CHAPTER 35

Formulation and Evaluation of Shatavari and Liquorice Powder Based Toothpaste: A Novel SLS Free and Fluoride Free Oral Care Alternative

Sonal Jadhav, Adnan Sami Shaikh** and Mansi Gautam****

ABSTRACT

This study aimed to develop and evaluate a novel toothpaste fornsslation that is free Domharsh chemicals like Sodium Lauryl Sulfate (SLS) and fluoride. The toothpaste incorporates Shatavari and Liquorice, herbal ingredients known for their medicinal properties. Physical and chemical properties of the toothpaste, including shape retention, moisture content, and solid content, were evaluated. The results showed that the toothpaste met the required standards, denomtrating good slupe retention, acceptable moisture content, and satisfactory solid content. This SLS-free, fluoride-free, and Shatavari, Liquorice-based toothpaste offers a natural and gentle oral care alternative, making it a viable option for consumers seeking chemical-free products

Keywords: SLS and fluoride free toothpaste; Shatavari; Liquorice.

1.0 Introduction

The oral care industry has experienced a remarkable shift in recent years, with an increasing focus on natural and sustainable products that support both individual health and environmental sustainability. A key advancement in this field is the introduction of toothpaste that is free from Sodium Lauryl Sulfate (SLS) and fluoride, utilizing natural ingredients such as Shatavari and Licorice.

These groundbreaking alternatives present a viable option to conventional oral care products, which frequently include harsh chemicals like SLS and fluoride that may pose risks to health and the environment. The movement towards natural oral care is fueled by heightened awareness of the significance of oral

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DOI: 10.17492/JPI/ICISI2025/251235 *ISBN: 978-93-49790-69-8*

health and the potential dangers linked to traditional products, resulting in a growing preference for gentle, eco-friendly options that are kind to teeth and gums. Shatavari and Licorice, two time-honored Ayurvedic herbs, have been thoughtfully chosen for their distinct benefits and are now incorporated into SLS-free and fluoride-free toothpaste, offering a natural and effective substitute for standard oral care solutions.

2.0 Literature Review

Thombre Nilima *et al.* 2021: This study focuses on formulating an SLS-free toothpaste to avoid the harmful effects of sodium lauryl sulfate, which is linked to irritation, organ damage, and other health risks. It investigates natural surfactants like liquorice and Hingot fruit extracts as safer alternatives. These plant-based saponins can generate stable foaming while lowering toxicity concerns. The work also includes methods for extracting these natural agents and evaluating their safety and effectiveness in toothpaste formulations.

Raval Bhairvi et al 2024: This research focuses on developing an herbal toothpaste free from sodium lauryl sulfate (SLS) to reduce its harmful effects, such as irritation and toxicity. Natural surfactants like sodium methyl cocoyl taurate were used along with ingredients such as babool powder, camphor, clove oil, and ginger extract. The study also involved extraction methods, safety evaluations, and a comparison of the new formulation with commercial toothpastes. Findings showed that the herbal alternative provides similar effectiveness while offering a safer option for oral care.

3.0 Aim and Objectives

Aim: Formulation and evaluation of Shatavari and Liquorice powder based toothpaste: A Novel SLS free and Fluoride free oral care alternative.

Objectives:

- Formulate SLS-free and fluoride-free toothpaste.
- Achieve consistent product texture.
- Achieve desired appearance.
- Control abrasiveness.
- Minimize turbidity.
- Maintain optimal pH.
- Ensure desired viscosity.
- Improve spreading ability.

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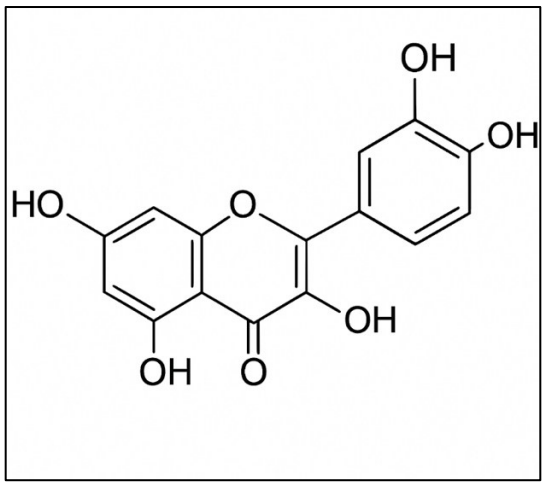
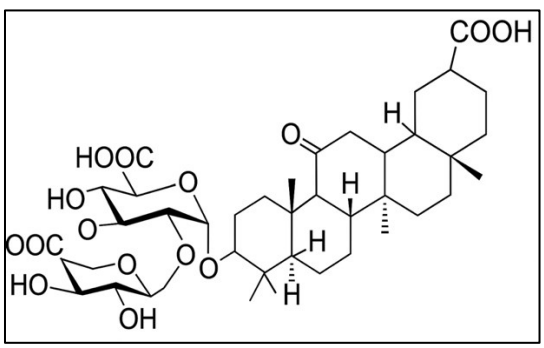
4.0 Drug Profile

