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Formulation and development of SLS free toothpaste.

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Abstract

The focus of the research is to formulate and develop the SLS free toothpaste to reduce the adverse effects caused by the SLS. It is observed that this surfactant is" Moderate Hazard" that has been linked to Cancer, neurotoxicity, Skin irritation, Organ toxicity, endocrine disruption and can cause harm if taken in excess. In this work we have revealed the Natural Surfactants which can be helpful in replacement of SLS in toothpastes. 2 naturally occurring surfactants Liquorice and Hingot Fruit are used in desired combination to produce the foam in toothpastes. The foam produced is concrete foam and by using this natural saponins we can reduce the toxicity related to SLS. This work is also comprised of the extraction process of these natural surfactants along with evaluation parameters.
Keywords – SLS, Liquorice, Hingot fruit, Carbopol, Foaming.

1. Introduction

Most of the toothpaste nowadays contains sodium lauryl sulphate which is used as surfactant and gives the foam it removes the stain and plaque from teeth. SLS is consists of a 12 carbons tail which is attached to sulphate group and it is a sodium salt of a 12 carbons alcohol that has been esterified with sulphuric acid. SLS present in the toothpaste shows adverse effects like allergic reactions, mouth ulcers or it might be toxic also. If large amount of toothpaste is swallowed it may show the toxic effect, hence toothpaste containing SLS should be avoided in children and not intended to stay in mouth after brushing. Some of herbal toothpastes in India also uses SLS as a surfactant. Instead of using SLS other naturally occurring surfactants can be used in manufacturing of the toothpaste. Some natural surfactants which can be used are liquorice and hingot fruit.

1.1. Liquorice

Liquorice is a common name of Glycyrrhiza glabra and belongs to family Fabaceae. Root of liquorice contains 10-25% of Glycyrrhizin which is saponin glycoside and gives foam. It is main component of the Liquorice which shows the saponin properties along with glycyrrhizitenic acid.It is also used as emulsifier and gel forming agent.MW of Glycyrrhizin – 822.92

Table no. 01: Pharmacological actions of liquorice

Class	**Present component**	**Effective against**
Chalcones	Licochalcone A	Candidiasis
Flavonoids	Liquritigenin	Candidiasis
Isoflavonoids	Glabridin Licoricidin Licorisoflavan A	Candidiasis Periodoutal disease Periodoutal disease
Pterocarpens	Glyarrhizol A	Dental carries
Saponins	Glycyrrhizin Glycyrrhizic acid 18 B-glycyrrhetinic acid	Candidiasis Dental carries Candidiasis and periodoutaldisesase
Stilbenes	Gancanin G	Dental disease

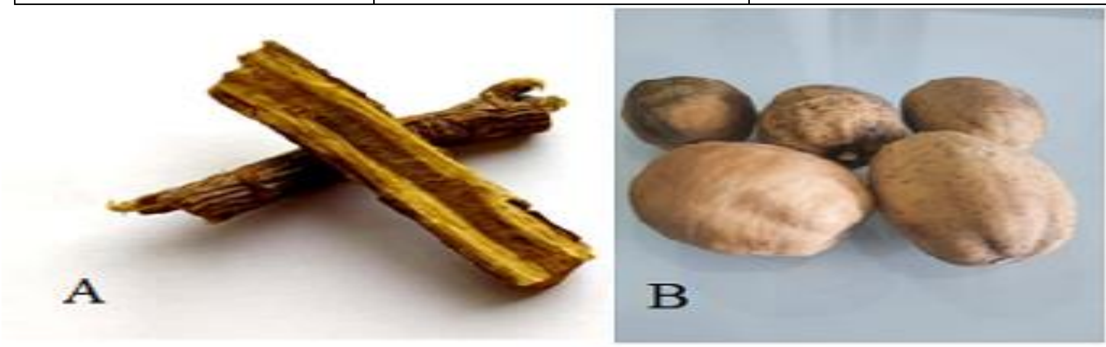


Fig. no.01: A. Liquorice, B. Hingot fruit

1.2. Hingot fruit

Hingot fruit (Balanites aegyptiaca) is a species of tree classified as a member of Zygophyllaceae. Basically, hingot fruit is used as Antibacterial agent. The seeds of the hingot fruit used as expectorant, antibacterial and antifungal. Fruit is used in whooping cough, also in leukoderma and other skin diseases.

