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Identification of Sodium Lauryl Sulphate in Toothpaste using Green Solvent by Thin-Layer Chromatography

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Abstract

Anionic surfactants are widely used in personal care products (toothpaste, soap, shampoo, liquid soaps) because of their excellent cleaning and emulsifying properties. Sodium lauryl sulfate (SLS) is popularly used as a foaming and cleaning agent in shampoo, toothpaste and washing products. Aqueous solutions of SLS are commonly used for the dispersion of carbon nanotubes (CNT). Anionic surfactants, being water soluble compounds, easily enter into rivers and other water bodies through wastewater discharge and at sufficient concentration become toxic to aquatic organisms. Thin layer chromatography (TLC) involves separation of components from their mixtures based on the competitive interactions of analyte with stationary and mobile phases. In the present study, sodium lauryl sulphate has been identified on a silica gel G static flat phase with 2-butanol/ethyl acetate as the mobile phase. Use of 2-butanol and ethyl acetate as the mobile phase makes TLC green for the identification of sodium lauryl sulphate in toothpaste. Densitogram of sodium lauryl sulphate has been also carried out.

Keywords: Anionic surfactants; Sodium lauryl sulphate; Thin-layer chromatography; Green solvent; Densitogram

Introduction

Surfactants or surface active agents are amphiphilic compounds containing both hydrophilic (head) and hydrophobic (long carbon chain) groups in the same molecule. Surfactants have unique property of lowering the surface tension between two interfaces. By lowering surface tension of water, surfactants play important role in removing dirt and grease.

On the basis of charge present on the head group, surfactants are broadly classified as cationic, anionic, non ionic and zwitterionic surfactants. Surfactants are the major ingredients of household, industrial and personal care products. Anionic surfactants are widely used in personal care products (toothpaste, soap, shampoo, washing liquid etc.) because of their excellent cleaning and emulsifying properties. Sodium lauryl sulfate (SLS) is popularly used as a foaming and cleaning agent in shampoo and washing products. Aqueous solutions of SLS are commonly used for the dispersion of carbon nanotubes (CNT) [1]. Surfactants are also used for the analysis of blood due to its capability of binding with oxidised iron in blood [2]. Anionic surfactants, being water soluble compounds, easily enter into river and water bodies through wastewater discharge and at sufficient concentration become toxic to aquatic organisms [3, 4].

With the help of thin layer chromatography (TLC), various components of a mixture are separated on the basis of competitive interactions of analyte with stationary and mobile phases. Using safer solvent in chemical processes is one of the twelve principles of green chemistry, in order to reduce the environmental pollution due to toxic and/ or volatile organic solvents [5]. In this direction, we focused our search on combinations of less toxic organic solvents or green solvents for the analysis of surfactants. In the present study, 2-butanol has been used as green mobile phase for the identification of sodium lauryl sulfate.

Experimental

All experiments were performed at 25 ± 2 ºC.

Apparatus

A TLC applicator, glass plates, glass jars and sprayer has been used.

Chemicals and Reagents

Silica gel G (Fischer Scientific, Mumbai, India), 2-butanol, sodium lauryl sulphate (SLS) and pinacryptol yellow purchased from Central Drug House, New Delhi, India.

Test Solutions

Double distilled water (DDW) was used as the solvent for the preparation of 1 % (w/v) solutions of sodium lauryl sulfate.

Stationary Phases

Silica gel G has been used as stationary phase.

Mobile Phases

2-Butanol has been used as green mobile phase.

Composition of Whitening Toothpaste

Ingredients present in the whitening toothpaste analyzed were calcium carbonate, water, sorbitol, hydrated silica, sodium lauryl sulfate, potassium nitrate, flavor, cellulose gum, sodium silicate, benzyl alcohol, sodium saccharin, perlite and sodium monofluoro phosphate.

Preparation of Toothpaste Solution

For the preparation of toothpaste solution 0.1 g of toothpaste was dissolved in 10 mL of DDW and the contents have been mixed thoroughly by shaking for 15 min and left for 24 h at room temperature. Since the toothpaste was not completely soluble in DDW, the upper layer of the toothpaste (clear solution) was decanted and 0.1 µL of it was applied onto TLC plates and developed with the 2-butanol (mobile phase system). Sodium lauryl sulphate has been detected as a yellow fluorescent spot with pinacryptol yellow under long UV light.

Preparation of TLC Plates

The slurry of silica gel G in double distilled water (1:3 w/v) was obtained by mechanically shaking for 15 min. The slurry was then coated onto glass plates with the aid of a TLC applicator. The thickness of the coated silica gel layer was 0.25 mm. These plates have been dried at room temperature before activating at 100 ºC for 1 h. The activated plates have been placed in a conditioned chamber before use.

