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Estimation of Sodium Lauryl Sulphate in Most Common Brands of Toothpastes in India

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Abstract

Estimation of concentration of Sodium Lauryl Sulphate (SLS) was conducted in 5 most common brands of toothpastes spectrophotometrically. Out of the 5 samples 2 were herbal toothpastes while the other 3 were conventional toothpastes. Comparison was made between the concentration of herbal and conventional toothpastes. The results obtained were of paramount importance. The values of Sodium Lauryl Sulphate ranged from 17.818 µg/1gm (conventional toothpaste) to 104.716 µg/1gm (herbal toothpaste). Out of this the conventional toothpaste had lesser concentrations than herbal toothpastes. Multiple studies have shown the harmful effects of Sodium Lauryl Sulphate.

However, there are no FDA/WHO Recomm endations for the regulation of concentration of Sodium Lauryl Sulphate. There is dire need for regulations of the concentration of this compound in toothpastes.

Keywords: Sodium Lauryl Sulphate, Toothpaste, Conventional Toothpaste, Herbal Toothpaste, Guidelines.

Introduction

Oral hygiene is the most important factor in maintaining oral health as well as general health. Poor oral health leads to various types of oral diseases also considered as one of the most common types of chronic disease. [1] There are many risk factors that might lead to poor oral health such as smoking, improper diet, poor oral health knowledge, improper oral hygiene aids, improper brushing technique, tobacco consumption and many more

For maintaining proper oral hygiene, regular oral hygiene practices with appropriate oral hygiene aids are paramount. Among these toothbrush and toothpaste is considered to be most widely used method for cleansing of teeth. The main purpose for which toothpaste is used,

is for reducing friction between the tooth surface and brush.[2] Apart from this it is also used for polishing of tooth surface, removal of extrinsic stain, reduction of oral malodour; reduce the incidence of tooth decay, and freshness of mouth. There are many forms of toothpaste available in market such as creams, gels and ayurvedic. Toothpastes consists of many ingredients composed of calcium carbonate, SLS- sodium lauryl sulphate, Glycerine, Gum tragacanth, water, saccharine, flavour and preservative.

While choosing toothpastes in a market that is flooded with different forms and varieties, people have certain criteria based on personal choices to choose. Choice of toothpastes could be on whether it is conventional or herbal, flavoured and also whether it is cavity preventing or reducing sensitivity. Majority might choose tooth paste based on fluoridated or non-fluoridated and might overlook other ingredients, one such that requires attention is Sodium Lauryl Sulphate (SLS). It acts as a surfactant (wetting agent).

Surfactants are those agents that help in decreasing the surface tension of a liquid and hence helps in spreading the particular droplet when applied on the surface. Because of this property it is also used as a foaming agent in many types of toothpaste. In fact, SLS has also shown to have antibacterial property and causes inhibition of growth of S.Mutans and non-mutans bacteria (streptococcus sanguine is and lactobacillus acidophilus).[3] Even though it is an important ingredient there is no mention about the concentration of SLS present in toothpaste. Apart from its benefits SLS also have some harmful effects on our body such as irritation to eyes, skin, and even the respiratory system at times, neurotoxicity and organ toxicity.[4] Being a skin irritant, it may harm the oral mucosa as well. It might also lead to increased aphthous ulcers since it has a property of causing denaturation and even irritating effects.[5] Hence assessment of the amount of SLS used in toothpastes is a necessary criterion. With the trend of awareness increasing in general population, SLS is one of the ingredients that is being marketed as a substance which should not be in the toothpaste.[6] Even though it has some pros to its usage, the cons of SLS cannot be neglected completely.

Aims

- To assess and compare the concentration of SLS in different brands of toothpaste.
- To assess and compare the concentration of SLS between conventional and herbal toothpastes.

Materials and Methods

Materials

Random Samples of 5 different toothpastes were selected based on wide usage and popularity. The selected toothpaste samples were coded and named from A to E. Out of these 5 samples, 2 were herbal or Ayurvedic, while the rest 3 were conventional toothpastes. Sample A and B were herbal while Sample C, D and E were conventional.

Methods:

Preparing the Samples

Samples were prepared using 5 gm of selected tooth paste by drying at 105^0 C in oven until constant weight of 1 gm was obtained and then allowed to cool in desiccator. Later 1g of the dried toothpaste was dissolved in 10 ml deionized water in plastic container and allowed to settle for 24 hours.[7]

Linearity

Linearity of the samples, meaning a linear graph, was required to calculate the concentration of SLS in the toothpaste samples. To determine the SLS in the tested samples, 10 ml standard SLS solution (concentration range 0.75 to 10 ppm) was prepared in laboratory using

analytical grade reagent such as benzene and crystal violet at different concentration. This Standard solution was prepared by adding 10 mg Sodium lauryl sulfate (solid) in deionized water which resulted in 1000 microgram/ml. 1ml of this prepared solution was taken and diluted up to 10ml (conc. 100 microgram/ml). After this 0.5ml, 1ml, 1.5ml, 2.5ml, was further diluted up to 10ml resulting in 5 microgram/ml, 10 microgram/ml, 15 microgram/ml, 25 microgram/ml respectively followed by addition of Crystal violet and 0.1ml of orthophosphoric acid. Finally, 5ml of benzene was added to the funnel and the contents are stirred for 1 minute. Solution was allowed to settle for 3 minutes. 2.5ml of the aqueous solution, is used directly for absorbance at 565 nanometer spectrophotometrically. [8] (Table No. 1)