Shatavari



Liquorice Structure



4.1 Pre-formulation study

4.1.1 Physical tests

A. Melting point:
   Shatavari: 202°C
   Liquorice: 217°C

B. Solubility:
   Shatavari and liquorice are soluble in water, ethanol, glycerin, oil soluble.

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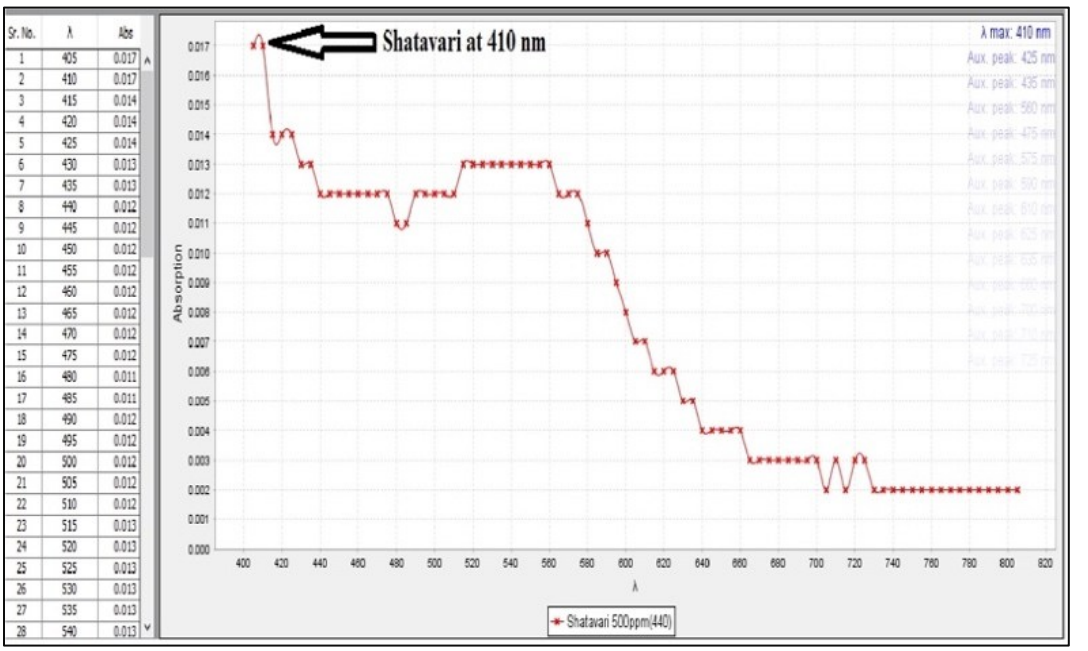
C. Viscosity:

Sr.No.	RPM	Speed	Torque
1.	0.3	347500	% 86.9
2.	0.5	111300	% 49.4
3.	0.6	157200	% 78.6
4.	1.0	77500	% 64.6
5.	1.5	76540	% 95.7
6.	2.0	53870	% 89.8
7.	2.5	45010	% 93.8
8.	3.0	34510	% 93.9
9.	4.0	27470	% 91.6
10.	5.0	EEEE	EEEE
11.	6.0	EEEE	EEEE

