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UV-Spectrophotometry Determination of Sodium Benzoate and Potassium Sorbate from Some Selected Food Samples in Ota, Ogun State, Nigeria

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Abstract
This study extracted and assessed the levels of Sodium benzoate and Potassium sorbate present in some food samples in Sango Ota, Ogun State in the western part of Nigeria. A UV Spectrometry technique is described for the determination of Sodium benzoate and Potassium sorbate content in 12 food samples. The food samples comprise fruit drinks, margarine, sauces, and ketchup. The pH values obtained in this study for all the 12 food samples are in the range of 2.71 – 4.89 and are proof of the existence of the presence of both preservatives, even those whose labels claim otherwise. The fruit drink samples recorded values in the range of 432.00 – 468.00 mg/L for Sodium Benzoate and 180.26 – 566.52 mg/L for the Potassium sorbate. The margarine samples recorded values in the range 360.00 – 1,260.00 mg/L for Sodium Benzoate and 154.51 – 618.03 mg/L for Potassium sorbate while the food sauces recorded values in the range 576.00 – 1,080.00 mg/L for Sodium Benzoate and 206.01 – 360.52 mg/L for Potassium sorbate. In all the 12 food samples analyzed, the margarine samples had the highest values, and in comparison, to their set permissible limits indicate that these commodities are generally unsafe for consumption due to the high level of preservatives added to them.

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Introduction
Preservatives are a group of chemical substances that are added to food products to increase their shelf-life and prevent the growth of bacteria and fungi as they delay the spoilage accidence (Nicole, 2013).
Benzoic acid, sorbic acid, and their salts are usually employed as chemical preservatives. They are the most widely used food preservatives used to ensure long shelf-life of food products (Akbari-Aderganiet al, 2013). The shelf-life of foods can be shortened during storage by microbial, enzymatic, or chemical changes. Preservatives can therefore be added to foods to increase their shelf life, guard against degradation, and/or stop the growth of pathogenic microbes. Controlling the growth of germs and extending product shelf life has grown increasingly dependent on the use of preservatives like benzoic acid and potassium sorbate (El-Ziney, 2009).To control the amount of preservatives in foods, the maximum allowable amounts are set by law (EU Commission Regulation, 2008).The FAO/WHO Expert Committee on Food Additives recommends benzoic acid and sorbic acid daily intakes of 5 mgkg-1 and 25 mgkg-1, respectively (Wen et al., 2007).

However, excessive addition of these chemicals has been known to induce allergic dermatitis, hives, convulsion, etc. making these chemicals harmful to consumers. Several studies have also proved the mutagenicity of benzoic and sorbic acid which may induce mutations in the DNA of human consumers (Silva &Lidon, 2016). Besides the ability of benzoic

acid to increase hyperactivity, internal upsets, headaches, and skin rashes may also be a consequence. (Sharma, 2015). Studies conducted on mice have also shown that cancer induction is a long-term effect as it was observed that the preservatives also contributed to the development of other malignancies like bladder cancer in addition to respiratory problems (El-Samragy, 2012).

Given this, the need to determine and monitor the levels of these preservatives in commonly consumed fruit juices and food samples is important. The study aims to determine the quantity of these preservatives and their compliance with regulatory standard values/requirements.

Materials and Methods

Study Area and Sample Collection

Ota (also spelled as Otta) is the capital of the Ado-Odo/Ota Local Government Area which is one of the twenty (20) Local Governments in Ogun State, Nigeria. It is a densely populated area and is mostly dominated by industries. Ota lies within the latitude and longitude of 6.6927^0N, 3.2365^0E respectively. A total of 12 food samples were selected based on the declaration of the presence of the selected preservatives on their labels. All the samples were categorized into 3 fruit drinks, 3 margarine, and 6 food sauces samples. All samples were appropriately labeled and then refrigerated before analysis.

Standard Preparation

The UV spectrophotometric method was, according to the Association of Official Analytical Chemists (AOAC*) Official Methods of Analysis* (Horwitz, 2000) and an International Organization for Standardization (ISO) guidelines (ISO, 2008). Individual standard stock solutions (1000 mgL^{-1}) of Sodium benzoate and Potassium sorbate were prepared in distilled water. Dilution of the stock solutions which yielded 2 mg/L, 5 mg/L, 10 mg/L, 15 mg/L, and 20 mg/L was made to give the standard solutions. Then 0.4 mL of 6M HCl was added to the 5 mL of each standard solution. This was followed by extraction with 45 mL petroleum ether and absorbance measured at 226 nm and 250 nm to generate calibration curves for Sodium benzoate and Potassium sorbate respectively.

