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Comparison of Benzoate and Saccharin Contents in Natural Sweetener Products Liquid Stevia and Liquid Sugar

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ABSTRACT

For several decades and in some cases, sugar has been proven to have harmful relationships with various health factors such as obesity, diabetes, cardiovascular diseases, hyperuricemia, gout, ectopic fat accumulation, dental caries, and certain cancers. Therefore, the market tends to seek safer alternative sweeteners as substitutes for sugar, such as artificial sweeteners like saccharin, cyclamate, aspartame, stevia, and others. Food products are often preserved to extend their shelf life; for liquid or paste food products, the preservative commonly used is sodium benzoate. A study was conducted to determine the levels of saccharin and benzoate in liquid stevia and liquid sugar products to identify the presence of saccharin and benzoate in these food products. The research was carried out using three samples each of liquid stevia and liquid sugar available on the market (online). The average benzoate content range in stevia samples was 0,0348–0,1548%, and in liquid sugar samples 0,0074–0,1128%. The saccharin content range in stevia samples was 11,3694–15,3773%, and in liquid sugar samples 3,4546–1,0634%. When compared with the maximum limits set by the Ministry of Health, BPOM, and SNI—where the maximum benzoate is 0,1% and maximum saccharin is 0,03% it can be concluded that the average benzoate level in liquid stevia (0,0980%) is higher than in liquid sugar (0,0610%), while the average saccharin level in liquid stevia (13,1628%) is also higher than in liquid sugar (7,3722%). This study indicates the addition of preservatives and artificial sweeteners in the samples beyond the permissible maximum limits, proving that the liquid stevia preparation is not 100% a natural sweetener. Further research with different samples and methods is recommended.

Keywords : Saccharin, Benzoate, Artificial Sweetener, Preservative, Titration, Extraction

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INTRODUCTION

As an essential component of the human diet, sugar has been shown for decades to be negatively associated with various risk factors, including obesity, diabetes, cardiovascular disease, hyperuricemia, gout, ectopic fat accumulation, dental caries, and some cancers [1]. Sugars are identified as monosaccharides and disaccharides frequently added to foods by manufacturers, cooks, or consumers. They are naturally found in honey, syrups, and

fruit juices. Therefore, the market is looking for safer sweeteners to replace sugar. Sweeteners other than sugar are divided into natural and synthetic sweeteners [2].

Several studies have shown that some artificial sweeteners are harmful to health, and this is where natural sweeteners add value in terms of health by reducing calories and using ingredients derived from natural sources rather than through chemical synthesis [3].

However, the number of natural non-caloric sweeteners is still limited, and among the currently known sweeteners, stevia (*Stevia rebaudiana*) has attracted the most scientific attention in recent years. Stevia can be used as a calorie substitute, especially in high-carbohydrate diets. Stevia leaves are delicious and have numerous health benefits, such as lowering blood pressure, cholesterol, kidney problems, obesity, cavities, and diabetes. Stevia has been shown to be an effective sucrose substitute and safe for human consumption in most tests, thus increasing market demand [4, 5].

Sodium benzoate is a compound that functions as an artificial preservative to extend the shelf life of food. Sodium benzoate is safe for consumption, but at low levels. It is dangerous when combined with citric acid, ascorbic acid, and vitamin C, as they can form benzene, a carcinogenic compound(6). Sodium Benzoate has a maximum limit for use, based on the Indonesian National Standard (SNI) 01-0222-1995, of 1 g/kg of material, in accordance with regulations stipulated in the Head of the Food and Drug Monitoring Agency of the Republic of Indonesia Number 36 of 2013.

The use of sodium benzoate as a food preservative in Indonesia is regulated by Minister of Health Regulation No. 722 of 1988, with a maximum limit of 0,1% (1000 mg/kg). The Food and Drug Monitoring Agency (BPOM) clarifies this limit through more specific regulations, such as BPOM Regulation No. 36 of 2013, which sets a limit of 600 mg/kg for soft drinks and soy sauce, and BPOM Regulation No. 11 of 2019, which sets a limit of 200 mg/kg for several other foods. Internationally, the FDA recognizes sodium benzoate as a safe preservative with a maximum limit of 0,1% (1000 mg/kg). The ADI for sodium benzoate, according to the WHO and the Food and Drug Authority (BPOM), is 0–5 mg/kg body weight per day. This regulation aims to protect consumers from the risks of excessive preservative use. The World Health Organization's permitted dose for saccharin is 5 mg/kg/day. Research by Kulkarni CP indicates that some ice cream products contain 22,.0 mg/kg–72.0 mg/kg(7).

