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Investigations of Sodium Lauryl Sulphate and Saccharin Concentrations in Brands of Toothpaste

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Abstract

Sodium lauryl sulphate (SLS) and Saccharin (SHN) levels in 10 different toothpaste brands were determined spectrophotometrically. The result obtained showed significant difference in SLS and SHN concentrations in the sampled toothpastes. The concentration of the SLS sampled toothpastes ranged from 1.56×10^4 ± 10.11 mg/Kg to 2.13×10^4 ± 10.22mg/Kg while that of the SHN ranged from 833×10^4 ±17.29 mg/Kg to 2.32×10^5 ± 11.47mg/Kg. The result obtained from the analysis of SLS in the toothpaste samples shows that T2 also had the highest concentration of 2.13×10^4 ±10.22 mg/Kg while T8 had the lowest concentration of 1.56×10^4± 10.11 mg/Kg.The concentration of SHN in the toothpastes are unacceptable when compare to the daily acceptable intake (ADI) established by regulatory agencies. This implies that these toothpastes could be a potential poison to consumers especially the vulnerable children that have the tendency for uncontrollable intake.

Keywords: Sodium lauryl sulphate, saccharin, toothpaste, spectrophotometric determination, cancerous.

Introduction

Sodium lauryl sulphate (SLS) ($C_{12}H_{25}SO_4Na$) is an anioinic surfactant, having a sulphate head group that is hydrophilic and water soluble, and the 12- carbon long chain that is hydrophilic and water insoluble. Surfactants are wetting agents that lower the surface tension of a liquid, allowing for easier spreading of a droplet on the surface, thus lowering interfacial tension between two liquids[1]. This property of SLS allows it to be used as the foaming agent in most toothpaste. SLS is also used as ingredient in household and industrial items such as shampoos, and similar body washes and cleaners. Surfactant such as ammonium laruryl sulphate has been used as corrosion inhibitor[2].

SLS though, it plays an important role in toothpastes which is a personal hygiene product used by individuals, its concentration is usually not indicated on the product. There is no guideline for the use of SLS in toothpaste. Studies on SLS have linked the substance to irritation of the skin, eyes, respiratory system if inhaled, organ toxicity and neurotoxicity. Others are endocrine disruption, eco toxicology and biochemical or cellular changes and possible mutation and cancer. SLS is a skin irritant that could damage the oral mucosa and skin[1]. SLS in mouth rinses can cause desquamation of oral epithelium and a burning sensation in humans[3]. SLS is also associated with increased apthous ulcers (cancer sores) due to the denaturing effects and irritation of the oral mucosa[4]. There is an urgent need for constant quality assessment of cosmetic products[5].

Saccharin (SHN) (O-benzoic sulfamide) and its salts are odourless, white crystalline powders having a taste of about 500 times sweeter than cane sugar[6] and 300 times sweeter than sucrose[7]. It is believed to be an important discovery, especially for diabetics, as it goes directly through the human digestive system without being digested. Saccharin is not only soluble in water, but its commercially available salt, used as a non-nutritive sweetener, is freely soluble in water. Saccharin, a petroleum based sugar substitute is used to sweeten a multitude of commercial food product including soft drinks, diet food and alcoholic beverages, canned goods, baked goods, candies and personal hygiene products such as lip balm and toothpastes. Saccharin has the longest history of usage, and has provoked strong controversy over its possible carcinogenic effects[8]. According to various scientific research reports, saccharin causes tumor and bladder cancer. Cancer is a disease affecting multiple cell types and with different stages, treatment of it remains as a biggest challenge[9]. Cancer is still a major cause of mortality and morbidity[10]. According to the World Health Organization report on February 2009, breast cancer alone kills 519,000 people worldwide annually[11]. It also causes skin allergic responses, toxic reaction, and particularly, it causes heart and gastrointestinal tract problems[12]. It is also believed to enhance cancer causing ability of other substances[13]. High levels of SLS and SHN intake, either orally or through the skin, are not ordinarily experienced in normal cosmetic use. However, cumulative effects of long – term, repeated exposures are of health concern. The present work is sought to investigate the level of SLS and SHN in locally manufactured and imported toothpaste.

Material and Methods

All reagents were of analytical grade and were used without further purification. Deionized water was used throughout the

experiment. Saccharin stock solution of 100 ppm was prepared from sodium saccharin. Working standards of 1,3,5,7 and 9 ppm were made by serial dilution to obtain the calibration curve. Ten (10) toothpaste samples of different brands were purchased from local retail outlet and label T1 to T10. A weighed amount of the samples were oven dried at 105^{o}C until constant weight was obtained and then cool in desiccators. 1g each of the dried toothpastes was dissolved in a 100 ml plastic container using deionized water and left to stand for 24 hour. It was then shaken and centrifuged. The supernatant of each sample was collected and its saccharin content was determined using Jenway UV-Spectrophotometer at 427nm after coupling with Diazotized 4-Nitroaniline[14].

The samples for the SLS determination were treated similarly. The supernatant of each of the solution obtained were collected and its SLS content was determined spectrophotometrically at 467nm. SLS concentration in the range of 1ppm to 9ppm for which a fluorescent yellow colour layer was obtained were used to obtain the calibration curve[15].