Sample Preparation

The samples were extracted using the method reported by Khosrokhavaret al., (2010) with slight modification. The liquid samples were allowed to reach room temperature after removal from the refrigerator, thoroughly homogenized and degassed for the removal of carbon dioxide. A 0.4 ml of 6M HCl was added to 5 ml of each of the filtered samples and extraction was done using 45 ml of petroleum ether for 5 minutes at 50°C using a sonicator (Qsonia Q55). The organic layer was collected and, a second and third extraction was carried out on the aqueous layer. A pool of the extract was used for absorbance measurement.

The semi-solid samples, after attaining room temperature were thoroughly homogenized. 1-2 g of each of the samples were weighed into a beaker and 15 mL of deionized water was added. To each mixture,0.4 ml of 6M HCl was added, and extraction was done using 45 ml of petroleum ether for 5 minutes at 50°C using a sonicator. The organic layer was collected and a second and third extraction was carried out on the aqueous layer. A pool of the extract was used for absorbance measurement. All absorbance was measured with a UV/Visible Spectrophotometer (Spectrulab 7525).

Results and Discussion

The verification of the accuracy and precision of the method adopted was achieved through recovery studies. Known amounts (2.0, 3.0, 4.0, and 6.0 mg/L) of Sodium Benzoate (SB)and Potassium Sorbate (PS)(2.0, 4.0, 6.0, and 8.0 mg/L) were spiked to 3 samples each of Fruit Drinks (FD), Margarine (MG), and Food Sauces (FS), the results are shown in Table 1. With the linearity and correlation coefficient for each standard curve.

Table 1: Precision and Accuracy of UV Method for Sodium Benzoate and Potassium Sorbate with Three Replicate Determinations

CONC(mg/L)	ABS. AVERAGE	SD	AMOUNT FOUND	%RECOVERY
		SB		
2.0	0.32	0.02	1.88	94.0
3.0	0.51	0.01	2.72	91.33
4.0	0.73	0.01	3.74	93.50
6.0	0.90	0.00	5.97	99.50
		PS		
2.0	0.05	0.00	1.96	98.0
4.0	0.17	0.01	3.96	99.0
6.0	0.32	0.03	5.62	93.60
8.0	0.74	0.03	7.85	98.10

Note: SD - Standard Deviation, SB - Sodium Benzoate, and PS- Potassium Sorbate.

Numerous studies have been conducted on the quantitative determination of sodium benzoate and potassium sorbate in drinks and food samples. The occurrence and concentration levels of Potassium Sorbate and Sodium Benzoate in the twelve (12) analyzed food samples are shown as the mean values of duplicate analysis given in Table 2. All three (3) fruit drink samples tested contained both SB and PS. Fruit drinks are usually pasteurized after filling into their containers. This and aseptic packaging without the addition of any preservatives can create enough protection against microbial growth in the fruit juices (Cemerroglu 2009). All the fruit drinks also had pH values in the range of 2.75-3.43 which indicates a high acidic character and this is another prevention factor against microbial growth. Generally, the acidity of the drinks might also prevent the growth of bacteria. Acidic drinks induce the demineralization of teeth because they decrease the pH of the oral cavity (Lussi et al, 2004).All fruit drink samples analyzed contain both SB and PS in concentrations lower than the permissible limit of 1000mg/Kg as stated by the FDA (Code of Federal Regulations, 1992).Lino and Pena (2010) analyzed 25 samples of traditional soft drinks and the reported concentrations of Sodium benzoate ranged from 91 – 172 mg/L with a mean concentration of 158 mg/L in Portugal. Onwordiet al., (2017) also reported a mean concentration of 336 mg/L of Sodium Benzoate and Potassium Sorbate in the range 74.5 - 109 mg/L for 14 fruit drink samples in Lagos, Nigeria.A study on the levels of SB and PS in fruit juices sold in Ghana recorded SB concentrations of 31.00 mg/L (Kusi & Acquaah, 2014) while Sultanaet al, 2016 also recorded levels of SB (151.76 – 190.04 mg/L) in commercial fruit drinks. These values are lower than the values

reported in this study. Similar studies conducted on fruit juice samples for Sodium Benzoate in Sri Lanka (Karunarathne, 2019) and India (Lakshmi & Anoop, 2019) recorded much higher values which were closer to the values recorded in this study; the reported values were 33 – 631 and 172.35 – 396.44 mg/L respectively.

In Iran, Khosrokhavar et al., 2010 reported PS concentrations in fruit drinks ranging from 1.5 – 233.33 mg/L while Ogunleye et al., 2017 reported higher values in the range of 1.15 – 499 mg/L in Nigeria. The results obtained from the research are in line with the reports of these two authors.