Procedure

The adopted experimental procedure has been same as described earlier [6]. For the identification of sodium lauryl sulphate, 0.1 µL of test solution and toothpaste solution has been applied separately onto TLC plate. The TLC plate has been developed with 2-butanol, the spots have been detected by spraying pinacryptol yellow under UV light and R_F values of the both spots of the SLS has been calculated and compared.

Result and discussion

Thin layer chromatography of sodium lauryl sulphate (test solution as well as toothpaste sample solution) has been performed on silica TLC plate using 2-buatnol as green mobile phase. After development of plate, spots of these two samples have been detected by spraying pinacryptol yellow followed by viewing the location of SLS under UV light (366nm) and then R_F value of both the spots has been calculated (**Table 1**). It is found that, the R_F value of SLS in test solution is nearly equal to the R_F value of toothpaste solution (**Figure 1**). With the help of this novel chromatographic system sodium lauryl sulphate present in toothpaste has been easily identified. Densitogram of SLS in both the samples has been taken (**Figure 2**).

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Conclusion

Combination of 2-Butanol as an eco-favourable mobile phase and silica gel as stationary phase has been found most suitable TLC system for the identification of sodium lauryl sulphate present in toothpaste.

References

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Table 1: R_F value of SLS in test and toothpaste solution.

Sample	R_F Value
SLS in test solution	0.44
SLS in toothpaste solution	0.45

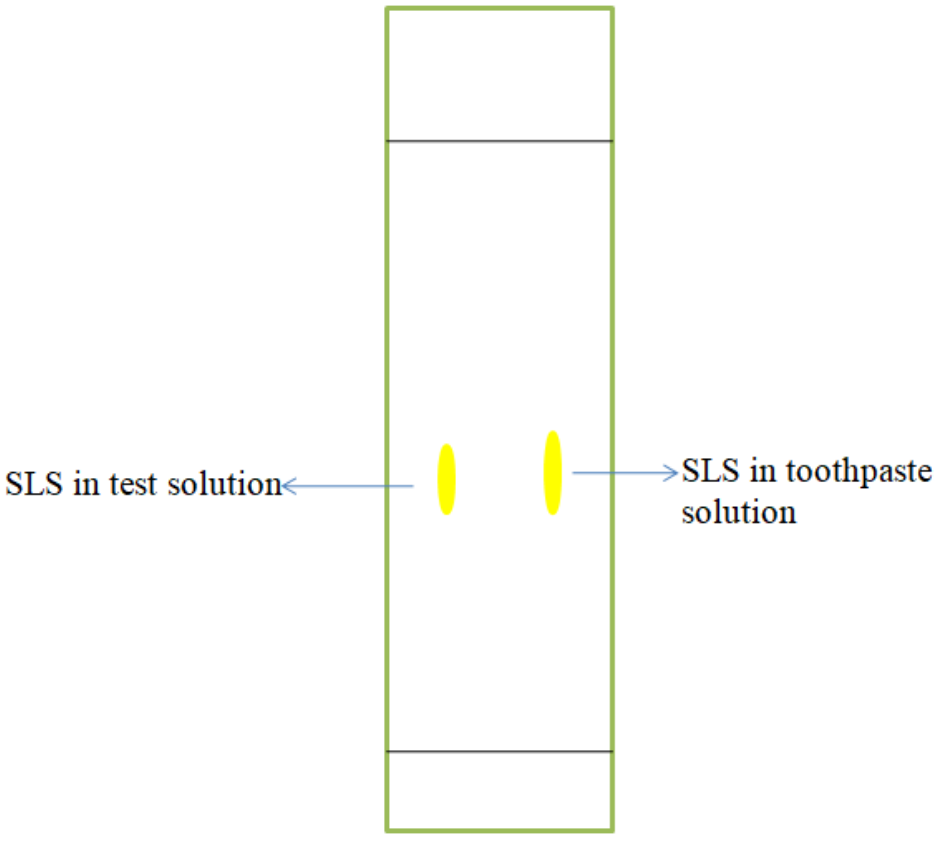

Figure 1: SLS spot detection on silica TLC plate in both sample solution.

