

Evaluation and Stability Study of Hair Conditioner: A Comparison

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Abstract

The evaluation and stability of hair conditioner was carried out. In this study, six different brands of marketed hair conditioners were randomly selected, evaluated and compared. The hair conditioners went through various evaluation tests like organoleptic evaluation (color, odor, texture, physical state, flowability, consistency and ease of application, visual appearance and texture), washability test; irritancy test; conditioning effect; pH determination; viscosity measurement; hair strand testing as well as stability studies at different temperatures including thermal stability. All six conditioners were homogenous in nature and easily washed off from the hairs during the washability test. There was no any redness or itching or irritation on the conditioner's part. Hair felt smoother, more hydrated and moisturized after applying it. During both chemical and herbal formulations, the pH and viscosity varied throughout stability study. Depending on these factors however it was observed that physical status as well as flowability of conditioners led to variation in consistency as well as easy application of the product. There was no oil separation according to the results obtained from thermal stability study.

Keywords: Hair conditioner, evaluation tests and stability studies

Abbreviation and Acronyms

1. S NO. - Serial number
2. °C - Degree Celsius
3. pH - Potential of Hydrogen
4. ml - Milliliter
5. cps - Centipoise
6. % - Percentage
7. ± - Plus-Minus sign

Introduction

Cosmetic is defined in the Drugs and Cosmetics Act, 1940 as, "any article intended to be rubbed, poured, sprinkled or sprayed on, or introduced into, or otherwise applied to, the human body or any part thereof for cleansing, beautifying, promoting attractiveness or altering the appearance, and includes any

article intended for use as a component of cosmetic”[1].The hair beauty has recognition of cleansing to repair, growing the tensile strength, decreasing oxidative damage, and stimulating growth. To make hair appear certainly extra lustrous, smooth, and possibly have evolved [2].

A conditioner is a creamy product that works like a mask to enhance our hair's texture. Its purpose is to restore and hydrate the hair, giving it a softer appearance. Additionally, it lessens friction between the hair strands, making brushing hair easier after a hair wash. Some of different benefits have once in a while being claimed for conditioners which includes repair of broken hair, strengthening of hair, restore of break up ends [5,6].

The conditioning effect is provided by the conditioning agents incorporated in the formulations. Conditioners can be chemical or natural ones and can be used alone or in combination. Nature of the conditioning agent determines the mechanism of conditioning provided. Based on the mechanism of action there are different types of conditioners which includes;

- a. Rinse Out Conditioner or Instant Conditioner
- b. Leave In Conditioner
- c. Moisturizing Conditioner
- d. Volumizing Conditioner
- e. Protein Conditioner
- f. Deep Conditioner
- g. Cream Rinse Conditioner [4,15].

Chemical conditioning agents includes:

- Fatty Materials – Fatty Alcohol, Sterols, Fatty Acids, Monoglycerides, Triglycerides, Lanolin and Lanolin Derivatives, Mineral Oil
- Silicones – Dimethicone, Dimethicones Copolyol
- Quaternary Compounds- Poly Oxyethylene, Lecithin
- Quaternized Polymer – Quaternium 10
- Surfactant (Cationic Surfactant) - Behentrimonium Chloride, Cetrimonium Chloride [7].

Natural conditioning agents include:

- Olive Oil, Coconut Oil, Almond Oil, Argan Oil
- Fenugreek, Aloe Vera
- Hydrolyzed Silk
- Egg, Honey, Shea Butter [3,8,17].

Methodology

Six different conditioner brands were selected randomly from the market. Out of the six three were of completely chemical combination (C1, C2 and C3) and the other three were herbal formulations (C4, C5 and C6).

Evaluation Tests

1. Organoleptic evaluation: The selected conditioners were evaluated for color, odor, physical state, flowability, visual appearance or texture and also for consistency and application ease [9].

2. Washability Test: Applied hair conditioner on damp hair and washed with tap water. Then the hair

was assessed for easiness of washability, rinse out and presence of residue [12].

3. Irritancy Test : Applied a small amount of the hair product on the elbow and behind the ear lobe using a cotton pad dipped in the product. Allowed the product to dry completely and then repeated the process twice. Held for a period of 24 hours [10].

4. Conditioning Effect: Applied conditioner on hair after shampooing and the observed the effect before and after drying [14].

5. pH: Precisely weighed out 5 ± 0.01 gram of conditioner into 100 ml beakers. Poured 45 ml of water and mixed the conditioner into it. The pH was then measured using a pH meter at room temperature [13].

6. Viscosity: The viscosity was measured using a Brookfield Viscometer [13].

7. Hair Strand Testing: After shampooing, 1 gram of conditioner was applied to the hair, subsequently rinsed out, and the hair was dried to evaluate the effects on both wet and dry hair. The spreadability and coating characteristics were noted during the application process [16].