For the purpose of control, a blank solution meaning solution without sodium lauryl sulphate was also made in the similar manner. Spectrophotometric analysis of this solution is done as a control to get the value of absorbance as 0. With the values of absorbance of the linearity solutions a graph was plotted and an equation of the line was derived. On the graph, the X axis was concentraion of SLS and Y axis was absorbance.

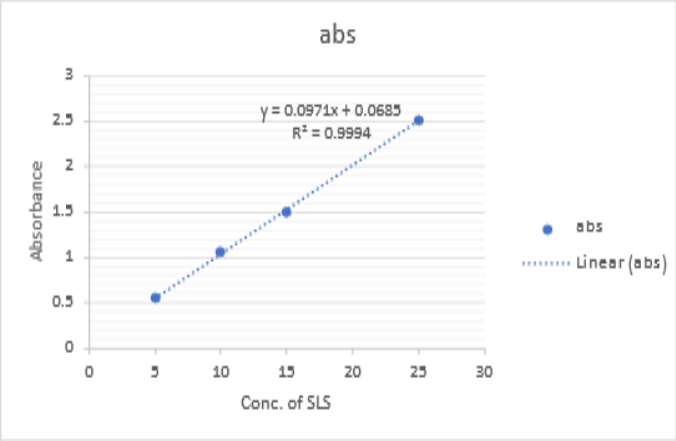

Table 1: Absorbance Values for Linearity Samples.

Sn.	Standard SLS Solution	Concentration of SLS	Absorbance at 565nm
1	1	5 microgram/ml	0.5571
2	2	10 microgram/ml	1.0550
3	3	15 microgram/ml	1.4965
4	4	25 microgram/ml	2.5073

Measuring Absorbance of Sodium Lauryl Sulphate in Study Samples of Toothpastes

After preparing samples, samples were left for 24 hours followed by gentle stir and centrifuged automatically in centrifugation unit. The supernatant of each sample was collected and its absorbance was measured. To standardize the measurements, Standard SLS Solution and tested Samples SLS was measured spectrophotometrically at 565 nanometers.

Table 2: Measuring Absorbance of Sodium Lauryl Sulphate in Samples of Toothpastes

Serial No.	Sample	Absorbance
1	A	0.4209
2	B	1.0853
3	C	0.2319
4	D	0.9295
5	E	0.4957

Measuring Concentration of Sodium Lauryl Sulphate in Samples of Toothpastes

After obtaining the absorbance values in toothpaste samples, the values were substituted in the equation of the line derived from graph of linearity. The equation of the line is y = 0.0971 x + 0.0685. In this equation the toothpaste sample absorbance is substituted at y and the value of x is calculated.

For example, for sample A value of absorbance is 0.4209. This is substituted in y in the equation.

So, it becomes 0.4209 = 0.0971x + 0.0685. Thus, value of x (SLS) is calculated.

Similarly, concentration of SLS in different toothpaste was calculated and the values were derived.

Results

Table 3: Concentration of Sodium Lauryl Sulfate in Each Sample.

Sample	Concentration of SLS (µg/1gm)
Sample A	36.292
Sample B	104.716
Sample C	17.818
Sample D	93.893
Sample E	46.586

The present study results show Concentration of sodium lauryl sulphate was higher in herbal toothpastes as compared to conventional toothpastes.it was observed that the highest concentration (104.716 µg/1gm) of sodium lauryl sulphate was in herbal tooth paste i.e Sample B, while the lowest concentration (17.818 µg/1gm) in conventional i.e Sample C. The rest of the sample values fell in between the values of Sample B and C. The sample with the 2nd highest concentration of SLS was Sample D, Sample E and then Sample A respectively.

Discussion

The present study shows herbal toothpaste has higher concentration (104.716 µg/1gm) of sodium lauryl sulphate compared to conventional toothpastes (17.818 µg/1gm) (Table 3). Exact and accurate comparison of our results with other studies could not be carried out as this is first of its kind to assess sodium lauryl sulphate in different toothpaste, however sincere effort is done to discuss the findings scientifically. Aye Mar et al. customized the herbal tooth paste preparation using neem extract and used 0.1 to 7 gm/100g concentration of sodium lauryl sulphate in herbal toothpastes prepared. [9]Our study findings show the values of sodium lauryl sulphate were similar to the study conducted by Aye Mar et al. According to Banani R Chouwdry et al. sodium lauryl sulphate should be excluded as an ingredient in herbal toothpaste formulations.[10] This calls for Scientific deliberation regarding usage of SLS in tooth paste.

