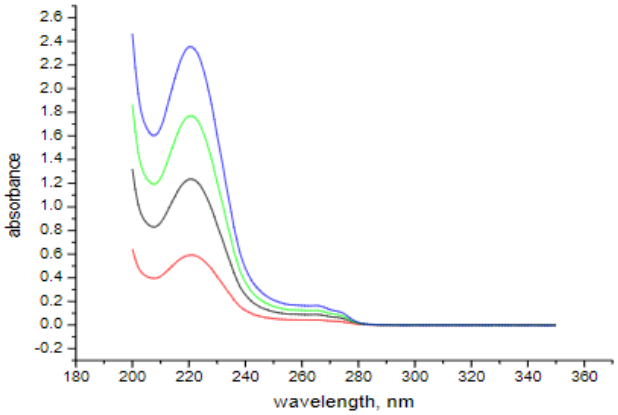

Figure (1): Spectrum of different concentrations of sodium benzoate at 221 nm.

Table (1): Relationship between the concentration and the absorption of sodium benzoate.

Volume of sodium benzoate / ml	Concentration of sodium benzoate / ppm	Absorbance at 221 nm
0.5	9	0.5922
1	18	1.2348
1.5	27	1.7692
2	36	2.3521

The Figure (2) shows the calibration curve for the standard solutions of different concentrations of sodium benzoate (9 - 36 ppm) at 221 nm.

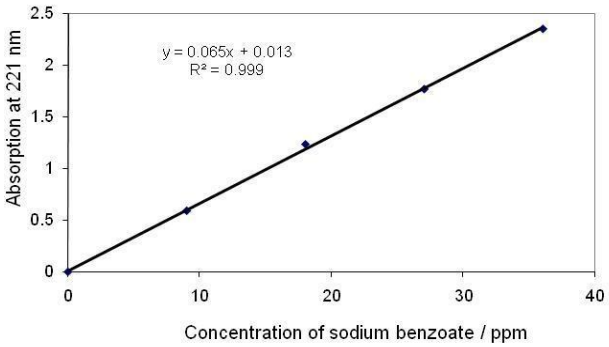

Figure (2): Calibration curve for sodium benzoate, expressed on a linear scale.

The standard linear calibration curve obtained from the standard solutions analysis presented in the figure (2). It showed a good linear relationship between the absorbance and concentrations of the standard solutions.

Samples collection

Samples under study were collected from local markets in El-Beida city- Libya and were divided into two part: Libyan products such as: (Brau, Murada and Sabaa 7), and imported from arabic countries such as: (Mirinda (Dubai), Nice (Jordan) and Pepsi (Saudi Arab)). 70

Procedure

After preparation of the standard solutions for sodium benzoate over the concentration range 9-36 ppm, and their ultra-violet spectra was measured at 221 nm. The purchased soft drinks samples were subjected to mild clean-up procedures such as filtration and degassing. All investigated soft drinks samples were analyzed directly without any further preparation steps such as extraction or concentration [(22)]. Part of each test sample was introduced to the spectrophotometric cell (usually after appropriate dilution (1:25 and 2:25)) and the molecular absorption was measured at the maximum wavelength (221 nm) for sodium benzoate.

RESULTS AND DISCUSSION

The absorption spectrum of benzoic acid standard solution (43.12 ppm) indicated that the acidic form of this food preservative was characterized by a single UV absorption band at λ_{max} = 221 nm (figure (3). It was observed that the increase in concentration of benzoic acid over the range (9-36 ppm), is accompanied by a proportional enhancement in the monitored absorption intensity.

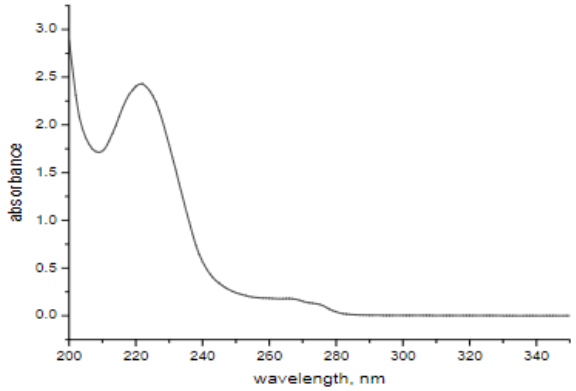

Figure (3): Spectrum of benzoic acid indicate the single UV absorption band at λmax = 221 nm.

