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ПАРАМЕТРИЧЕСКОЕ ИССЛЕДОВАНИЕ ПОРЧИ КОНСЕРВАНТОВ В БЕЗАЛКОГОЛЬНЫХ НАПИТКАХ

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Употребление безалкогольных напитков является очень распространенной практикой. В частности, безалкогольные напитки особенно популярны среди детей и подростков. В результате состав напитков должен быть проверен в соответствии с законом. Консерванты в безалкогольных напитках должны определяться во всем мире для обеспечения безопасности и качества продукта. В целях продления срока годности продукта консерванты представляют собой соединения, которые предотвращают, останавливают или задерживают рост микроорганизмов или любую порчу элементов, вызванную бактериями. Целью данного исследования является определение того, как консерванты в безалкогольных напитках портятся на разных этапах их срока годности. Для определения порчи были проанализированы различные физико-химические характеристики и состояние консервантов. Для оценки общей растворимости твердых веществ, объема CO_2, процентного содержания лимонной кислоты, pH и процентного содержания бензойной кислоты использовались химические методы, такие как дегазация газированных напитков, определение pH, общего количества растворимых твердых веществ, объема газа и бензойной кислоты.

Ключевые слова: консерванты, прохладительный напиток, порча, физико-химические показатели, профилактика самочувствия человека

PARAMETRIC STUDY OF DETERIORATION OF PRESERVATIVES IN SOFT DRINK

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Soft drink consumption is a highly frequent practice. Soft drinks, in particular, are particularly popular among children and teenagers. As a result, the content of drinks should be examined in accordance with the law. Preservatives in soft drinks must be determined all over the world to ensure product safety and quality. For the purpose of extending the shelf life of a product, preservatives are compounds that prevent, stop, or delay the growth of microorganisms or any deterioration of elements caused by bacteria. The purpose of this study is to determine how preservatives in soft drinks deteriorate at different phases of their shelf life. To determine deterioration, different physicochemical characteristics and the state of the preservatives were analysed. To estimate Total solubility solids, CO_2 volume, Citric acid percentage, pH, and Benzoic acid percentage, chemical methods such as degassing of carbonated beverage, determination of pH, total soluble solids, gas volume, and benzoic acid were used.

Key words: preservatives, soft drink, deterioration, Physico-chemical parameters, Prevention Human well-being

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INTRODUCTION

Food preservation is a term that refers to a strategy for preventing food from rotting and extending the shelf life of foods. Present procedures are based on the use of certain technologies that provide high-quality products that are less preserved, include no additives, have nutritional value, and are microbiologically safe. Preservatives are compounds that can hinder, stop, or delay the growth of germs, as well as any deterioration of foods caused by microorganisms. As the manufacturing of processed and ready-to-eat foods has increased, food preservatives have become increasingly crucial in modern food technology. Food preservatives have been used to improve the quality of food for generations, with smoke, oil, vinegar, salt, and spices among the most common. Natural preservatives such as sugar, salt, acids, and others, as well as chemical preservatives, are used. During the late 1950s, as technology advanced and people's living conditions improved, the use of preservatives in foods skyrocketed. By the early 1960s, foods contained around 2000 distinct compounds. From then till now, there has been a growth in demand for novel, flavorful, convenient, and healthy foods. Over 2500 different preservatives are being used in foods, according to estimates [1]. Preservatives prevent hazardous poisons from forming in foods like cured meats, such as botulism, a food poisoning illness [2]. One of the earliest chemical preservatives used in food, drinks, and cosmetics is benzoic acid. As a food preservative, benzoic acid and its salts, such as sodium, potassium, and calcium benzoates, are typically favoured. In the food and beverage business, preservatives such sorbic acid, methyl and propyl parabens are utilised. E210-benzoic acid, E211-sodium benzoate, E212-potassium benzoate, and E213-calcium benzoate are the most common E- numbers. Beverages, fruit drinks, soft drinks, chemically leavened baked items, and canned foods all contain benzoic acid and its salt as food preservatives. Mold, yeast, and certain bacteria are all inhibited by it. Benzoic acid can be used directly or as a salt of sodium, potassium, or calcium. In the soft drink industry, sodium benzoate is used as a preservative in particular. Benzoic acid (sodium benzoate) is one of the authorised food preservatives that non-alcoholic beverage companies are permitted to employ. Non-alcoholic beverages that include a variety of beverages are commonly referred to as soft drinks (Table 1). It can be characterized based on the carbonation level, functionality, non-water as a key ingredient juice, flavoring, juice content, and sugar foundation.