4.1.2 Chemical tests

A. Ultraviolet-visible. (UV-Vis) spectroscopy

Shatavari



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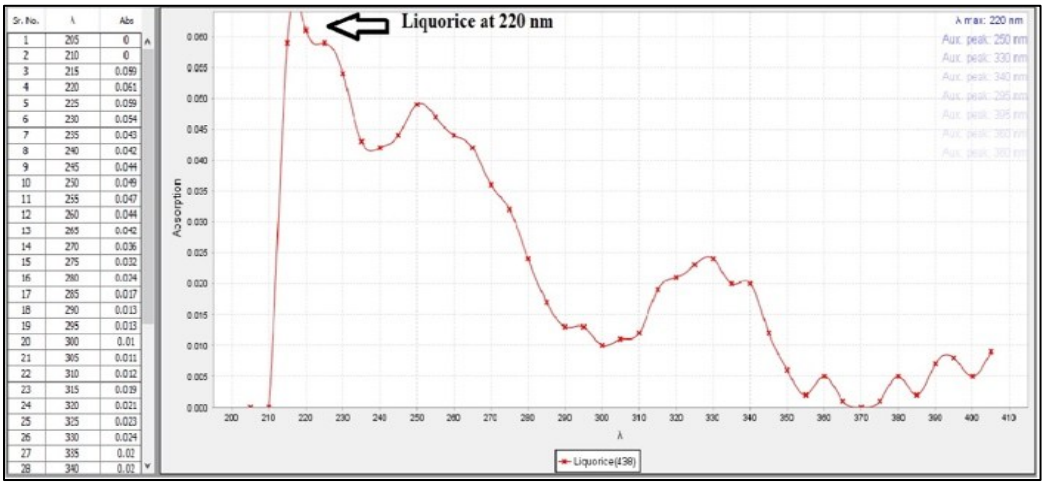
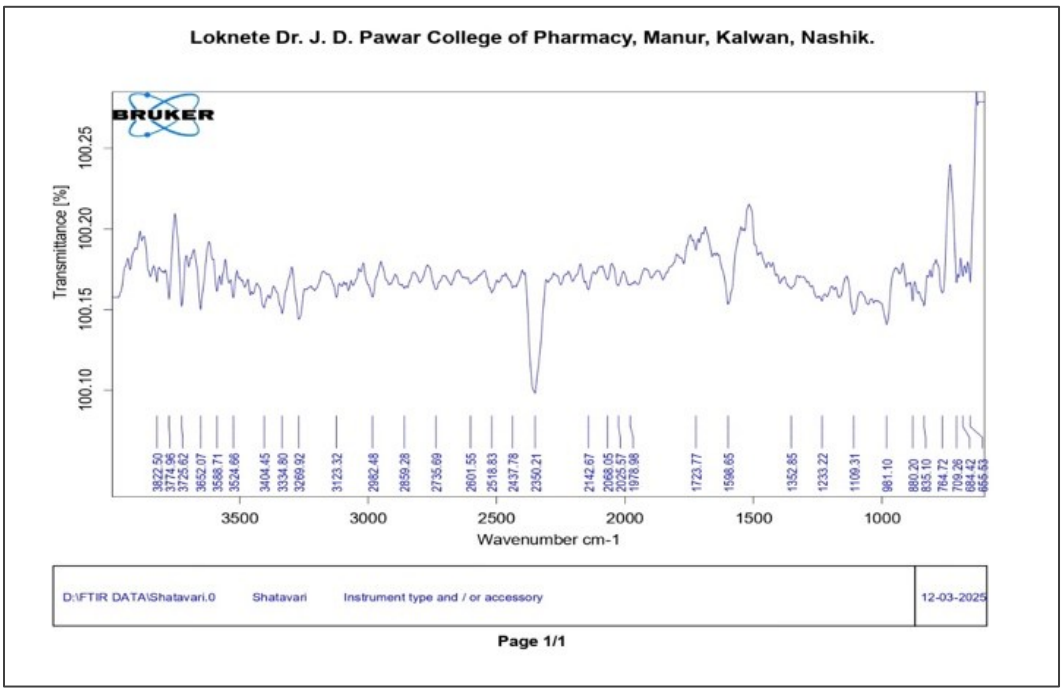
Liquorice



Sr. No.	λ	Abs
1	205	0
2	210	0
3	215	0.059
4	220	0.061
5	225	0.059
6	230	0.054
7	235	0.043
8	240	0.042
9	245	0.044
10	250	0.049
11	255	0.047
12	260	0.044
13	265	0.041
14	270	0.036
15	275	0.032
16	280	0.024
17	285	0.017
18	290	0.013
19	295	0.013
20	300	0.01
21	305	0.011
22	310	0.012
23	315	0.019
24	320	0.021
25	325	0.023
26	330	0.024
27	335	0.02
28	340	0.01

