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A Review on: Analysis of Sodium Benzoate Preservative and impacts on Health.

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ABSTRACT:

Sodium benzoate is a soluble molecule in ethanol and water, odorless, and has a molecular weight of 144.1 $g.mol^{-1}$. Its chemical formula is $C_7H_5O_2Na$. Generally, it serves as a preservative in some food, pharmaceutical, and cosmetic items. It is used in the pharmaceutical industry to treat a wide range of illnesses, including multiple sclerosis, liver conditions, and urea cycle abnormalities. Sodium benzoate is used in food products because, in addition to being simple to use, it effectively inhibits the growth of germs and fungus during storage. There have been reports of many analytical techniques for determining preservatives. The suggested techniques were applied to identify distinct preservatives in a range of foods by different analytical techniques like UV-Visible, Colorimetric, HPLC, GC, LCMS and Electrophoresis.

Key words: Preservatives, Analytical techniques, Sodium benzoate

INTRODUCTION:

Sodium benzoate is a sodium salt represented by the chemical formula $C_7H_5O_2Na$, with a molecular weight of 144.1 g.mol-1. It is typically used as a preservative in some products from the cosmetic, pharmaceutical and food industries [1, 2]. Sodium benzoate (SB) is white in color, odorless crystallized and found as a grain or powder easily crystalline in appearance and found as powder or grain, water-soluble and in ethanol, it is slightly dissolved [3]. The method of analyzing sodium benzoate in food can be carried out qualitatively and quantitatively. Qualitative tests can use the addition of $FeCl_3$, test kits, and KLT, while quantitative tests can use KCKT, spectrophotometry UV-Vis and titration [4]. It can be used in a number of foods, including fruit juices, fruit-based fillings, pickles, salad dressings, jams, and carbonated beverages, as well as cosmetics[5]. Sodium benzoate is one of the synthetic additives that are widely used in the food industry and is generally recognized as safe (GRAS) [6]. Sodium benzoate is a salt of benzoic acid, which is used as an important preservative in the food industry against bacteria, fungi and yeast with the natural pH of 4.5. Also, this substance can be used in pharmaceutical and cosmetics industries [7]. Sodium benzoate was approved as the first of all food preservatives by the Food and Drug Administration (FDA). The permissible limit of its consumption is 0–5 mg/kg of body weight [8].

IDEAL PROPERTIES OF PRESERVATIVES:

1. It should not be Irritant.
2. To maintain product consistency.
3. To maintain palatability and wholesomeness.
4. It should not be toxic.
5. It should be stable (physically and chemically).
6. It should be compatible with all other ingredients.
7. It should be act as good antimicrobial agent.
8. It should be potent in action.
9. It should have higher shelf life [9].

CLASSIFICATION OF PRESERVATIVES:

Preservatives are classified as:

1. Class I (natural preservatives): Eg: Salt, sugar, vinegar, syrup, spices, honey and edible oil.
2. Class II (chemical or synthetic preservatives): Eg: Benzoates, sorbates, nitrites and nitrates of sodium or potassium, sulfites, glutamates and glycerides .

Class II preservative should be used in one food item. People consuming or using items containing more than one preservative are at risk of exposure to multiple chemicals

Both natural and synthetic preservatives are categorized as antimicrobial, antioxidant, antienzymatic. Antimicrobials destroy or delay the growth of bacteria, yeast, molds.

Antioxidants slow or stop the breakdown of fats and oils in food that occurs in the presence of oxygen leading to rancidity. Preservatives are commonly found in most oral, dental, dermal, nasal, parenteral products and including vaccines, rectal and ophthalmic products7-16 [10-12].

S.NO	CLASS	PRESERVATIVES	APPLICATIONS
1.	Anti-microbial	Nitrites, Nitrates, sulfur dioxide, benzoates and sorbates.	Destroy or delay the growth of bacteria, yeast, molds
2.	Anti-oxidants	Butylated Hydroxy Anisole (BHA), Butylated Hydroxy Toulene(BHT), ascorbic acid.	Slow or stop the breakdown of fats and oils to prevent rancidity
3.	Anti-enzymatic	Erythorbic acid (isoascorbic acid) and citric acid	Block the process during ripening and harvesting

Table: 1 - Preservatives and their Applications [13].

Preservatives	Foods containing
Sodium benzoate	Fruit products, margarine, acidic foods
Sodium nitrate and nitrite	Cured meats, fish, poultry
Sodium propionate	propionate Breads and other baked products
Sodium sorbate	Dairy products, mayonnaise, processed meats, fermented products
Sorbic acid	Dairy products, fruit products, syrups, sweets, Beverages, fermented products
TBHQ(Tetra butyl hydroquinone)	Snack foods, fats and oils
Tocopherol (Vitamin E)	Oils and shortenings

Table: 2 - Foods products containing different types of preservatives [13].