The high concentration in herbal tooth pastes could be probably influenced by the interaction of other ingredients herbal toothpastes. Ingredients such as neem, clove, tulsi could have influenced the concentration of sodium lauryl sulphate. Further studies have to be carried out to establish the exact reason for higher concentration of SLS in herbal toothpaste

The study findings revealed conventional toothpastes with lesser concentration of sodium lauryl sulphate and could be because of method of preparation and combination of different ingredients present in these toothpastes than in herbal ones. The concentration ranged from 17.818 µg/gm to 93.893 µg/gm (17.818 mg/kg to 93.893 mg/kg). According to Gimba et al, the concentration of sodium lauryl sulphate in their samples ranged from $1.56\times10^4 \pm 10.11$ mg/Kg to $2.13\times10^4 \pm 10.22$ mg/kg. Our results were lesser than their concentration of sodium lauryl sulphate in toothpastes. The reason being difference in methodology and samples. Further studies need to be carried out to find the exact reason for the difference in values.[7]

Sodium Lauryl Sulphate is an additive in toothpaste**,** its main action is as a foaming agent which reduces the surface tension. It has also been documented that sodium lauryl sulphate has an anti-bacterial effect on Streptococcus mutans, yet nomention of its required concentration to inhibit the S mutans growth is labeled on any toothpaste packages.[3] Moreover there are no FDA/WHO recommendations for concentration of

sodium lauryl sulphate to be present in toothpastes. Another study showed decrease in plaque with increasing concentrations of sodium lauryl sulphate. It was also found that salivary flow was negatively linked with sodium lauryl sulphate meaning that sodium lauryl sulphate decreases salivary flow rate. [11]

However, studies have shown and reported with alarmingly dangerous effect of sodium lauryl sulphate ranging from the recurrent aphthous stomatitis, dry mouth, sensitivity to cell toxicity [12] [13] [14]. According to a study by Herlofson et al., oral mucosal desquamation was shown with the use of sodium lauryl sulphate containing toothpastes. [15]

The human lethal dose for sodium lauryl sulphate is 0.5-5.0 g/kg body-weight. The values derived from this study is less than the lethal dose of sodium lauryl sulphate. Probably topical usage doesn't warrant the minimal dose of SLS in toothpaste, however accidental swallowing or inappropriate usage of SLS containing toothpaste by pediatric or geriatric population might result in SLS toxicity. There should be special attention towards kids' toothpaste as they are more prone to ingesting toothpastes.[16]

The method to determine SLS used in this study was customized for measuring concentrations of sodium lauryl sulphate using linearity assessment and absorbance assessment.

A study by Nazrul Haq et al. used a newly developed method 'green' planar high performance thin layer chromatography for measuring sodium lauryl concentrations.

The concentration of sodium lauryl sulphate ranged from 0.052% to 2.332% compared to 0.0017% to 0.0104% our study. The different in concentration of sodium lauryl sulphate might be due to difference in method of assessment. [17] Study done by Gimba C.E. et al. used spectrophotometric analysis to determine concentration of sodium lauryl sulphate in different brands of toothpastes, the results were different compared to the present study possibly because of the difference in samples and methodology. [7]

To overcome the potential harmful effects of Sodium Lauryl Sulphate it could be replaced by Betaine in toothpastes as a study by Rantanen I *et al* states that it is a non-irritant to oral mucosa.[18] Thus alternatives for sodium lauryl sulphate can be used in toothpastes. It is known that sodium lauryl sulphate is a foaming agent however, it was the least expected attribute evaluated before buying toothpaste as seen in the study done by Dr. Vinit Dani.[19] This implies foaming is not considered an important attribute when it comes to selecting a toothpaste. However, the customer should have all the information needed about their oral health product and their ingredients its role and action to make an informed choice. This information includes the uses and adverse effects of sodium lauryl sulphate. Awareness of pros and cons of sodium lauryl sulphate in toothpaste should be provided to the multitude. People who are prone to recurrent aphthous ulcers or stomatitis and dry mouth should opt for sodium lauryl sulphate free toothpaste as it might aggravate their condition. Thus, spreading awareness of the adverse effects and uses of sodium lauryl sulphate should be focused on among the multitude.

Limitations of our study

The study has its own inherent limitations as only five tooth pastes were tested, and the present study employed the customized methodology due to the resource limitations. further studies should be conducted on multiple brands with the newer technology to determine the SLS.

Summary and Conclusion

According to our study, the conventional toothpastes have a lesser amount of sodium lauryl sulphate as compared to herbal or ayurvedic toothpastes. Even though sodium lauryl sulphate is an important ingredient in toothpastes with beneficial as well as adverse reactions less attention is paid to its concentration in toothpastes. This provides an impetus to determine the accurate concentration of SLS to be in tooth paste for beneficial effect and cutoff to overcome the adverse effect. The authorities regulating formulations of toothpastes should recommend and issue guidelines regarding SLS concentration in toothpastes. Attempt should be made to create awareness about the uses and limitations of SLS in tooth Paste, this will enable the public to make an informed decision about choosing the toothpaste that's right for them.

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