B. **Infrared (**IR**) spectroscopy**

Shatavari



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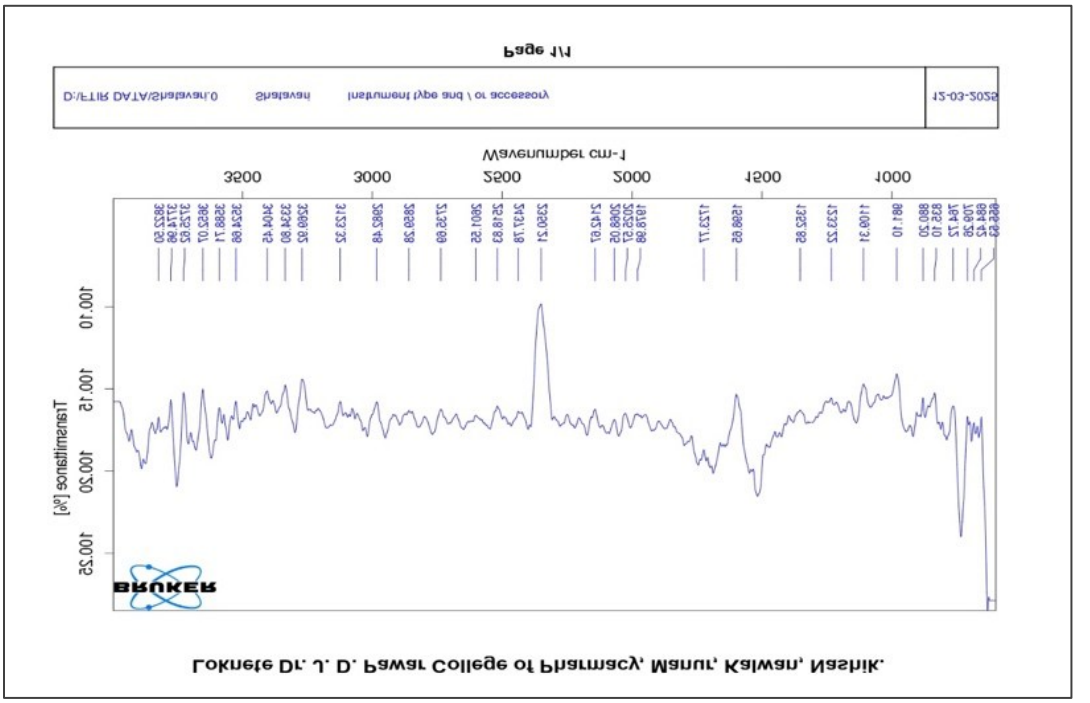
Liquorice



4.2 Formulation development

Toothpaste Formulation (SLS-Free, 20g Batch)

Liquid Ingredients (Approx. 12.4 mL)

1. Water: 8 mL
2. Glycerin: 2 mL
3. Sorbitol Solution (70%): 2 mL
4. Liquorice Extract Solution (10%):0.4mL
5. Shatavari Extract Solution (10%):0.2mL

Solid Ingredients (Approx. 7.6g)

1. Silica: 4g
2. Calcium Carbonate: 2g
3. Carrageenan: 0.4g
4. Potassium Sorbate: 0.1g
5. Peppermint Oil: 0.2g
6. Spearmint Oil: 0.1g

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4.3 Procedure

Step 1: Liquid Preparation

- Combine water, glycerin, sorbitol solution, liquorice extract solution, and shatavari extract solution in a vessel.
- Heat the mixture to 40°C to facilitate dissolution.

Step 2: Solid Preparation

- Mix silica, calcium carbonate, carrageenan, and potassium sorbate in a separate vessel.

Step 3: Liquid-Solid Mixing

- Gradually add the solid mixture to the liquid mixture while stirring.
- Continue stirring until the mixture is uniform and lump-free.

Step 4: Flavoring Oil Addition

- Add peppermint oil and spearmint oil to the mixture.
- Stir well to ensure uniform oil distribution.

Step 5: Cooling and Filling

- Allow the mixture to cool to room temperature.
- Fill the toothpaste mixture into tubes or containers.