Salting, sugaring, drying, prickling, and cold storage were all methods of preservation employed in the past to preserve fruits, vegetables, meat, and fish. The development of food science technology has resulted in a number of modern food preservation technologies. These are classified in Table 2. Table 3 describe the detailed description on use of variety of soft drinks.

Table 1

Properties and categories of soft drinks
***Таблица 1.* Свойства и категории безаалкогольных напитков**

Category of soft drinks	Example	Ingredients used	Carbonation level	pH	Sugar Concentration
1	2	3	4	5	6
Lemonades and colas	7Up, Coca- cola, Pepsi	Additives, Flavouring agent, Acids, Sugars, Sweetener	Medium to high carbonation level	2.4 to 3.2	0 to 10%
Drinks for wellness	Hyvaa Paivaa, Fenix	Additives, Minerals, vitamins, soluble fibres, herbal extracts	Low to medium carbonation level	3.5 to 4.5	2 to 7
Beverages based on malt	Naturade, Bionade	Sweetener agent, organic flavours, Fermented wort	Low to medium carbonation level	Data not available	Data not available

1	2	3	4	5	6
Drinks for Energy	Battery, Red Bull	Additives, Vitamin B, glucuronolactone, sugars, L-carnitine amino acids, extracts from herbs, taurine, caffeine	Low to medium carbonation level	2.5 to 3.2	1.4 to 14%
Drinks for sports	Gatorade	Additives, Sugars, amino acids, caffeine, salts	Negligible to low carbonation level	3.2 to 4.0	5.5 to 8%
Beverages which is friendly for tooth	Good for me	Additives, carbohydrates, Non-nutritive	Negligible to low carbonation level	More than or equal to 5.0	No sugars

Table 2

Methods of Food Preservation

***Таблица 2*. Методы пищевой консервации**

Method	Description & Uses
Freezing	Food preservation is achieved by maintaining a low temperature environment in which bacteria cannot grow. Low temperature and a lack of water prevent microbial growth. It's commonly used to keep fish and meat fresh.
Pasteurization	High-heat preservation of food Processing that eliminates bacteria while inactivating autolytic enzymes. Fruit juice preservation is a common application.
Dehydration	The drying procedure is used to preserve food. To limit microbial growth, the water content of food is lowered to a particular level. Dehydration causes storage to take longer, as well as a reduction in size and weight.
Ionizing Irradiation	Food is preserved by exposing it to a controlled dose of radiation in order to kill the organisms that cause deterioration. Spices, for example, are sterilised by irradiation. It aids in the preservation of chemical makeup in food after exposure, ensuring that microbes do not reproduce or generate poisons.
Use of Chemical Preservatives	The addition of chemical chemicals to food to limit the growth of microbes is used to preserve it. Bacteria and fungus are killed or prevented by chemical preservatives. When food is exposed to oxygen, it prevents the oxidation of ingredients, preventing it from turning rancid or forming black spots (like an opened cut apple).

