



## **SODIUM BENZOATE**

**FORMULA:** C<sub>6</sub>H<sub>5</sub>COONa (C<sub>7</sub>H<sub>5</sub>NaO<sub>2</sub>)

**MOLECULAR WEIGHT:** 144.12 **FEMA NUMBER:** 3025

**CAS REGISTRATION NUMBER:** 532-32-1 **EINECS REGISTRATION NUMBER:** 208-534-8

**GRADES AVAILABLE:** N.F./F.C.C., BP, EP, INS 211, EEC 211

**PRODUCT FORMS AVAILABLE:** DENSE & POWDER (Granular) & EDF™ (Extruded)

**SALES SPECIFICATIONS and PACKAGING INFORMATION ARE AVAILABLE UPON REQUEST:**

### **TYPICAL PHYSICAL PROPERTIES of SODIUM BENZOATE:**

Sodium benzoate is the sodium salt of benzoic acid. One gram of the salt is soluble in 2 ml of water, in 75 ml of ethyl alcohol, and in 50 ml of 90 % ethyl alcohol. The salt is insoluble in ethyl ether. Additional solubility data for the salt in water is as follows (values are *grams sodium benzoate per 100 grams water* at the indicated temperature):

62.9	@	15° C	64.5	@	60° C
62.9	@	30° C	70.2	@	88° C
63.1	@	50° C	73.3	@	97° C

A typical aqueous solution will be slightly alkaline and typically has a sweetish astringent taste. Sodium benzoate is a slightly hygroscopic, white, odorless or nearly odorless product. It is offered for sale in two densified granular forms (DENSE and POWDER) and as an extruded product (EDF™). Typical "tap" bulk densities for these product forms POWDER - 44 # / ft<sup>3</sup> (0.70 g/cc); DENSE - 48 # / ft<sup>3</sup> (0.77 g/cc); and EDF™ - 34 # / ft<sup>3</sup> (0.55 g/cc). Sodium benzoate contains 84.7 % of available benzoic acid.

## **FOOD and PHARMACEUTICAL APPLICATIONS**

### **FOOD AND BEVERAGE PRESERVATION:**

Food and beverage spoilage has been a problem throughout history. Most food spoilage is due to enzyme action upon food. Enzymes are complex organic compounds that may act as catalysts and cause a chemical change to occur. Most enzymes that cause food to spoil are produced by living organisms, e.g., bacteria, molds and yeast. Fresh foodstuffs may have some of these microorganisms present and others may be encountered by exposure to the air or in processing. The enzymes that cause spoilage may be generally described as two types; "endoenzymes" which exist within the microorganism and "exoenzymes" which are released by the microorganism. Consequently, the quality of microorganism enzymes of both types which cause food to spoil is directly related to the concentrations of the microorganism present, its species, and its general activity.

Microorganisms are largely responsible for the presence of these enzymes in food. By its general nature, food cannot resist the action of enzymes which may lead to food spoilage. Thus, the

elimination of food spoiling enzymes is accomplished most easily by either destroying or inhibiting the source of the enzymes; the microorganisms themselves.

There are basically four generally accepted methods for preserving foodstuffs and these methods rely on one or the other methods of microorganism control. 1) Sterilization by heat or radiation destroys the microorganisms; 2) refrigeration reduces or stops the activity of microorganisms; 3) drying reduces or stops the activity of the microorganism by removing essential water; and 4) chemical preservatives reduce or inhibit the activity of the microorganisms.

The addition of chemical preservatives to food is not new and been practiced for centuries. Some of the most familiar preservation methods, those of brining, pickling with vinegar, smoking, and preserving with sugar solutions, depend upon chemical preservatives. These methods inhibit microorganism activity and retard microorganism growth and multiplication. These methods act in one of two generalized ways: 1) by physically increasing the density of the microorganisms environment (raising the osmotic pressure) or 2) chemically, by a direct inhibiting action on the microorganism themselves.

Consequently, chemical preservatives which perform by a direct inhibiting action on the microorganisms themselves are not new. Sodium benzoate is a chemical preservative which in very low concentration inhibits the activity of the microorganisms themselves.