This plant has been reported to be an antihelmintic, a purgative, vermifuge, febrifuge, emetic and can also cure other types of ailments like skin boils, leukoderma, malaria, wounds, colds, syphilis, liver and spleen disorders, and aches.

It shows the anti-bacterial, anti-diabetic, anti-fungal**,** Anti-helmintic, Anti-oxidant, Anti-inflammatory, Anticancerous, Molluscicidal. Extract of hingot fruit shows the properties of surfactant. Hingot Fruit is a source of saponin based surfactant.[4]

B. aegyptiaca contains different types of saponins, namely, balanitin -1, 2, 3, 4, 5, 6 and 7. This saponins are responsible concrete and stable foam.

2. Methodfor extraction

2.1. Extraction method for Liquorice

3. 50gm of liquorice powder was weighed and then 300ml of distilled water added in it. The mixture was on standing for 30min. After that residue was filtered and filtrate was collected. pH was adjusted to 2.8 by the addition of acid. Then precipitate was collected by filtration and washed with cold water to remove the excess of water from precipitate.

Fig. no.02: A. Filtration of liquorice and water mixture, B. pH adjustment to form precipitate of glycyrrhizin.

4. Characterization of prepared formulations

4.1. Purity and compatibility of ingredients

The purity and compatibility of glycyrrhizin and hingot was determined using FTIR technique. The graphs obtained and then compared with standard.

4.2. Foaming ability

1gm of prepared formulation was diluted with 9ml of distilled water in the test tubes. Then this test tube was shaken for 5 min and allow to stand for 15 min. then the length of foam was measured**.**

4.3. Spreadability

It is the test to check the spreading ability of semi solid formulation. Where 1 gm of sample was placed in between two glass slide and 1000gm weight was placed on it for 3 min.

After 3 min, the diameter of the formulation was measured thrice and mean was calculated. And then spredability was calculated using the formula,

$$S = MxL/T$$

Where,

M is weight placed

L is diameter and

T is time

4.4. pH determination

By using digital PH meter, the pH of the prepared batches was determined. The pH meter was calibrate using phosphate buffer at pH 4, 7 and 9.2

4.5. Viscosity determination

The viscosity of formulations was determined using Brookfield's viscometer at different RPM using 94 spindle.

4.6. *Collapsibility of formulation*.

Collapsibility of formulation was determined by applying the pressure on the tubes in which paste was filed earlier.

5. Formulation of batches

Table includes the formula for different batches having different concentration of drug and excipients. The formula represents % weight by weight of the components.

Table no.02: Formula for batches (% weight by weight)

Sr. no.	Component	F1	F2	F3	F4	F5	F6	F7	F8
1.	Clove oil	3.74	3.74	3.74	3.74	3.74	3.74	3.74	3.74
2.	Carbopol	4	5	4	5	5	4	5	4
3.	PEG 400	75	75	75	75	75	75	75	75
4.	Glycerine	25	25	25	25	25	25	25	25
5.	Methyl paraben	9	9	9	9	9	9	9	9
6.	Propyl paraben	1	1	1	1	1	1	1	1
7.	Sodium saccharine	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5
8.	Glycyrrhizin	-	-	0.3	0.1	-	-	0.3	0.1
9.	Hingot	0.8	0.5	-	-	0.8	0.5	-	-
10.	Distilled water	Q.S.	Q.S.	Q.S.	Q.S.	Q.S.	Q.S.	Q.S.	Q.S.