8. Stability Test: The stability of the sample under accelerated conditions was evaluated by heating and cooling methods at 45°C and 4°C for 24 hours. All the evaluations were repeated after the stability test [11].

9. Thermal Stability: Using the material to be tested, a stripe of even thickness and width was made on a glass slide. Maintain the glass slide in the humidity chamber for eight hours at a temperature of $37 \pm 1^{\circ}\text{C}$ and 60 to 70% relative humidity and checked for oil separation [16].

RESULTS AND DISCUSSION

1. Organoleptic evaluation: The observations made during organoleptic evaluations, viz; colour, odour, visual appearance and texture, physical state and flowability were found as specified in the table below.

Table 1: Organoleptic Evaluation of Different Conditioners

S.NO	Brand Names	Evaluation					
		Colour	Odour	Physical State	Flowability	Visual Appearance /Texture	Consistency and Application Ease
1	C1	Artic blue	Lavander	Semi solid	Un-continuous flow	Homogeneous	Easy to use
2	C2	White	Flora smell	Semi solid	Un-continuous flow	Homogeneous	Easy to use
3	C3	Pure white	Argan oil	Semi solid	Continuous flow	Homogeneous	Easy to use
4	C4	Pure white	Avocado	Semi solid	Continuous flow	Homogeneous	Easy to use
5	C5	Snow white	Argan oil	Liquid	Un-continuous flow	Homogeneous	Easy to use

6	C6	Light green	Herbal	Liquid	Good continuous flow	Homogeneous	Easy to use
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Colour and odour were same as specified in their respective packaging. The formulations C1 to C4 were found to be semi solid whereas C5 and C6 were found to be more of a liquid state. All formulations except C3 are having a smooth texture. A continuous flow was observed for C3 and C4, more and good continuous flow for C6 and an uncontinuous flow pattern was observed for the remaining formulations. All the six were homogenous without any lumps and were uniformly coloured. The conditioners were consistent while application and were easy to apply.

2. Washability test

The conditioners were easily washed off with minimal efforts; it rinsed off completely leaving no residue and the hair was manageable and clean.

3. Irritancy test

None of the formulations produced any redness, itching or irritation while the application or during the 24 hours of application.

4. Conditioning effect

After using the conditioners, the hair felt smoother, hydrated, moisturized with reduced frizz. Detangling was much easier and hair had a healthy shine to it. Formulations C4, C5 and C6 showed a slightly more frizziness compared to the other three conditioners.

5. pH determination

pH of the conditioners was found to be in the range of 3.53 - 6.26. The conditioner C1 and C4 were found to have the least and the highest pH value respectively.

6. Viscosity

Viscosities of the conditioners were found to be in the range of 2532-5660 cps. The conditioner C6 and C3 were found to have the least and the highest viscosity respectively. The C5 and C6 showed a lower viscosity compared to the other formulations due to their liquid consistency.

Table 2: Results pH and Viscosity Determination

S.NO	Brand Code	Ph	Viscosity (cps)
1	C1	3.53	5601
2	C2	4.79	5647
3	C3	3.98	5660
4	C4	6.26	4767
5	C5	5.92	5057
6	C6	5.38	2532

7. Hair strand testing

After conducting the hair strand testing, the effects of conditioner visibly smoother and shiner with improvement in texture. During application, the chemical conditioner exhibits moderate spreadability, requiring some efforts to distribute evenly to provide adequate coverage. Herbal conditioners provided superior spreadability with minimal resistance, resulting in more uniform coverage and saturation. In addition to the moderate coating, some areas are unevenly coated and lacking saturation while the application of chemical conditioner (C1, C2 and C3). Herbal conditioners (C4, C5 and C6) exhibited superior coating effectiveness, forming a consistent layer over the hair with minimal variation in coverage.

8. Stability test

Stability study of all the six brands was done at 45°C and 4°C for 24 hours. No variations were found in the colour, odour, and visual appearance and texture same before and after stability testing. Physical state was found to change after stability testing which in turn affected the physical state, flowability and ease of application. The results were as reported in the table below. Stability studies revealed that the ease of application has varied.