The results obtained from this study are presented in the following Tables and Figures:
Table (2) shows the concentrations of sodium benzoate in soft drinks samples for the Libyan products samples. The quantity levels of sodium benzoate in these samples (Libyan products soft drinks samples) were in the range of 131.9269 – 278.8285 ppm.

Table (2): Concentrations of sodium benzoate in soft drinks samples (Libyan products samples (Benghazi)).

Type of soft drink	Volume of Sample / ml	Absorbance at 221 nm	Concentration of sodium benzoate /ppm in 25 ml	Concentration of sodium benzoate in the sample
Brau / Benghazi	1	0.727	10.9280	273.2006
	2	1.47	22.3063	278.8285
Murada / Benghazi	1	0.564	8.43185	210.7963
	2	1.14	17.25267	215.6585
Sabaa / Benghazi	1	0.358	5.27718	131.9296
	2	0.779	11.72434	146.5544

From the Table (2), it is clear that the Sabaa / Benghazi Libya sample represents the lowest concentration of sodium benzoate (131.9269 ppm), while the Brau / Benghazi Libya sample shows the highest sodium benzoate concentration (278.8285ppm). Note that there is no sodium benzoate or benzoic acid indicated on the label of the Brau and Sabaa soft drinks samples.
Table (3) shows the concentrations of sodium benzoate in soft drinks samples for the imported samples. The quantity levels of sodium benzoate in the imported soft drinks samples were in the range of 230.7044 - 357.3124 ppm.

Table (3): Concentrations of sodium benzoate in soft drinks *imported* samples.

Type of soft drink	Volume of Sample / ml	Absorbance at 221 nm	Concentration of sodium benzoate /ppm in 25 ml	Concentration of sodium benzoate in the sample
Mirinda / Dubai	1	0.908	13.6998	342.4962
	2	1.88	28.5851	357.3124
Nice / Jordan	1	0.647	9.7029	242.5727
	2	1.25	18.9372	236.7152
Pepsi / Saudi Arabia	1	0.616	9.2282	230.7044
	2	1.292	19.5804	244.7551

From the Table (3), it is clear that the Mirinda / Dubai sample represents the highest concentration of sodium benzoate (357.3124 ppm). Note also that there is no sodium benzoate or benzoic acid indicated on the label of the Pepsi/Saudi Arabia soft drinks sample. But sodium benzoate indicated only on the label of the Mirinda/ Dubai and Nice/Jordan samples without any specification of the quantity.

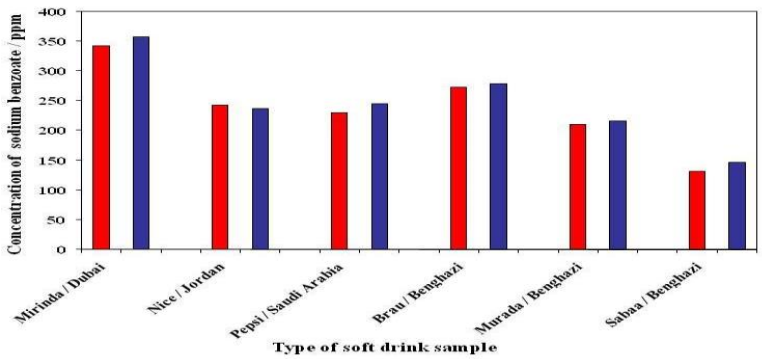

Figure (4) shows the values of sodium benzoate concentrations for all the soft drink samples under study.

The lowest sodium benzoate concentration was observed in the Sabaa / Benghazi - Libyan product sample (131.9269 ppm), figure (4) and table (2), while the highest sodium benzoate concentration was observed in the Mirinda/Dubai - United Arab Emirates sample (357.3124 ppm), Figure (4) and Table (3).

CONCLUSION

The results obtained in this work lead us to the following conclusions:

- The concentrations of sodium benzoate in Libyan soft drinks samples (first part of this study) were less than their concentrations in the imorted soft drinks samples (second part of this study).
- The minimum sodium benzoate concentration was observe in the Sabaa / Benghazi sample (Libyan products sample), while the Mirinda / Dubai - United Arab Emirates sample (imorted sample) showed the highest sodium benzoate concentration.
- The Spectrophotometric methods using in this study was useful and accurate to determine the concentration of sodium benzoate in soft drinks samples.
- The sodium benzoate content in all the samples analyzed in this study are below the allowable limits according to the standards and specifications of the World Health Organization (WHO).
- We advise the other researchers to study the determination of sodium benzoate and other additives in another samples to complete our study.

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