Artificial Preservatives:

These preservatives are made by humans through chemical synthesis, which works against a range of bacteria at low doses. Take benzoates, sodium benzoate, nitrites, and propionates, for instance [10]. The European Union's commission assigns an E-number to an additive following approval by the Scientific Committee on Food (SCF), which is in charge of evaluating the safety of food additives. E numbers, which are often used in the food industry, identify chemicals that are permitted for use in Switzerland and the European Union. The E-number for the class "Preservatives" ranges from 200 to 299. Lysozyme, E-1105, is another preservative that is allowed [18].

E NUMBER: E Numbers are number codes for food labels. This is international numbering system (INS).

E stands for Europe- E100-E199 - colors E200-299 - preservatives E 300-E399 - antioxidants, acidity regulators.

S.NO	E- NUMBER	PRESERVATIVES
1.	E200-209	Sorbates
2.	E210-219	Benzoates
3.	E220-E229	Sulphites
4.	E230-E239	Phenols and formats
5.	E240-E259	Nitrates
6.	E260-E269	Acetates
7.	E270-E279	Lactates
8.	E280-E289	Propionates
9.	E290-E299	Others

Table: 3 - E – Number for Preservatives [14, 18].

SODIUM BENZOATE:

Structure:

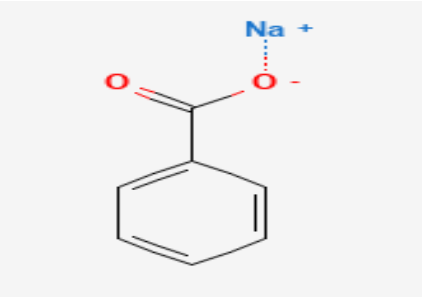

Fig: Structure of Sodium Benzoate.

Molecular formula: C_6H_5COONa
Molecular weight: 144.103
Category: Preservative
Melting point: 410°c
Wavelength: 232 nm
Description: White crystalline powder
Solubility: Soluble in methanol
Storage: Store at room temperature
Functions: Bacteria static and fungi static under food as preservatives acidic condition [14]

MECHANISM OF ACTION: PRESERVATIVES HOW THEY ACT?

Conventional preservatives also include natural ingredients like diatomaceous earth, sugar, vinegar, and salt. Food can also be preserved by using techniques like pickling, smoking, freezing, and salting. Certain enzymes in fruits and vegetables that continue to metabolize after they are sliced are the focus of another class of preservatives. Citrus juices, such as lemon, include ascorbic and citric acids that can impede the activity of the phenolase enzyme, which is responsible for the browning of chopped potatoes and apples. However, as fruit and vegetable product labels are currently exempt from FDA rules requiring them to appropriately disclose the type of preservative used in the goods, caution must be exercised [15].

Determination of preservatives in food by different analytical methods:

There have been several analytical techniques published for determining preservatives. The suggested methodologies were applied to identify distinct preservatives in different food items using a variety of analytical methods, including colorimeter, GC, LCMS, HPLC, UV Visible, and electrophoresis [16].

Experimental analysis of sodium benzoate:

Using modified protocols outlined by Pylypiw and Grether (2000), a high-performance liquid chromatography technology was utilized to determine the amounts of sodium benzoate in the samples. The mobile phase was diluted 1:5 in each of the 1 ml samples. The mobile phase was added to the diluted sample one again, dilution 1:10. A PTFE syringe filter was used to filter the transparent aqueous solution. After that, the solution was put into the dry HPLC vials and injected onto the column to be measured and detected [17].

CONCLUSION:

Through study, the current review outlines the primary side effects that people and animals experience after consuming sodium benzoate. It also shows how toxicity can vary based on the species, dosage, and length of exposure to the preservative. Overdosing (5 mg kg-1) led to allergic response, ADHD, and hyperactivity. If using food additives is necessary due to their benefits, then the natural ones that are generally accepted as safe and have few side effects should be used. "These systems are not commonly used in marketed products because their cost and performance are still not comparable to that of traditional preservatives." Therefore, using natural preservatives rather than synthetic ones may be preferable as they give us so many positive outcomes. I draw the conclusion that the HPLC approach is an easy, precise, dependable, and repeatable way to estimate the amount of SB present in food products. Following validation, it was discovered that the improved HPLC techniques were linear, accurate, and exact. A more recent high performance liquid chromatographic technique was employed to examine the presence of sodium benzoate as a preservative in every food item.

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