Results and Discussion

The concentration of SHN and SLS as determined in each of the sampled toothpaste is as shown in table 1.

Table-1
SHN and SLS concentration in different toothpaste brands

Sample ID	Type	SHN $\times 10^5$ (mg/Kg)	SLS $\times 10^4$ (mg/Kg)
T1	Local	0.83 ±17.29	1.64 ± 12.05
T2	Foreign	2.32 ±11.47	2.13 ± 10.22
T3	Local	1.48 ±13.74	1.81 ± 12,30
T4	Local	1.53 ±12.01	1.67 ±11.11
T5	Foreign	1.63 ±12.57	1.90 ± 11.51
T6	Foreign	1.55 ±12.35	1.78 ± 10.31
T7	Local	1.65 ±12.39	1.79 ± 15.67
T8	Local	1.66 ±12.39	1.56 ±10.11
T9	Local	1.59 ±12.47	1.86 ± 12.00
T10	Foreign	1.58 ±12.19	1.79 ± 12.51
FDA/WHO	00	5mg/Kg/b.wt	00

The results obtained showed that, SHN concentration in the sampled toothpastes, ranged from 8.33×10^4 ± 17.29mg/Kg to 2.32×10^5 ± 11.47 mg/Kg. T1 had the lowest SHN concentration while T2 had the highest SHN concentration (table-1). According to European Commission (EC) regulations, the allowable saccharin, sodium saccharin or calcium saccharin in non-alcoholic drinks is 80–100 mg/Kg, in desserts and similar products (100 mg/Kg), in confectionery (80–1200 mg/Kg) and in vitamins and dietary preparations (1200 mg/Kg)[16]. Saccharin, are appetizing substance added to animal feedstuffs[17,18].

Saccharin is currently approved as dietary food additive in the United States. The food additives saccharin, ammonium saccharin, calcium saccharin and sodium saccharin are authorized for use as sweetening agents only in special dietary foods, such as beverages and fruit juices (not to exceed 12 mg of the additive, calculated as saccharin, per fluid ounce), as a sugar substitute for cooking or table use, in amounts not to exceed 20 mg of the additive and in processed foods, in amounts not to exceed 30 mg of the additive[19]. SHN therefore find use in a wide variety of consumable products including toothpaste. Toothpaste is however of concern because of children uncontrollable intake. The level of SHN in the studied samples are high and therefore called for urgent attention.

According to the Food and Drug Administration (FDA), the acceptable daily in-take (ADI) for SHN is 5 mg/Kg of body weight, meaning that a child weighing about 10 Kg will have a calculated ADI of about 50 mg/Kg. 80% of the samples have SHN level in the range of 1.48×10^5 to 1.65×10^5 mg/Kg.

The Scientific Committee for Food of the European Commission (EC) increased the ADI for SHN from 2.5 mg/Kg bw to 5 mg/Kg bw[20]; however, intake of SHN by children should be minimized, and use of SHN in infant foods is prohibited[21, 22].

The Joint FAO/WHO Expert Committee on Food Additives approved a group ADI of 5 mg/Kg bw for saccharin, singly or in combination[23]. In 1977, it had changed the unconditional ADI for humans of 5 mg/Kg bw established for saccharin and its potassium and calcium salts to a temporary ADI of 2.5 mg/Kg bw[24].

Generally, the concentrations of SHN and SLS for both imported and locally produced toothpaste average 1.58×10^5 mg/Kg and 1.79×10^4 mg/Kg respectively. The concentrations of SHN and SLS in T2 are however, exceptionally high compared to the average values for the sampled toothpaste as shown in table 1.

The concentration of SLS in the sampled toothpaste ranged from 1.56×10^4± 10.11 mg/Kg to 2.13×10^4 ±10.22 mg/kg (table 1). Although, there is currently no ADI for SLS in toothpaste, many environmental and health regulatory authorities have fixed stringent limits for anionic detergents as standard. The stipulated guideline for SLS in drinking water is 0.5 mg/L and relaxable up to 1.0 mg/L for other purposes[25]. The result obtained from the analysis of SLS in the toothpaste samples shows that T2 also had the highest concentration of 2.13×10^4 ±10.22 mg/Kg while T8 had the lowest concentration of 1.56×10^4± 10.11 mg/Kg. High levels of SLS intake (orally) are hardly experienced in normal toothpaste use, but because it is water soluble and the mouth tissues are soft and readily absorb it. This therefore can accumulate in the body, and the effects of prolong exposures become a real concern. Swallowing SLS leads to nausea and diarrhea[26], hence one must be careful not to swallow much of toothpaste if it contains SLS.

Conclusion

The results obtained from these studies show a significant variation in the concentration of SHN and SLS in the sampled toothpastes. The concentration of SHN in the toothpastes are unacceptable when compare to the daily acceptable intake (ADI) established by regulatory agencies such as FDA, FAO and WHO for an individual. This implies that these toothpastes with such a high concentration of SLS and SHN could be a potential poison to consumers especially the vulnerable children that have the tendency for uncontrollable intake. This can lead to any of the side effects associated these substances. The concentrations of SLS in the toothpastes were also very high. It is unfortunate that manufacturer hardly indicates its concentration on the label and that there is no guideline for the substance. There is therefore the need to be cautious with the usage to avoid the health problem associated with the substance.

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