Sodium benzoate is a food preservative that has been in use for years. As early as 1909, the "harmlessness" of sodium benzoate as a food preservative was extensively verified in actual human feeding studies performed by three independent research organizations under the direction of the Secretary of Agriculture. A summary of these studies was published in a 784 Page book titled Report No. 88 of the US Dept. of Agriculture. This report verified that sodium benzoate, when mixed with food in the quantities specified, was not injurious to the general health nor found to adversely affect or impair the quality or nutritive value of such food.

For a long time, sodium benzoate has been generally recognized as safe (GRAS) as a direct food additive and recently this status was reaffirmed (21 CFR §184.1733) for use as an antimicrobial agent, as defined in 21 CFR §170.3(o)(2), and as a flavoring agent and adjuvant, as defined in 21 CFR §170.3(o)(12). Sodium benzoate may be used in food at levels not to exceed good manufacturing practice. Current usage results in a maximum level of 0.1 % in food.

Sodium benzoate is most suitable for use as an antimicrobial agent in foods and beverages which naturally are in the pH range below 4.5, or can be brought into the range by addition of a water soluble acidulant. Sodium benzoate is not recommended as a preservative at pH ranges higher than 4.5.

The effectiveness of sodium benzoate as a preservative increases with decreasing pH (increasing acidity). This is because the ratio of undissociated (i.e., free) benzoic acid to ionized benzoic acid increases as the pH decreases. It is generally accepted that the undissociated benzoic acid is the active antimicrobial agent. Although no definite theory has been yet proposed to explain this antimicrobial effect, it is believed to be related to the high lipoid solubility of the undissociated benzoic acid which allows it to accumulate on the cell membranes or on various structures and surfaces of the bacterial cell, effectively inhibiting its cellular activity.

Sodium benzoate has activity against yeast, mold, and bacteria. Although several studies have been performed on the antimicrobial activity of sodium benzoate on these species, it is difficult to obtain substantial evidence on relative activities of sodium benzoate against specific members of those general species. Actual field application trials are recommended for assurance of satisfactory antimicrobial activity against the species in question.

At low pH values, sodium benzoate may impart a slight tang in taste attributable to the undissociated benzoic acid. If this effect is undesirable, it may be overcome by using other approved preservatives

in conjunction with sodium benzoate to lower the concentration of sodium benzoate below the taste threshold.

An important consideration in preserving with sodium benzoate is the addition of the preservative as early as possible in the food processing. The early addition of sodium benzoate will prevent the microorganisms from forming enzymes which may continue to cause deterioration even though the microorganism growth will be inhibited at the later stage in processing.

One of the most important considerations in preserving with sodium benzoate is the maintenance of absolute cleanliness. It should be clearly understood that although preservatives such as sodium benzoate serve a very useful purpose in foods, they cannot take the place of cleanliness in food processing. Products that have already spoiled will not benefit from the use of sodium benzoate as a preservative.

Sodium benzoate may be added conveniently and efficiently in the form of a concentrated stock solution in water. A simple stock solution may be prepared by dissolving one pound of sodium benzoate in one gallon of water. One fluid ounce of this solution when added to one gallon of beverage gives a concentration of about 0.1 % sodium benzoate. If the specific gravity of the beverage is significantly higher than water after sodium benzoate is added in processing, and an acidic pH adjustment is needed with the addition of a strong acid such as citric acid, sufficient agitation should be available to prevent localized precipitation of benzoic acid, which has a solubility of about 0.2% in water at 20° C. This processing step is important because the relatively water insoluble benzoic acid may precipitate inside the processing vessels and lines causing plugging problems and loss of essential preservative in the total batch contents.

Sodium benzoate, N.F./F.C.C. is widely used in carbonated and still beverages, syrups, cider, salted margarine, olives, sauces, relishes, jellies, jams, preserves, pastry and pie fillings, low fat salad dressing, fruit salads, prepared salads, and in storage of vegetables. Some generalized applications are described in the following examples. Keep in mind that both federal and state regulations may apply to specific applications. These regulations should be reviewed and verified as applicable or non-applicable for each specific use application.