Table 3: Physical State, Flowability and Ease of Application After Stability Studies

S. NO	Brand Code	Evaluation Test					
		Physical State		Flowability		Application Ease	
		At 45°C	At 4°C	At 45°C	At 4°C	At 45°C	At 4°C
1	C1	Solid	Semisolid	No flow	Un-continuous flow	Difficult	Easy
2	C2	Semisolid	Semisolid	Un-continuous flow	Un-continuous flow	Easy	Easy
3	C3	Solid	Semisolid	No flow	Continuous flow	Difficult	Easy
4	C4	Solid	Semisolid	No flow	Continuous flow	Difficult	Easy
5	C5	Semisolid	Semisolid	Continuous flow	Un-continuous flow	Easy	Easy
6	C6	More liquid	Semisolid	Free flow	Free flow	Easy	Difficult

Table 4: pH and Viscosity After Stability Studies

S.NO	Temperature	Tests	Brand Codes					
			C1	C2	C3	C4	C5	C6
1	45°C	pH	3.89	3.95	3.85	6.25	6.11	5.35
2	4°C		4.47	5.4	4.08	5.92	5.97	5.35
3	45°C	VISCOSITY (cps)	5913	4504	4812	5665	5350	1272
4	4°C		5813	5894	5555	5531	4832	4101

Figure 1: pH Conditioners Before and After Stability Studies

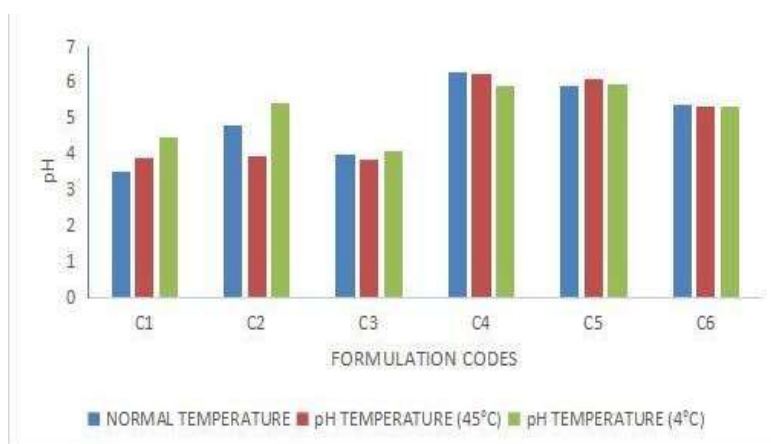
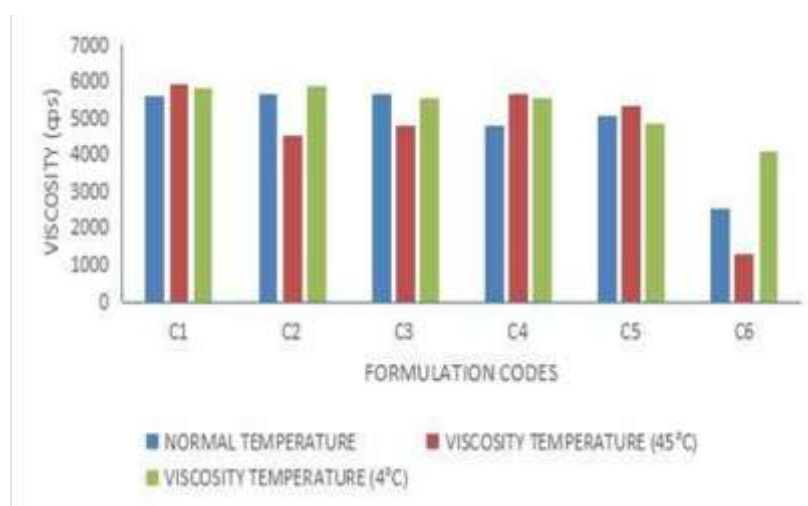


Figure 2: Viscosity Conditioners Before and After Stability Studies



pH and viscosity values and plots were as shown above. Conditioner C2 showed a significant change in pH after stability study at 45°C, but it was found to be in normally accepted pH range. C6 and C2 showed large variations in viscosity after stability study at 45°C. The variations in the viscosity may be due to the change in physical state during the stability study.

8. Thermal stability

During the thermal stability study a slight reduction in the weight of the sample was noted. But no oil separation was found during the study. So, the products were found to be stable at 37°C at a relative humidity of 60 – 70 % without oil separation.

Summary and Conclusion

The conditioners taken for the evaluations are commercially available in the market. Different evaluations were done on them such as Organoleptic Evaluations, Washability, Irritancy, Conditioning test, pH, Viscosity, Hair Strand testing. Stability testing and Thermal stability studies were also done. The colour and odour of all conditioners were characteristic and same as that mentioned in their packaging. All six brands were homogenous in visual appearance and more or less smooth in texture.