Step 6: Quality Assurance

- Evaluate the toothpaste's texture, consistency, and flavor.
- Conduct necessary quality control tests to ensure regulatory compliance.

5.0 Results and Discussion

Compatibility Study of Drug and Excipients

Sr. No.	Physical mixture	Day -1	Day -2	Day -3	Day 4-15
1.	Liquorice	N.C	N.C	N.C	N.C
2.	Liquorice+Glycerin	N.C	N.C	N.C	N.C
3.	Liquorice+ Sorbitol sol^{n}	N.C	N.C	N.C	N.C
4.	Liquorice + Silica	N.C	N.C	N.C	N.C
5.	Liquorice+ Calcium Carbonate	N.C	N.C	N.C	N.C
6.	Liquorice Guar gum Ep	N.C	N.C	N.C	N.C
7.	Liquorice+ Sodium benzoate	N.C	N.C	N.C	N.C
8.	Liquorice+ Pappermint oil	N.C	N.C	N.C	N.C
9.	Liquorice + Water	N.C	N.C	N.C	N.C

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Figure - Physical compatibility study of shatavari and liquorice + Excipients

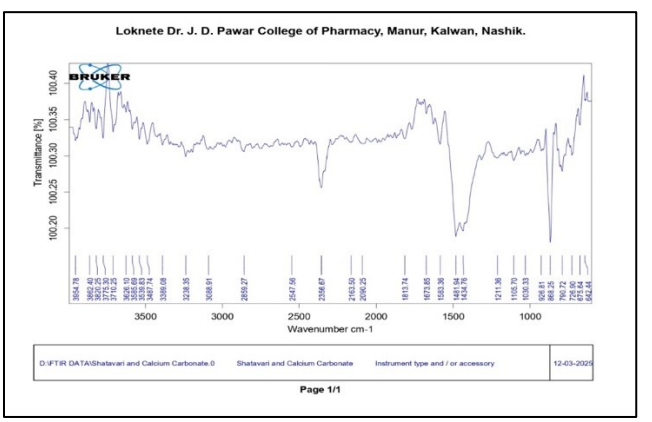
A. Physical compatibility study:

Observation Table of Compatibility Study of Liquorice and Excipients

Sr.No.	Physical mixture	Day -1	Day -2	Day -3	Day 4-15
1.	Liquorice	N.C	N.C	N.C	N.C
2.	Liquorice + Glycerin	N.C	N.C	N.C	N.C
3.	Liquorice + Sorbitol soln	N.C	N.C	N.C	N.C
4.	Liquorice + Silica	N.C	N.C	N.C	N.C
5.	Liquorice + Calcium Carbonate	N.C	N.C	N.C	N.C
6.	Liquorice + Guar gum Ep	N.C	N.C	N.C	N.C
7.	Liquorice + Sodium benzoate	N.C	N.C	N.C	N.C
8.	Liquorice + Pappermint oil	N.C	N.C	N.C	N.C
9.	Liquorice + Water	N.C	N.C	N.C	N.C
4.	Shatavari + Silica	N.C	N.C	N.C	N.C
5.	Shatavari + Calcium Carbonate	N.C	N.C	N.C	N.C
6.	Shatavari + Guar gum Ep	N.C	N.C	N.C	N.C