Table 3

Types of soft drinks

***Таблица 3*. Типы безалкогольных напитков**

Type of soft drink	Description
Bottled water	Water contains minerals and vitamins, as well as potable water. (i) Still water: noncarbonated, mineral, spring, or table water, with or without additional flavours, vitamins, or minerals. (ii) Carbonated water: mineral, spring, or table water, low carbonated fluids, naturally sparkling or sparkling with the addition of CO_2. (iii) Flavoured water: water that has been flavoured with essences and/or fragrant compounds.
Juice	With the exception of allowed minerals and vitamins, 100 percent pure fruit or vegetable juice with sweetening agents (less than 2%).
Fruit powders	Non-ready-to-drink products in powder form
Iced/ready-to-drink tea/coffee drinks	Non-ready-to-drink powders and liquid concentrates for dilution, as well as tea- or coffee-based drinks.
Sports drinks	"Isotonic," "hypertonic," or "hypotonic" powders and concentrates, still or carbonated, ready-to-drink, or non-ready-to-drink; also fruit and nonfruit flavoured drinks.
Energy drinks	Drinks that boost energy and contain taurine, guarana, glucose, caffeine, exotic plants and chemicals, minerals, and vitamins.

EXPERIMENTAL PROCEDURE

Experimental work is done for the determination of Physicochemical characteristics followed by 3 types of Soft drinks viz., Sprite, 7Up and Mirinda during shelf life of three month. Total 5 parameters are determines viz., Total soluble solids (TSS) [3], Gas volume [4], pH, Citric acid percentage, Benzoic acid percentage [5]. As per the standard methods of analysis.

RESULT AND DISCUSSION

Table 4 shows observations of physicochemical characteristics of Sprite during the shelf life of six months. The T.S.S of Sprite during the three storage periods was found to be 13.200 Brix which is approximately similar. These results are in range with that recorded by Saeed et al. [6] who found no change in the T.S.S during the storage periods at different temperatures. The CO_2 volume of Sprite during the first, third and sixth months after production were found to be 3.00, 2.55 and 2.58 volume, respectively. The original pH of Sprite is 3.24 (±0.05) during the shelf life it was delete significantly ($P < 0.05$) decreased. The pH of the beverage showed a slight decrease after 90 days of storage at ambient temperature. The citric acid concentration of Sprite during the shelf life period was found to be 0.12%. The concentration of benzoic acid in 7Up soft drink during the three storage periods was found to be 0.01% (100 ppm).

Table 4

Physicochemical characteristics of Sprite Soft drink during shelf life
Original pH of Sprite Soft drink – 3.24 (±0.05)
***Таблица 4*. Физико-химические характеристики напитка Спрайт в течение его срока годности. Начальный pH Sprite 3.24(±0.05)**

Parameter	First month	Third month	Sixth month
TSS (Brix)	11.00	11.00	11.00
CO_2 delete CO_2 volume	3.00	2.55	2.58
pH	2.89	2.86	2.79
Citric acid (%)	0.12	0.12	0.12
Benzoic acid (%)	0.01	0.01	0.01

Table 5 shows observations of physicochemical characteristics of 7Up during shelf life of six months. The T.S.S of 7Up during the three storage periods was found to be 12.000 Brix and it was not significantly different ($P > 0.05$). The original pH of 7 Up is 3.24 (0.02) and during the three storage periods it was delete ($P < 0.05$) decreased. The pH of 7up Up soft drink shows a slight decrease after 90 days of storage at ambient temperature. The citric acid concentration of 7Up soft drink during the shelf life period was found to be 0.10%. The citric acid in 7Up soft drink during the three storage periods was not significantly different ($P > 0.05$) at ambient temperature. The concentration of benzoic acid in 7Up soft drink during the three storage periods was found to be 0.01% (100 ppm). This value was below the standard (0.1%) specified by the FDA [7]. This value was within the range of 98-262 ppm recorded by Hardisson et al. [8].

Table 5

Physicochemical characteristics of 7 Up Soft drink during shelf life
Original pH of 7Up Soft drink – 3.24 (±0.02 SD)
***Таблица 5*. Физико-химические характеристики напитка 7-Up в течение его срока годности. Начальный pH 7Up 3.24(±0.02)**

Parameter	First month	Third month	Sixth month
TSS (Brix)	12.00	12.00	12.00
CO_2 volume	2.45	2.43	2.32
pH	3.00	2.90	2.83
Citric acid (%)	0.10	0.10	0.10
Benzoic acid (%)	0.01	0.01	0.01