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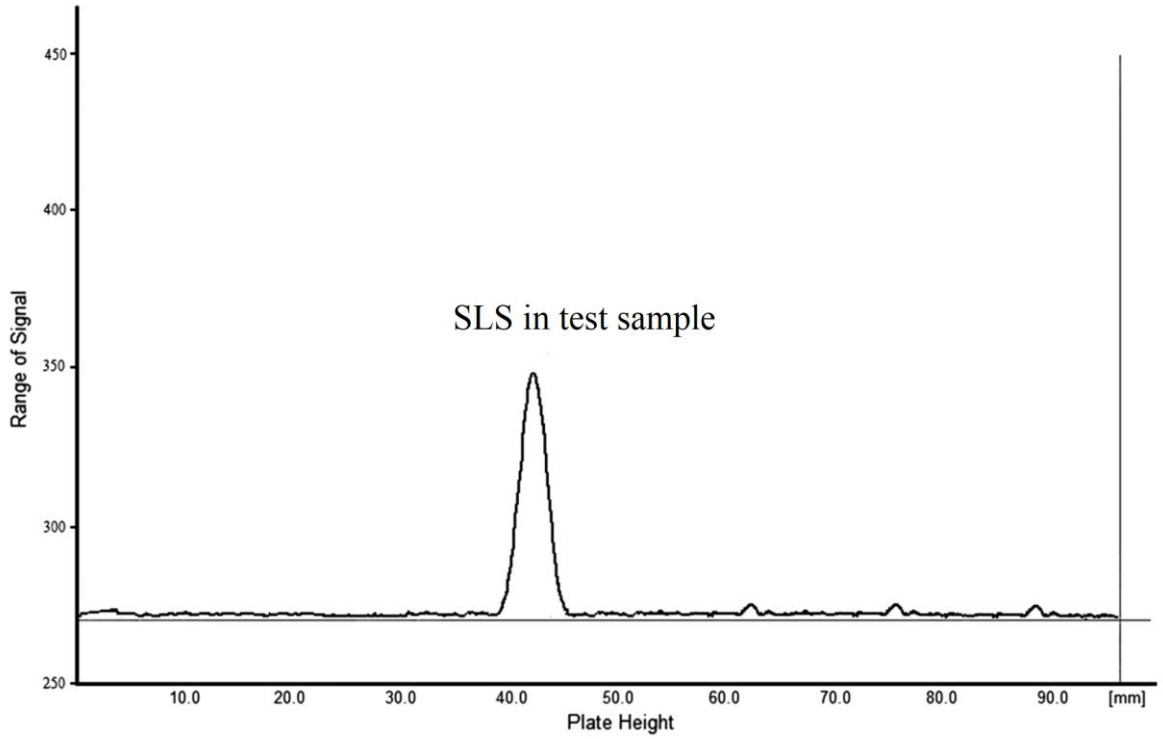

Figure 2: Densitogram of SLS in test solution.

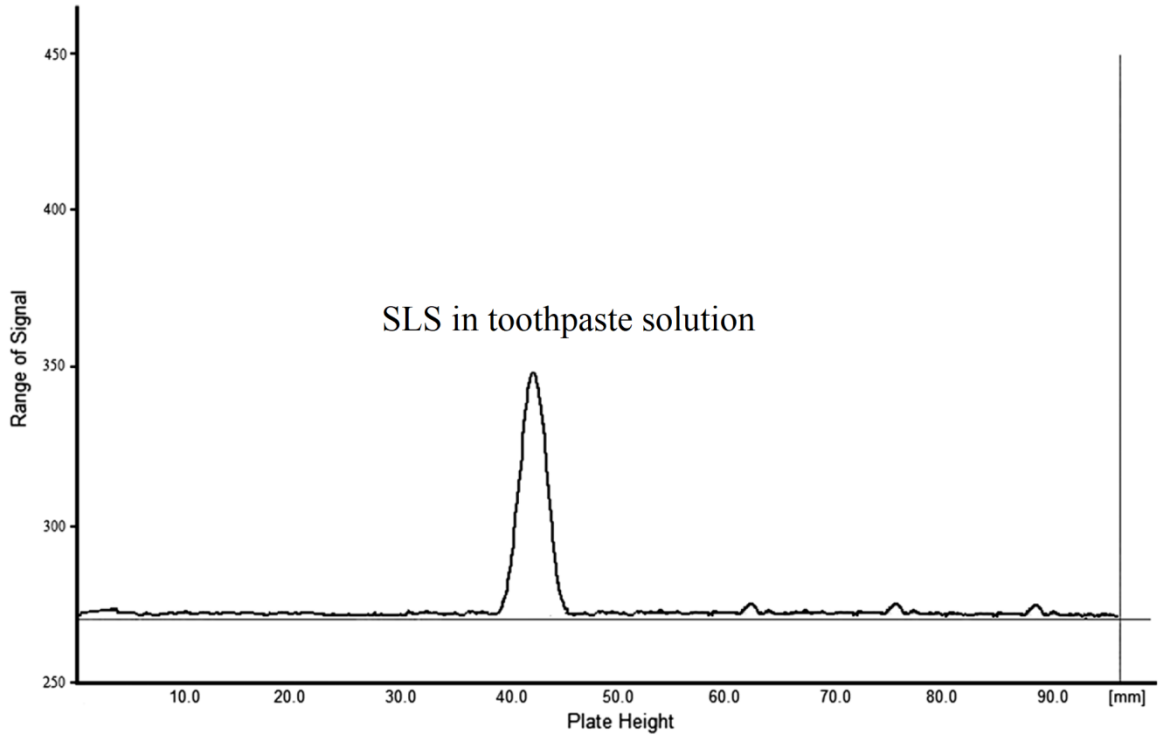

Figure 3: Densitographic representation of SLS identified in toothpaste solution.