Saccharin use in Indonesia is regulated by Minister of Health Regulation No. 722/Menkes/Per/IX/1988, with a maximum limit of 300 mg/kg in food products. Subsequently, BPOM Regulation No. 4 of 2014 updated this limit to 100 mg/kg in certain foods. Saccharin use must be monitored and is not permitted for infants, toddlers, pregnant women, and breastfeeding mothers. Internationally, the FDA sets the Acceptable Daily Intake (ADI) for saccharin at 5 mg/kg body weight per day and recognizes saccharin as a food additive considered safe (GRAS). This regulation aims to ensure consumer safety from the risks of excessive saccharin consumption [8].

According to Regulation of the Minister of Health of the Republic of Indonesia Number 722/Menkes/Per/IX/1988 concerning Food Additives, the use of saccharin and sodium benzoate in food products, including the natural sweetener liquid stevia, has certain maximum limits. The maximum permitted saccharin content is 300 mg/kg of food product, while sodium benzoate, as a preservative, is limited to 0.1% or 1,000 mg/kg. These regulations aim to maintain food safety and protect consumers from the health risks associated with excessive consumption of these two additives [9, 10].

MATERIALS AND METHODS

This type of research is an experiment with a comparative quantitative approach because it uses numerical data to compare two or more samples. The research design is analytical observational with a cross-sectional study approach. With 12 treatments (namely 6 brands of liquid sugar and examined for benzoate and saccharin levels) then for sample repetition is 3 times. The research method is extraction and titration. Benzoic acid is extracted from the solution at pH 4 with diethyl ether then the liquid phase is separated from the ether extract; the ether extract is evaporated, the benzoic acid residue (like a needle) is titrated with NaOH solution with phenol red indicator. The liquid phase is then acidified with concentrated HCl and extracted with diethyl ether. The ether extract is evaporated, the saccharin residue (sweet taste) is titrated with NaOH solution with BTB indicator. The assay reaction usually involves hydrolysis of sodium benzoate to benzoic acid by adding hydrochloric acid (HCl), then extraction with diethyl ether. Each mL of 0,05 N NaOH is equivalent to 0,0061 g of benzoic acid. Each mL of 0,05 N NaOH is equivalent to 0,00916 g of saccharin.

RESULTS AND DISCUSSION

The following are the average results of benzoate and saccharin levels in each sample:

Table 2. Percentage of Benzoate and Saccharin in Samples

No	Type of Samples	Benzoate (%)	Saccharin (%)
1	Sv	0,1043	12,7416
2	St	0,1548	11,3694
3	Vk	0,0348	15,3773
4	Gl	0,0074	3,5985
5	Ks	0,0628	3,4546
6	Kp	0,1128	15,0634