Table 6

Physicochemical characteristics of Mountain Dew (regular) Soft drink during shelf life.
Original pH of Mountain Dew (regular) Soft drink – 3.22 (±0.07)
***Таблица 6*. Физико-химические характеристики напитка Mountain Dew (обычного) в течение его срока годности. Начальный pH напитка 3.22(±0.07)**

Parameter	First month	Third month	Sixth month
TSS (Brix)	13.20	13.20	13.20
CO_2 volume	2.00	1.95	1.89
pH	3.15	3.09	2.83
Citric acid (%)	0.11	0.11	0.11
Benzoic acid (%)	0.01	0.01	0.01

Table 6 shows observations of physicochemical characteristics of Mountain Dew (regular) during shelf life of six month. The T.S.S of Mountain Dew (regular) during the three storage period was found to be 13.200 Brix & it was not significantly different ($P > 0.05$) The pH of Mountain Dew (regular) soft drink after the first, third and sixth months of production were found to be 3.15, 3.09 and 2.83. The original pH of Mountain Dew (regular) during the three storage periods was significantly ($P < 0.05$) decreased. These results conform to those reported by Saeed et al. [6] who stated that the pH of the Mountain Dew (regular) slightly decreases after 90 days at ambient temperature. The concentration of citric acid in Mountain Dew

(regular) during the three storage periods was found to be 0.11%. The concentration of benzoic acid in 7 up soft drink during the three storage periods was found to be 0.01% (100 ppm). This value was below the standard (0.1%) specified by the FDA [7]. This value was within the range of 98-262 ppm recorded by Hardisson et al. [8] and less than the range of 0.019-0.051% reported by ISO (2004).

CONCLUSION

Soft drink intake has become a highly prevalent habit in recent years. To minimize negative health impacts, daily soft drink consumption should be kept to a minimum, especially for children and youth. This study on soft drink preservatives examines the quality criteria of three prominent soft drink brands purchased from a local market in Nagpur, Maharashtra, India. Because acidity is connected to pH, the pH of these three soft drinks drops with time and their acidity rises. Soft drinks with a high acidity level are unfit for consumption. As a result, public awareness of the hazardous consequences of these compounds in soft drinks must be raised. This experiment employed Benzoic acid, which is often used in drinks, to assess the exact usage amounts of these preservatives in drinks and guarantee manufacturers are following the law. The purpose of this study is to raise public awareness regarding the detrimental effects of preservatives on soft drink shelf life. Nimbu pani, Neera, Thandai, Butter Milk, and a variety of other traditional soft drink options are available. These traditional drinks should be preferred over soft drinks by youth and children.

The authors declare the absence a conflict of interest warranting disclosure in this article.

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REFERENCES
ЛИТЕРАТУРА

1. **Branen Al., Haggerty Rj.** Introduction To Food Additives. In: Food Additives. New York: Marcel Dekker. 2002. P. 1-9. DOI: 10.1201/9780367800505.
2. **Sunitha J., Preethi R.** FDST Food Additives. Acharya N.G. Ranga Agricultural University. 2000. P. 65-69.
3. AOAC. Association of Official Analytical Chemists. Official Methods of Analysis. Washington, D.C. 1980. 1018 p.
4. IS. Indian standard specification for carbonated beverages. No. 2346. Indian Standards Institution Mank Bahavan ,9 Bahadur Shah Zafarmag New Delhi, India. 1973.
5. **Pearson D.** Pearson's Chemical Analysis of Foods. Longman Scientific and Technical, Longman Group Ltd, UK. 1981. 591 p.
6. **Saeed A.R., Ahmed M.O.** // *J. Fd. Sci. Technol.* 1977. 9. P. 78-81.
7. FDA. U.S. Food and Drug Administration. Code of Federal Regulations. 2003. Title 21. V. 6. Sect. 582.3733 sodium benzoate, Washington.
8. **Hardisson A., Gonzalez P.A., Frias I., Bonis A.D., Reguera J.I., De B.A.** // *Alimentacion, Equiposy Technologia*. 1999. 18 (4). P. 113-116.

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