B. Chemical compatibility study:

Shatavari + Calcium carbonate



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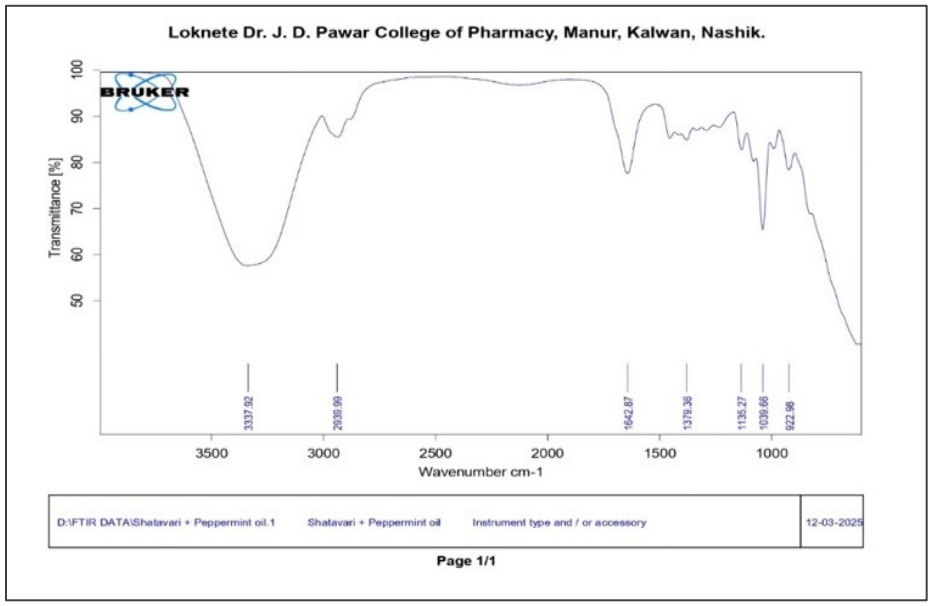
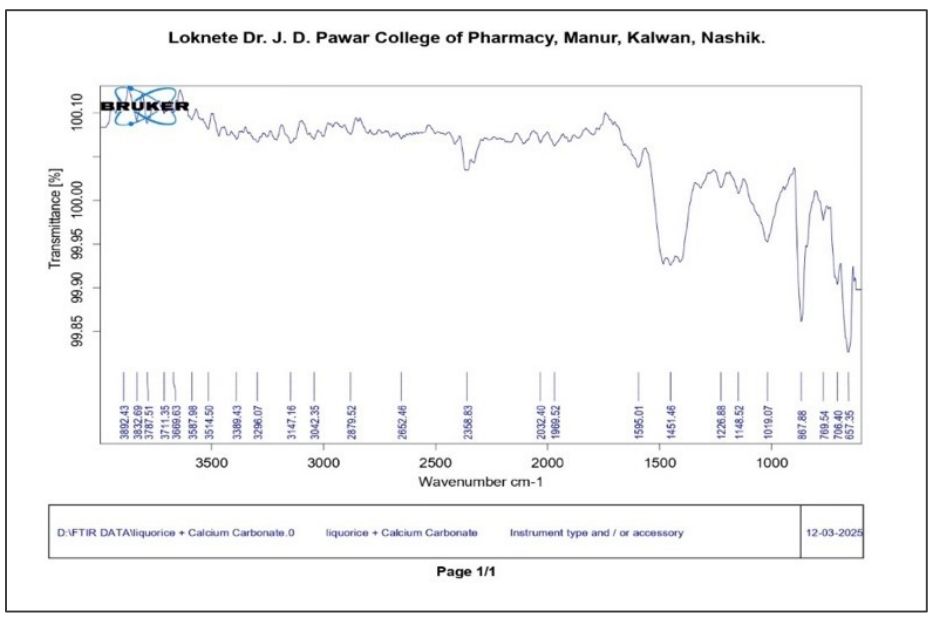
Shatavari + Peppermint oil



Liquorice + Calcium carbonate



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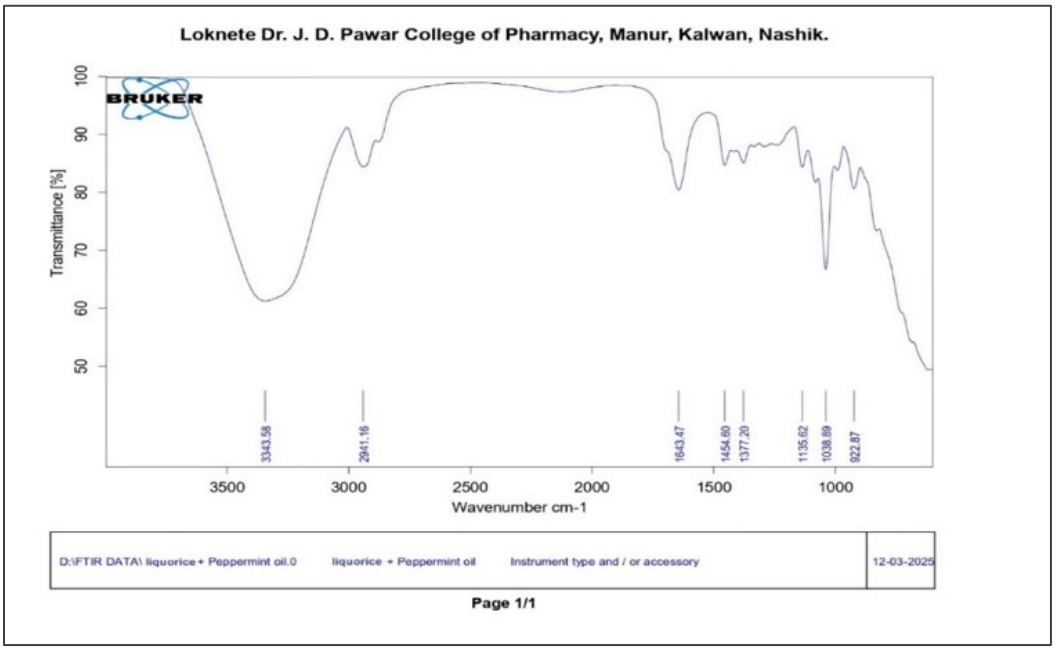
Liquorice + Peppermint oil