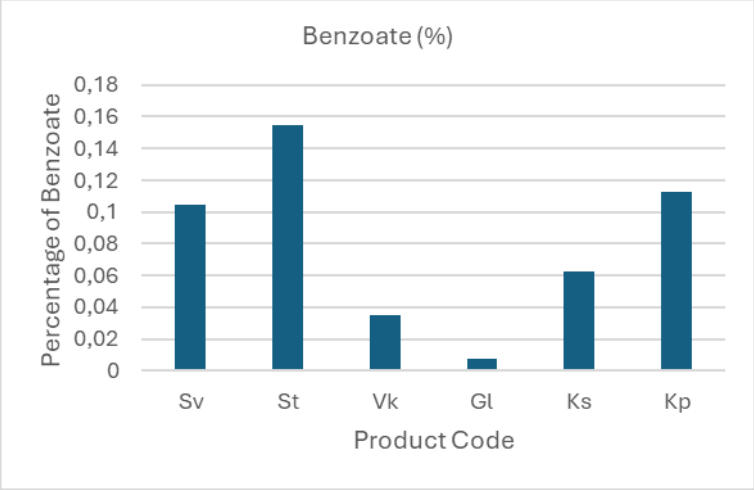

Figure 1. Percentage of benzoate in each product

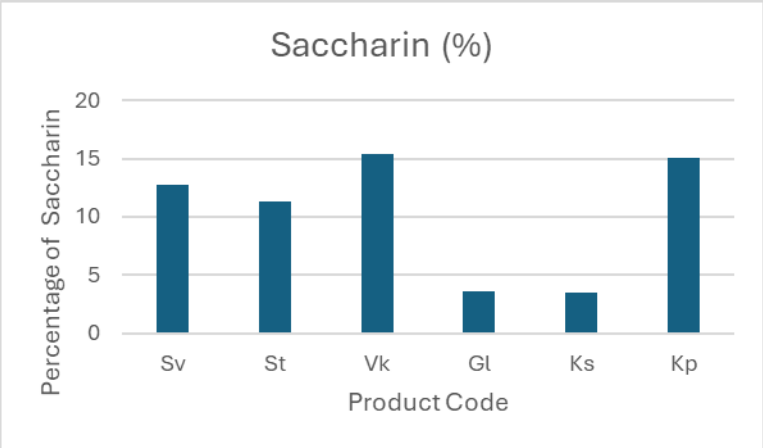

Figure 1. Percentage of saccharin in each product

Table 2. Comparison of benzoate content in stevia and sugar in products

No	Type of Samples	Benzoate in Liquid Stevia Content (%)	Type of Samples	Benzoate in Liquid Sugar Content (%)
1	Sv	0,1043	Gl	0,0074
2	St	0,1548	Ks	0,0628
3	Vk	0,0348	Kp	0,1128
	Average	0,0980	**Average**	0,0610

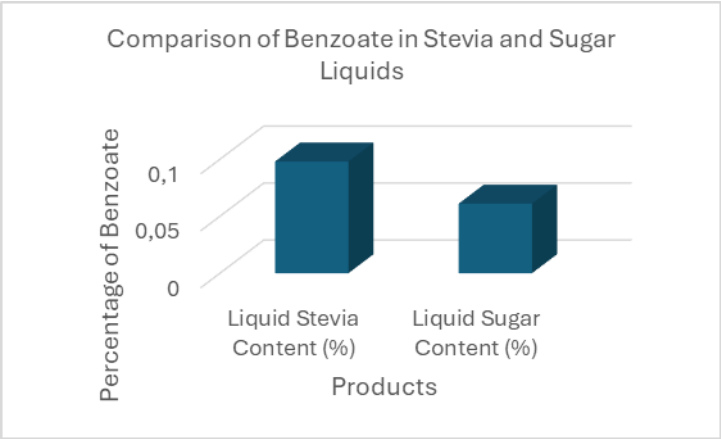

Figure 3. Comparison of average benzoate in products

Table 4. Comparison of Saccharin in Products

No	Type of Samples	Saccharin in Liquid Stevia Content (%)	Type of Samples	Saccharin in Liquid Sugar Content (%)
1	Sv	12,7416	Gl	3,5985
2	St	11,3694	Ks	3,4546
3	Vk	15,3773	Kp	15,0634
	Average	13,1628	**Average**	7,3722

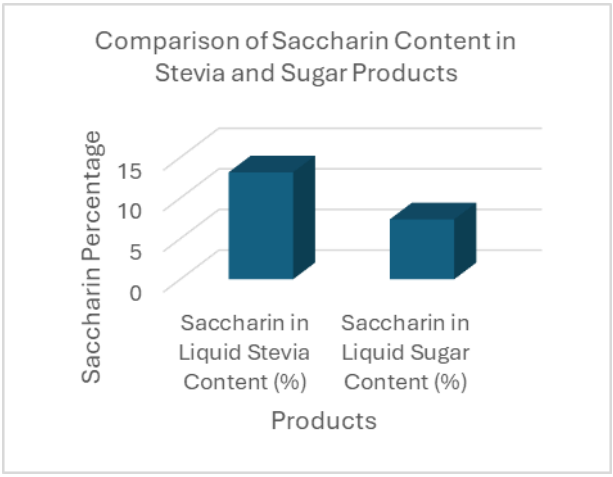

Figure 4. Comparison of average saccharin in products

The maximum use limit for benzoic acid and sodium benzoate as food preservatives is regulated by the Minister of Health Regulation (PERMENKES). Based on Permenkes No. 722/Menkes/Per/IX/88 and No. 1168/Menkes/Per/X/1999, the maximum use limit for benzoic acid and sodium benzoate is 0,1%, or 1 gram per kg of food. The BPOM (Indonesian Food and Drug Monitoring Agency) limits the use of benzoate as a food preservative to 600 mg/kg (0,06%) (Regulation of the Head of the Food and Drug Monitoring Agency of the Republic of Indonesia Number 36 of 2019).