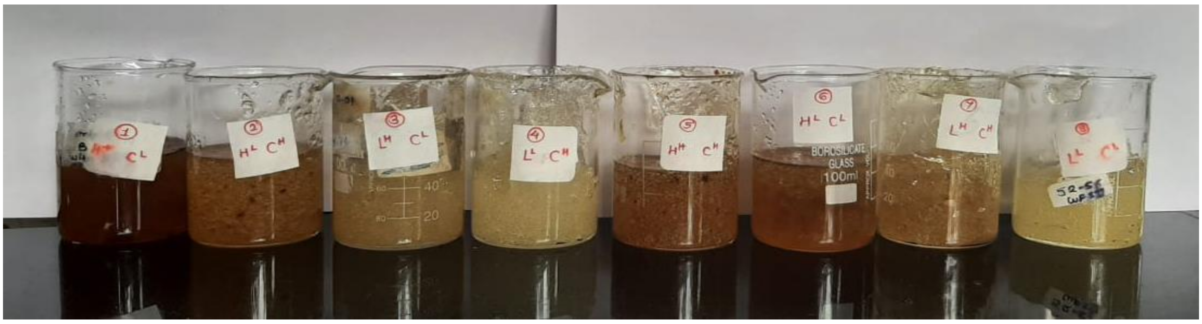


Fig. no.03: Formulated batches

formulation and development of sls free toothpaste.

6. Result and discussion

6.1. Purity and compatibility of ingredients

FTIR(SHIMADZU) was performed for 4 samples. 2 samples were glycyrrhizin and hingot and other 2 are formulations developed by using glycyrrhizin and hingot. The graphs were obtained and compared with standards.

Structure of glycyrrhizin contains groups like O-H, O=C-OH And C-C=O-C which shows peaks at 3325, 1712, 2933 frequency. This groups are retaining in the formulation which implies that excipients do not interfere with foam forming groups in the glycyrrhizin.

Similarly, in hingot groups like O-H, C-C=O-C, C=O, C-O shows peak at 3325, 2927,1714 and 1093 frequency which are also retained in formulation.