Table 2: Sodium Benzoate and Potassium Sorbate Levels (mg/Kg)

	SB (mg/Kg)	Permissible Limit (FAO/WHO) (mg/Kg)	PS (mg/Kg)	Permissible Limit (FAO/WHO) (mg/Kg)	pH
FD-1	432.00	1000	566.52	1000	3.43
FD-2	432.00	1000	180.26	1000	2.75
FD-3	468.00	1000	180.26	1000	2.83
MG -1	360.00	150	309.01	300	4.80
MG -2	1,260.00	150	154.51	300	3.97
MG -3	1,044.00	150	618.03	300	4.89
FS -1	828.00	1000	257.51	1000	4.83
FS -2	468.00	1000	257.51	1000	3.56
FS -3	576.00	1000	360.52	1000	3.81
FS -4	1,080.00	1000	206.01	1000	3.59
FS -5	720.00	1000	257.51	1000	3.49
FS -6	684.00	1000	309.01	1000	3.38

Note: FD – Fruit Drinks, MG – Margarine, and FS – Food Sauces.

A total of three (3) margarine samples were analyzed and the result of the margarine samples ranges from 360 – 1,260 mg/Kg and 154.51 – 618.03 mg/Kg for SB and PS respectively. These values are above the maximum limit of SB – 150 mg/Kg and PS – 300 mg/Kg except for MG-2 with 154.51 mg/Kg respectively.

Mahmood et al (2013) analyzed ten (10) margarine samples and recorded mean concentrations of 17.34 ± 1.22 for SB and 8.31 ± 1.54 mg/L for PS; these values were well below the values recorded for this

study. El-Ziney (2009) recorded a mean concentration of PS - 476mgKg^{-1} for the analyzed margarine samples while no value was reported for BA. The PS values fall in the range recorded in the study. Benzoate, according to Stanojevic et al. (2009), has no harmful effects on health and has no negative effects on the nutritional value or quality of food products, however potassium sorbate has been linked to flavor loss in food. Although both sodium preservatives have been generally recognized as safe (GRAS), short-term exposure can irritate theeyes, skin, and respiratory tract, yet prolonged or repeated contact may cause high skin sensitization, diarrhea, and nausea (do Nascimento et al., 2004). When sodium benzoate is used in large amounts, histamine and prostaglandin are released, ulcers form, and the amount of stomach mucus secreted varies. In a 2007 study, sodium benzoate raised blood pressure, finally causing the tearing of the vessels in blood cells of the rats (Eberechukwu et al, 2007).Other adverse effects of eating sodium benzoate include liver and kidney malfunction, crista losses in mitochondria, attachment to the outer shell of vacuole mitochondria in the cytoplasm, and damage to the hepatocyte cell membrane (Bakar & Aktac, 2014).

The results of the analyses of the food sauces for both SB and PS were in the range of 468 – 1,080 mg/kg and 206.51 – 360.52 mg/Kg respectively. The values obtained from the analysis showed that all the values were within the permissible limit of 1000 mg/Kg, however, FS – 4 had a value that slightly exceeded the permissible limit for SB with a value of 1,080 mgKg^{-1}. A previous study (Mahmood et al., 2013) reported lower values in comparison to this study with mean concentrations of 12.44±2.62 and 5.51±0.84 mgKg^{-1} for SB and PS respectively in a total of eleven (11) food sauces. In contrast, a very recent study recorded values in the range 180 – 1,479 and 414 – 849 mgKg^{-1} for BA and PS respectively (Lais et al, 2021).

Preservative levels found in this study have been compared with values from comparable investigations conducted in Nigeria and other nations. Sodium benzoate seems to be the most popular preservative in all brands of food items. Asabe et al (2020) recorded similar results with the average quantity of SB being higher than the average quantity of PS discovered to be present in the analyzed food products.

Conclusion

This study has a concentration range of 360 –1,260 mg/Kg and 154.51 – 618.03 mg/Kg for SB and PS. Generally, the highest values observed in the analysis of the twelve (12) samples were those observed for Sodium benzoate with the highest value of 1,260 mg/Kg which is 1.26%, a very high figure when compared to the U.S Food and Drug Administration figure of 0.1%. Of all the twelve samples analyzed, only eight (8) samples had values below their permissible limits with the remaining four (4) exceeding this limit and are therefore considered unsafe for consumption.

The values observed for the Potassium sorbate were considerably lower in comparison to those observed for Sodium benzoate. Of all the twelve (12) samples analyzed, ten (10) samples had values lower than the permissible limits while MG-1 and MG-3 exceeded their limits.

The implementation of National Intensive Inspections to ensure that the amount of preservatives added to food products remains well within the safe levels for consumption is highly recommended. The results of this study can be used to provide a status of preservative addition to food products.

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