**BEVERAGES** - Sodium benzoate is the standard preservative used in carbonated beverages. Typically 0.03 to 0.08 % is used for the finished products. Sodium benzoate is often used to preserve the flavor syrup prior to the addition of the beverage acidulant. Non-carbonated beverages normally require somewhat higher concentrations of 0.05 to 0.1 % sodium benzoate in the finished products.

**CIDER** - The shelf life of non-pasteurized cider can be greatly extended by using sodium benzoate and it should be added as soon as the juice is pressed. A slight tang, which many tasters apparently prefer, may be imparted to the cider by concentrations of sodium benzoate as low as 0.04 %.

**MARGARINE** - Margarine is regulated by standards of identity described in 21 CFR 166.110. sodium benzoate is allowed as a preservative up to 0.1 %. Special attention to the preservation may be required for low salt or salt free margarine, as salt may exhibit a synergistic effect with sodium benzoate.

**SYRUPS** - Concentrated sugar solutions are somewhat resistant to fermentation under ideal conditions but may be subject to quality deterioration in non-ideal circumstances. Sodium benzoate may be used to inhibit microbial growth in these syrups at levels of about 0.1 % at pH values below 4.5. In chocolate syrups and other fountain syrups with pH values above 4.5, sodium benzoate may be used in conjunction with other preservatives that are more effective in that pH range.

**FRUITS, FRUIT JUICES, AND FRUIT SALADS** - Typically sodium benzoate will be used at levels of 0.05 to 0.1 % to preserve these products. Maraschino cherries are preserved with 0.05 to 0.1 % sodium benzoate. The shelf life of chilled citrus salads is materially improved by the use of 0.03 to 0.08% sodium benzoate in the cover syrup.

**ORANGE JUICE PRODUCTS** - Orange juice products are regulated by standards of identity of "Orange Juice with Preservative" described in 21 CFR §146.152 and "Concentrated Orange Juice with Preservative" described in 21 CFR §146.154. These regulations allow the use of GRAS preservatives such as sodium benzoate. The label on these products must disclose the name of the preservative, preceded by a statement of the weight percent of the preservative.

**FRUIT BUTTERS, JELLIES, PRESERVES, AND RELATED PRODUCTS** - Fruit butters, jellies, preserves, and related products are regulated by standards of identity for those products as described in 21 CFR §150. According to that regulatory description, GRAS preservatives such as sodium benzoate are permitted as optional ingredients in a concentration reasonably required for preservation. Artificially sweetened fruit jelly is specifically described in 21 CFR §150.141 and artificially sweetened fruit preserves and jams are specifically described in 21 CFR §150.161. Both sections specifically allow these products to contain sodium benzoate up to a level not to exceed 0.1 %, by weight, of the finished food.

**SALAD DRESSINGS** - Non standardized salad dressings which have a relatively low fat content may be preserved by the use of sodium benzoate at a use level of 0.1 %, if the product is below a pH of 4.5.

**PREPARED SALADS** - Prepared salads are generally kept under refrigeration but additional protection against mold and yeast growth may be gained by using 0.1 % sodium benzoate. The pH of these products should be below 4.5 for the preservative to be effective. The preservative should be added with the salad dressing or with the gelatin solution.

**NON STANDARDIZED SAUCES AND CONDIMENTS** - Many non standardized sauces and condiments that have a pH range below 4.5 may be effectively preserved with sodium benzoate at 0.05 to 0.1 %.

**PICKLES AND PICKLE PRODUCTS** - Yeast and mold contamination and scum formation in pickles and pickle products may be controlled with up to 0.1 % sodium benzoate. The sodium benzoate may be added with the sweet juice to be used on the pickles, which may make up about one-third of the total bulk content. Consequently, 0.3% sodium benzoate could be added to the sweet juice to attain not more than 0.1 % sodium benzoate in the entire finished product.

## **PHARMACEUTICAL, TOILETRY, and COSMETICS APPLICATIONS**

Sodium benzoate, N.F./F.C.C. is used extensively in pharmaceutical preparations, toiletries, and cosmetics. Sodium benzoate is a well known and widely used preservative for pharmaceutical products such as syrups, flavored vehicles, and multiple dose containers for liquid preparations. The pH is an important factor and use levels may vary.