The maximum use limit for sodium benzoate in food and beverages according to the Indonesian National Standard (SNI) is 1 g/kg or 1000 mg/kg (or 0,1%), according to SNI 01-0222-1995. The FDA limits sodium benzoate, a common food preservative, to a maximum concentration of 0,1% by weight in food and beverages. At this level, the FDA generally recognizes sodium benzoate as safe.

The antioxidant activity test was carried out using the DPPH (1,1-diphenyl- 2- pykrilhydrazil) method which was repeated 2 times with various variations in concentration. The results of determining the levels of benzoate and saccharin in various brands of liquid stevia and liquid sugar were as follows: In this study, the benzoate levels were Sv: 0,1043%, St: 0,1548%, Vk: 0,0348%, Gl: 0,0074%, Ks: 0,0628%, and Kp: 0,1128%. Therefore, Kp, Sv, and St

exceed the safe limits for benzoate in food as stipulated by the Minister of Health Regulation (PERMENKES), BPOM (Indonesian Food and Drug Authority), SNI (Indonesian National Standard), and FDA.

The levels of saccharin in food in Indonesia are regulated by the Minister of Health Regulation (PERMENKES) No. 033/Menkes/Per/IX/2012 concerning Food Additives. The maximum permissible limit for saccharin is 300 mg/kg of material. This regulation also applies to other artificial sweeteners, such as cyclamate, with different maximum usage limits.

The safe limit for saccharin as a food additive has been regulated by the Food and Drug Authority (BPOM). BPOM Regulation No. 4 of 2014 sets a maximum limit of 100 mg/kg of saccharin. The maximum limit for saccharin use in food products in Indonesia is regulated by the Indonesian National Standard (SNI) and the Minister of Health Regulation (PERMENKES). SNI 01-6993-2004 concerning Artificial Sweetener Food Additives sets a maximum limit for saccharin use in various types of food products, namely 300 mg/kg for saccharin. The FDA has set an Acceptable Daily Intake Limit (ADI) for saccharin. The FDA limits saccharin in beverages to 120 mg/kg. When converted to ppm (or milligrams/kilogram), the PERMENKES figure is 0,03%, BPOM 0,01%, SNI 0,03%, and FDA 0,012%.

In this study, the saccharin levels were Sv: 12,7416%, St: 11,3694%, Vk: 15,.3773%, Gl: 3,5985%, Ks: 3,4546%, Kp: 15,0634%. Therefore, all samples were above the maximum limit for saccharin in food based on the BPOM, Permenkes, and FDA. Saccharin, a non-nutritive sweetener, is restricted for use in food due to potential health concerns, particularly related to its effects on gut bacteria and the possibility of causing bladder tumors in rodents. Although human studies have not shown the same risks as those observed in animals, it is recommended to maintain recommended intake levels and conduct further research, especially in vulnerable populations. The liquid stevia and liquid sugar samples contained exceptional data; this occurred due to errors in processing, including inadequate homogenization, resulting in uneven distribution of saccharin and benzoate levels in the samples taken due to imperfect shaking.

The levels of benzoate and saccharin contained in the stevia samples were visibly higher than those in liquid sugar. For benzoate, the stevia samples showed an average of 0,0980%, while in liquid sugar it was only 0.0610%. Likewise, the saccharin sample levels were higher, with an average of 13,1638% compared to liquid sugar, which only contained 7,3722% of stevia. This difference indicates that the levels of benzoate and saccharin in stevia are higher than in liquid sugar. Based on the Minister of Health Regulation, SNI, and BPOM, the levels of benzoate and saccharin in these two samples exceed the maximum permissible limits.

CONCLUSIONS

Based on the research conducted, it can be concluded that the average benzoate content in the three types of liquid stevia was 0,0348%, 0,1043%, and 0,1548%, while the corresponding benzoate content in liquid sugar was 0,0074%, 0,0628%, and 0,1128%. In addition, the average saccharin content in the three types of liquid stevia was 12,7416%, 11,3693%, and 15,3773%, whereas the saccharin content in liquid sugar was 3,5985%, 3,4546%, and 15,0634%. A comparison of the average values showed that the benzoate content in liquid stevia, 0,0980%, was higher than that in liquid sugar, 0,0610%, and similarly, the average saccharin content in liquid stevia, 13,1628%, was higher than that in liquid sugar, 7,3722%. Based on these findings, further research using different samples and analytical methods is recommended.

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