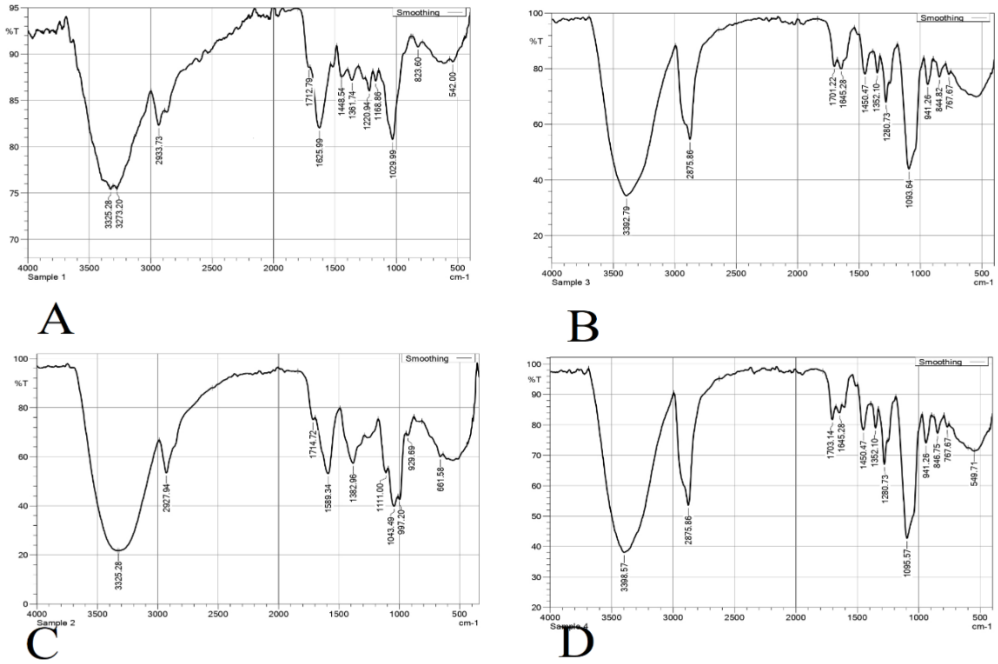
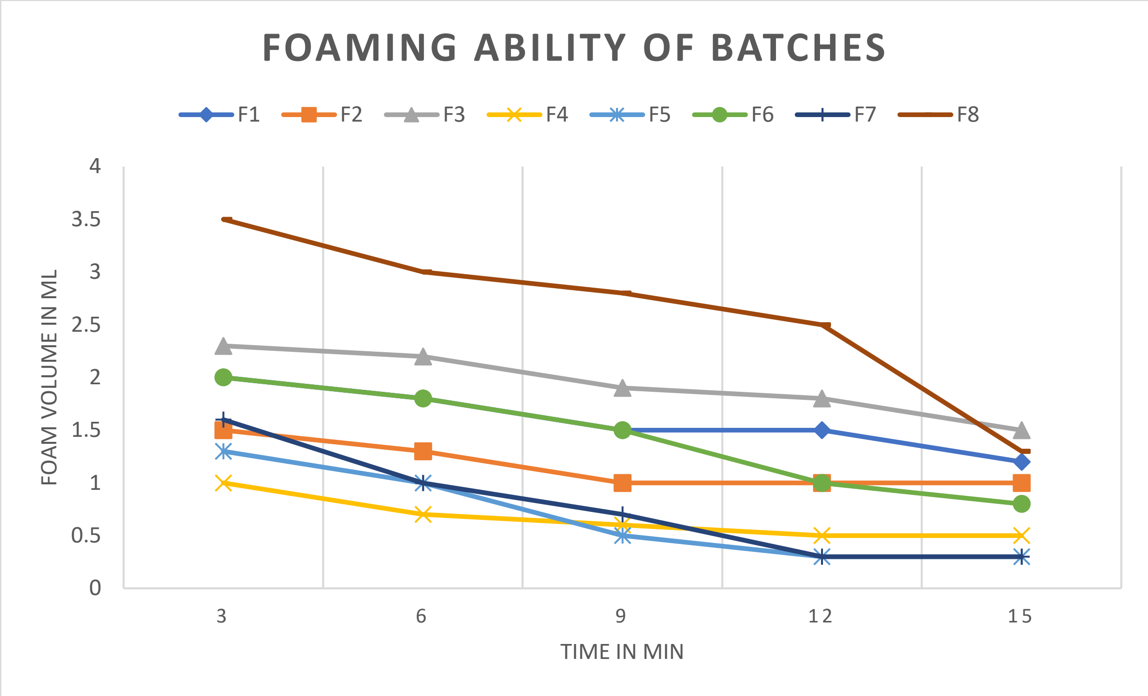


Fig.no.04: FTIR graphs for A Glycyrrhizin, B. formulation with glycyrrhizin, C. Hingot, D. formulation with hingot

6.2. Foaming ability

Foaming ability for the formulations were check and it is concluded that F3 has highest foaming, followed by F8 and F1.