C. Stability Testing SLS free toothpaste:

Observation table

Sr.No.	Evalution Parameters	Before storage at 40°C/35°C Humidity	After storage at 40°C/35°C Humidity
1.	Colour	Light Brown	Light Brown
2.	Odour	Minty smell	Mild minty smell
3.	pH	6	6
4.	Foaming ability	**Positive**	**Positive**
5.	Odour	Smooth	Smooth
6	Dispensability	Good	Good

The SLS-free toothpaste demonstrated remarkable stability and consistency, exhibiting no significant alterations in its Colour, Odour, pH level, foaming ability, Odour, Dispensability or potential for tooth sensitivity subsequent to prolonged storage at elevated temperatures and humidity levels of 40°C and 35°C, respectively.

D. Comparative study of marketed preparation and SLS free toothpaste:

Observation table

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Sr.No.	Properties	Marketed preparation	SLS-free Toothpaste
1.	Colour	White	Light Brown
2.	Odour	Minty smell	Minty smell
3.	Texture	Smooth	Smooth
3.	pH	6	6
4.	Foam	1 cm	0.5 cm
5.	Turbidity	+ ve	+ ve
6.	Foaming index	13.33%	6.66%
7.	Moisture content	2.82 gm	5.01 gm
8.	% Moisture content	71.8 %	49.9 %
9.	Dispensability	Good	Good

Studies have shown that SLS-free toothpaste exhibits similar cleaning and physical properties like colour, odour, texture, pH, etc. such as marketed preparations containing SLS, while offering additional benefits such as fresh breath reduced gum irritation and tooth sensitivity.

6.0 Future Scope

The potential for SLS-free and fluoride-free toothpaste incorporating Shatavari and Licorice is extensive and encouraging, presenting numerous opportunities for growth, innovation, and exploration within the natural oral care sector. As consumer preferences shift towards natural and sustainable options, manufacturers must evolve and innovate to satisfy these emerging demands. With continuous research and development, the expansion of product formulations, and a commitment to sustainability and eco-friendliness, the prospects for SLS-free and fluoride-free toothpaste featuring Shatavari and Licorice are substantial. As the market progresses, we can anticipate new product introductions, extensions of existing lines, and collaborations within the industry that will foster innovation and expansion. In summary, the outlook for SLS-free and fluoride-free toothpaste with Shatavari and Licorice is promising, driven by an increasing demand for natural and sustainable oral care solutions.

7.0 Conclusion

The development of an SLS-free and fluoride-free toothpaste incorporating Shatitaki (Shatavari) and Liquorice extract offers a novel and effective alternative for oral

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care. This formulation combines the natural antibacterial and anti-inflammatory properties of Shatavari and Liquorice, providing a safe and gentle option for consumers seeking to avoid harsh chemicals. The results demonstrate that this toothpaste is capable of maintaining good oral health while promoting a healthy and balanced oral microbiome. Overall, this innovative formulation has the potential to revolutionize the oral care industry, providing a natural, effective, and chemical-free solution for consumers worldwide.