The physical state varied from semisolid to liquid from C1 to C6 and flowability from non-continuous to good continuous flow. The hair exhibited enhanced smoothness, increased hydration, and improved moisture levels, resulting in diminished frizz. Detangling became significantly easier, and the hair displayed a healthy luster. Nevertheless, conditioners C4, C5, and C6 demonstrated a slight increase in frizz compared to the other three conditioners. The pH levels were found to be within acceptable limits, and all formulations exhibited viscosity consistent with their physical states. No irritation was noted, although the ease of application varied based on the physical state of the products. The stability tests revealed differences in physical state and flowability, which subsequently influenced the ease of application and overall consistency. However, the other sensory evaluations remained unchanged. In the thermal stability assessment, a reduction in sample weight was observed, yet no oil separation occurred in any of the formulations. The physical state and alterations in properties, as well as tests related to physical state, were particularly pronounced in C2 and C6. The remaining four formulations also exhibited variations in stability, which impacted their physical characteristics. Chemical formulations (C1, C2, and C3) showed less easiness in uniform application and change in physical state during stability study compared to herbal formulations (C4, C5, and C6). Herbal formulations showed greater easiness in application at normal condition and after stability testing but showed slight frizziness in hair after application. The physical state change during the stability study made them less preferable for application especially C6. As a comparison chemical conditioners were found to be more effective as a conditioner. But both chemical and natural one showed variation in physical state, flowability and ease of application after stability studies. In this case further evaluations should be done for toxicity, microbial presence and long-term stability for a more clear and precise comparison between chemical and herbal formulations.

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Reference

1. Basavaraj K.N., Gurudev M.H., "Pharmaceutical Jurisprudence", 1st edition, New Delhi, CBS Publishers and Distributors, 2011.
2. Nina M., Kaleem K., "Hair Cosmetics", Indian Journal of Dermatology, Venereology and Leprology, September 2013, Volume: 79, Issue: 5, PMID: 23974582, page no: 653. <https://ijdv1.com/hair-cosmetics/>.
3. Manoja K., "9 Best Homemade Natural Conditioners for Common Hair Problem" TheFitIndia. <https://www.thefitindian.com/blog/6-best-indian-homemade-natural-conditioners-for-healthy-hair/>

4. Jane M., “The 6 Types of Hair Conditioner – A Complete Guide”, Loved by Curls, July 1, 2022
5. Dr Aijaz A.S., Dr Subhash V.D., Dr Kailash R.B., Dr Rageeb M.U., “A Textbook of Cosmetic Science, Punjab, S Vikas and Company Medical Publisher”, 2019.
6. Marc P., Andre O.B., Howard I.M., “HandBook of Cosmetic Science and Technology”, New York, Informa healthcare, 2001.
7. Sanju N., Arun N., Roop K.H., “Cosmetic Technology”, 1st edition New Delhi, Birla Publication Pvt. Ltd, 2006.
8. Venkataram M., Arpita A., “Hair Oils: Indigenous Knowledge Revisited”, International Journal of Trichology, 24 May 2022, volume 14, PMID: 35755964, doi: 10.4103/ijt.ijt_189_20
9. Kuntal D., “Herbal Plants and Their Application in Cosmeceuticals”, 1st edition, New Delhi, CBS Publishers and Distributors, 2014.
10. Camelia S., “Hair Patch Test 101- How to Avoid Allergic Reactions to Products”, Salon Worthy Hair, 1 August 2023. <https://salonworthyhair.com/hair-patch-test>
11. Sitthiphong S., Buppachart P., Itsara K., Wanlapha S., Suchipha W., Cholticha N., “Stability Evaluation of a Hair Conditioner Comprising a Mixed Extra from Fruits of Phyllanthus Emblica and Zanthoxylum Limonella”, The Thai Journal of Pharmaceutical Sciences, 1 January 2013, Volume 38. <https://doi.org/10.56808/3027-7922.2048>.
12. Kaveri H.S., Gauri S.C., Balu T.J., “Formulation and Evaluation of Herbal Hair Conditioner”, International Journal of Pharmaceutical Sciences, 2023 Article Id IJPS/230105052.
13. Pratiksha B.D., Harshali K.P., Kaveri S.P., Dipali D.S., Jyostnaa H.W., “Formulation and Evaluation of Herbal Hair Conditioner”, International Journal of Creative Research Thoughts, ISSN 2320-2882
14. Khansa, Rashidah K.A., Fathima A.P.P., Shamna C., Nishad K.M., Sirajudheen M.K., Shijikumar P.S., “Formulation and Evaluation of Hair Conditioner Containing Hibiscus Mucilage and Vitamin E”, World Journal of Pharmaceutical Research 28 March 2022, DOI: 10.20959/wjpr20226-23938.
15. “Here's What You Should Know About Men's Hair Conditioners”, Keeps Blog. <https://www.keeps.com/learn/types-of-conditioner>
16. Kumari S., “Hair conditioner”, June 13 2020. <https://www.slideshare.net>
17. Wilbur J. “Safety Assessment of Silk Protein Ingredients as Used in Cosmetics”, Cosmetic Ingredient Review, February 8 2016. slkprt122015rep.pdf (cir-safety.org)