In the manufacture of compressed tablets that will give clear solutions, a level of 2 to 4% sodium benzoate powder in the granulation has been described as an efficient lubricant and provides rapid disintegration times. Sodium benzoate has a solubilizing effect of certain drugs, which is useful, for instance, in caffeine preparations or certain anesthetic compositions. Sodium benzoate is also used as a diagnostic acid for liver function.

Sodium benzoate is a safe, economical preservative in certain toilet preparations such as creams, lotions, gum solutions, and toothpaste. The advantages of sodium benzoate in these applications are that it is colorless, odorless, readily soluble, and generally is compatible other ingredients. Sodium benzoate has been generally reported to be used at concentrations below 3%. The preservative is also most efficient at lower pH values. The inhibitory level of sodium benzoate in emulsions increases with oil content. Sodium benzoate has found antimicrobial applications in mouthwashes, dermatological creams and ointments, and deodorants.

## **OTHER USES FOR SODIUM BENZOATE, N.F./F.C.C.**

Sodium benzoate has been used as a preservative for various juice extracts during processing steps and in the finished product. One such application is in the use of sodium benzoate as a preservative for yucca juice extract, which is a natural surfactant used in dairy waste control.

Many other uses of sodium benzoate, N.F./F.C.C. are possible in these industries whenever there is an application for a preservative and the parameters of the media are suitable or may be made suitable for sodium benzoate.

## ***INDUSTRIAL APPLICATIONS***

### **CORROSION INHIBITION**

Sodium benzoate has found considerable application as a corrosion inhibitor in low concentrations. Corrosion inhibition has been reported for steel, zinc, copper, copper alloys, soldered joints, aluminum, and aluminum alloys. As a liquid phase inhibitor, low concentrations of sodium benzoate have been reportedly been used for corrosion control at a pH as low as 5.5, but the most effective inhibition appears to be in the pH range of 6 to 12. The effectiveness of the corrosion inhibition has been reported to be positively affected by small concentrations of Sodium Nitrite and negatively affected by concentrations as low as 0.1% of Sodium Chloride and / or Sodium Sulfate.

A critical minimum pH for inhibition with respect to the sodium benzoate concentration has also been indicated.

It has been suggested that sodium benzoate reduces fouling by reducing the tendency of rust and scale to dislodge from corroded surfaces. Sodium benzoate does not cause foaming or frothing when used as a corrosion inhibitor in these applications. Sodium benzoate also presents no toxicity problems when used as a corrosion inhibitor, which could be an asset in applications sensitive to odor and toxicity.

The use of sodium benzoate impregnated in paper wrappers has also been used to inhibit the corrosion of tin, steel, chrome plated, and galvanized surfaces even in humid environments. Total contact of the metal surfaces by the wrapping medium is required. In some instances, wrapper protection has been unsuitable and the metal parts have been reported to be inhibited by dipping in solutions of Sodium benzoate. Sodium benzoate has also proved useful in protecting the metal containers for such products as agricultural chemical solutions, household products, waxes, polishes, and aerosol products. Corrosion around labels on tins has been prevented by Sodium benzoate in the adhesive emulsion. Can rusting in neutral to slightly acidic emulsion paints has been prevented by use of sodium benzoate. Sodium benzoate undoubtedly has additional applications as a corrosion inhibitor and has been more extensively evaluated outside the United States where it is more frequently used in that application, especially in automotive engine cooling service.

### **OTHER INDUSTRIAL USES FOR SODIUM BENZOATE**

Several other industrial uses for sodium benzoate have been discovered and they are quite valuable. Some of these uses include chemical intermediates, catalysts, and as nucleating agents for polyolefin manufacture.

## **METHODS OF ANALYSIS**

Some general methods of analysis for sodium benzoate (as Benzoic Acid) in food and drug products are described in Official Methods of Analysis of the Association of Official Analytical Chemists.

## **STORAGE CONDITIONS**

Sodium benzoate is slightly hygroscopic and should be stored in sealed containers. Exposure to conditions of high humidity and elevated temperatures should be avoided for general storage.

**NOTE:** *The information presented herein is believed to be true and accurate. However, all suggestions and recommendations are made without guarantee. Our technical personnel are always ready to respond to inquiries regarding the safe handling of any of our products.*

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### **Stock Points**

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