References

1. Paul N, Clark H. Foaming at the bit: sodium lauryl sulphate (SLS)-free toothpastes. NZDA News. 2021; 202:27-36.
2. Limeback H, Enax J, Meyer F. Improving oral health with fluoride-free calcium-phosphate-based biomimetic toothpastes: an update of the clinical evidence. Biomimetics. 2023 Jul 27;8(4):331.
3. Harvima RJ, Airaksinen TH. Toothpaste Hypersensitivity-A Case Report. Ameri J Clin Med Re: AJCMR-166. 2024.
4. Kanoja AP, Ghuge PV, Holap PB, Jagdale A. To Formulate and Evaluate Herbal Toothpaste.
5. Thombre N, Lokhande R, Mahale T, Pathade N, Yamagar P, Bhagat S, Navare D, Shinde P, More D. Formulation and development of SLS free toothpaste. Turkish Online Journal of Qualitative Inquiry. 2021 Oct 1;12(9).
6. Cvikl B, Lussi A, Gruber R. The in vitro impact of toothpaste extracts on cell viability. European journal of oral sciences. 2015 Jun;123(3):179-85.
7. Harvima RJ, Airaksinen TH. Toothpaste Hypersensitivity-A Case Report. Ameri J Clin Med Re: AJCMR-166. 2024.
8. Green A, Crichard S, Ling-Mountford N, Milward M, Hubber N, Platten S, Gupta AK, Chapple IL. A randomised clinical study comparing the effect of Steareth 30 and SLS containing toothpastes on oral epithelial integrity (desquamation). Journal of Dentistry. 2019 Jan 1; 80:S33-9.
9. Setiawatie EM, Sari DS, Wahyudadi BS, Fitria E, Supandi SK, Bargowo L, Gani MA. Viability of Nigella sativa toothpaste with SLS compared non-SLS on fibroblast cell culture. Journal of International Dental and Medical Research. 2021;14(2):525-8.
10. Kasi SR, Özcan M, Feilzer AJ. Side effects of sodium lauryl sulfate applied in toothpastes: A scoping review. American journal of dentistry. 2022 Apr 1;35(2):84-8.
11. Kumar M, Prakash S, Radha, Kumari N, Pundir A, Punia S, Saurabh V, Choudhary P, Changan S, Dhumal S, Pradhan PC. Beneficial role of antioxidant secondary

DOI: 10.17492/JPI/ICISI2025/251235 *ISBN: 978-93-49790-69-8*

metabolites from medicinal plants in maintaining oral health. Antioxidants. 2021 Jun 30;10(7):1061.
12. Jolly A, Kim H, Moon JY, Mohan A, Lee YC. Exploring the imminent trends of saponins in personal care product development: a review. Industrial Crops and Products. 2023 Dec 1; 205:117489.
13. Agrawal A, Ahirwar B, Agrawal K. Saponins: a natural raw material for cosmeceuticals. In Specialized Plant Metabolites as Cosmeceuticals 2024 Jan 1 (pp. 191-220). Elsevier.
14. Klaophimai A, Tosrisawatkasem O, Horsophonphong S. Antibacterial effects of children's and adults' toothpastes containing different amounts of fluoride: An in vitro study. Journal of Dental Research, Dental Clinics, Dental Prospects. 2024 Mar 29; 18(1):23.
15. Chowdhury BR, Garai A, Deb M, Bhattacharya S. Herbal toothpaste: A possible remedy for oral cancer. Journal of natural products. 2013; 6:44-55.
16. Roy S. Preparation and Evaluation of Herbal Cosmetic. Recent Trends in Cosmetics (RTC). Recent Trends in Cosmetics. 2024; 1 (2): 26–43p. Preparation and Evaluation of Herbal Cosmetic Sudipta Roy STM Journals. 2024:2.
17. Anwar MA, Sayed GA, Hal DM, Hafeez MS, Shatat AA, Salman A, Eisa NM, Ramadan A, El-Shiekh RA, Hatem S, Aly SH. Herbal remedies for oral and dental health: a comprehensive review of their multifaceted mechanisms including antimicrobial, anti-inflammatory, and antioxidant pathways. Inflammopharmacology. 2025 Feb 5:1-76.
18. AL-AMILI ML, AL-JOBORI KM. Evaluation of the effects of Glycyrrhiza glabra and Syzygium aromaticum extracts on gene expression of Streptococcus mutans in patients with dental caries. Biodiversitas Journal of Biological Diversity. 2025 Feb 3;26(1).
19. Agarwal R, Singh C, Yeluri R, Chaudhry K. Prevention of dental caries-measures beyond fluoride. Oral Hyg Health. 2014;2(122):2332-0702.

DOI: 10.17492/JPI/ICISI2025/251235 *ISBN: 978-93-49790-69-8*