Fig. no.05: Foaming ability

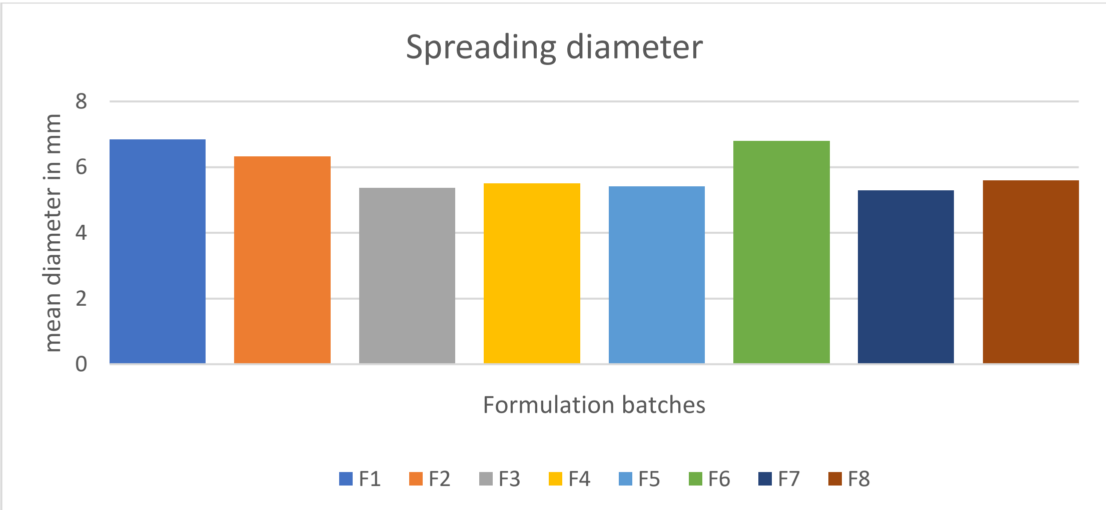


Graph no.01: Time in min Vs. Foam volume in ml

Foam of F3 was found to be highest, 1.5 cm after 15 minutes, followed by F1 and F8 was 1.3 cm. The foam of F5 and F7 was found to be lowest as 0.3 cm.

6.3. Spreadability

Spreadability and viscosity has corelation in between. Formulation with high viscosity shows less spreadability and low viscous formulation show high spreadability.



Graph no.02: Formulation batches Vs. Mean diameter in mm

Table no.03: Readings for spreadability

Sr.no.	Formulation batches	Calculated spreadability (gm.cm/sec)
1.	F1	37.94
2.	F2	35.16

3.	F3	29.77
4.	F4	30.55
5.	F5	30
6.	F6	37.77
7.	F7	29.44
8.	F8	31.11

Batch F5 and F7 shows less spredability this is because of high viscous nature of the formulation. Formulation with high viscosity shows less spreading. Both batches contain high concentration of Carbopol and liquorice or hingot this imparts the high viscosity to the formulation.

6.4. pH determination

pH for all the formulation was determined using pH meter and the values of formulation lies in acidic pH which shows the suitability of formulation for oral flora.

Table no.04: Readings for pH

Sr.No.	**Formulation batches**	**pH**
1.	F1	4.16
2.	F2	3.85
3.	F3	3.83
4.	F4	3.87
5.	F5	3.85
6.	F6	3.88
7.	F7	3.60
8.	F8	3.97

The ideal pH for gel toothpaste lies in between 3.6 to 6.5. All the formulation batches have the pH I in between 3.6 to 6.5 expect the F7 this is because of high concentration of glycyrrhizin, as glycyrrhizin contains carboxylic group in structure.

6.5. Viscosity determination

The viscosity of all formulations was determined using Brookfield's viscometer. The viscosity of F4, F5 and F7 was found to be very high. This are the formulation which has high concentration of Carbopol. Carbopol gives the viscosity to the formulation.And the viscosity of other formulation found to be appropriate.

6.6. Collapsibility of formulation

The collapsibility of formulations was determined. All formulation expects F4, F5 and F7 were collapsible. Collapsibility is also related to the viscosity of the formulation. Hence, those formulations have high viscosity were not collapsible.

Conclusion

Toothpaste containing Glycyrrhizin and hingot was found to have good foaming properties, along with appropriate pH, spreadability, viscosity and collapsibility. From FTIR determination it is concluded that ingredients used as surfactant are compatible with other excipients. Batches with low concentration of Carbopol also shows good viscosity and collapsibility as well as compatibility.
Groups present in the glycyrrhizin and hingot retains their properties of foaming even in presence of excipients and gives stable foam. These 2 ingredients together will give more foaming and cleaning action. Along with there foaming action, other pharmacological actions which plays important role in maintaining oral hygiene are also taken in to consideration.

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Confect of Interest

All authors declare there is no conflict of interest.

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