QUALITY EVALUATION OF DIFFERENT COMMERCIAL SHAMPOO BRANDS MADE IN NEPAL

Baniya DP[1*] , Adhikari D[1] Bajracharya M[1]

[1]Department of Pharmacy, Manmohan Memorial Institute of Health Sciences, Soalteemode, Kathmandu, Nepal

**Corresponding Author:*
Deepti Piya Baniya,
Associate Professor
Department of Pharmacy, Manmohan Memorial Institute of Health Sciences, Kathmandu, Nepal
piyadipti123@gmail.com

ABSTRACT

Background: Shampoo is one of the most popular cosmetic items for washing the hair and scalp. It is necessary to evaluate shampoo in order to understand its performance, quality, and effectiveness, as well as to ensure compliance with the standards of many journal articles.

Objective: The purpose of the research study was to evaluate the quality of four commercial and two medicinal shampoo brands made in Nepal.

Method: A cross-sectional, descriptive study was carried out in order to evaluate label information, microbiological quality, and physiochemical parameters such as (pH, density, viscosity, surface tension, foaming ability & stability, detergency power, wetting time etc. Furthermore, a UV-visible spectrophotometer was used to measure the percentage of assay of medicated sample.

Result: When compared to secondary data from journals, the study found that not all shampoos met specifications. It was found that only S5 of the six samples tested positive for microbial growth and exceeded the limit. Except for S5, the pH ranged between 5-7.The surface tension of all samples meets the specifications. S1-S4 had normal detergency power, however the medicated sample had low detergency power. All demonstrated good wetting time and dirt dispersion. The percentage of solid content in S1-S2 was very low. The assay percentage was within the prescribed range for medicated sample.

Conclusion: When compared to a standard journal, the study found that certain parameters were within range while some were out of range.

Keywords: *Evaluation, Shampoo, Commercial, Medicated, Physiochemical, Nepal*

INTRODUCTION

Shampoo is the largest market for sale among hair care products because it is used on a daily basis.[1] A shampoo is a surfactant-based cosmetic preparation used to wash the hair and scalp, leaving the hair soft, shiny, and manageable.[2] Surfactants, solvents, foam boosters, thickeners, conditioning agents, preservatives, pH adjustments, coloring agents, and active substances are all blended in exact formulae.[3] Shampoos can be grouped into the following categories based to their specific uses: baby shampoos, acid balanced shampoo, anti-dandruff shampoos, powder shampoos, clear liquid shampoos, and conditioning shampoo.[2]Surfactants form 15–40% of all shampoo formulations, SLS is primary used surfactant and gentler to skin.[4] Surfactants reduce surface tension between water and dirt, forming micelles that bond with sebum and dirt. This allows dirt particles to dissolve in water and be removed from the hair shaft.[5]

Medicated shampoos with ingredients like ketoconazole and zinc pyrithione are effective in treating scalp issues. Ketoconazole has strong anti-Malassezia properties, making it useful for dandruff treatment. Additionally, it may indirectly reduce hair loss by having a mild anti-inflammatory effect.[6]

Different types of shampoos are available in local market & it is important to measure their performance, quality, and effectiveness.[2] Shampoos should meet national requirements, be free of harmful microbes[7], and maintain a suitable pH to prevent eye irritation.[3] Excessive detergents can strip away natural oils, leading to dryness[3], while effective dirt dispersion is crucial for evaluating cleansing action.

Shampoo evaluation includes quality control tests such as visual inspection and measurement of physiochemical controls such as pH, density, viscosity, surface tension, foam volume, and wetting ability.[2] Therefore, the purpose of this study was to analyze commercial and medicated shampoos produced in Nepal based on their scientifically measurable physiochemical characteristics, as well as their microbiological evaluation and assay using the UV method.

MATERIAL AND METHODS

Various shampoo brands made in Nepal were purchased from the market.

Some hair tresses were purchased from a salon.

From the market, a canvas piece, olive oil, and coconut oil were purchased.

Chemicals used :(Ketoconazole, ethanol, hexane, methanolic HCL, culture media, Indian ink)

Determination of microbial contamination and identification:

1ml of each sample was aseptically taken from surface of the respective product and homogenized with buffer peptone water serially diluted up to 10^{-3} and aliquot of 0.1ml of each suspension from the dilution of 10^{-1} and 10^{-3} spread onto the surface of solidified and sterile TSA and SDA for bacteria and fungi respectively. Also For identification plated in Macconkey and BA for identification. The plate were incubated for 24 hours and 3-5days for SDA plate.[8]

Determination of pH:

The pH levels of the different shampoos tested in 1%w/w and 10%w/w solutions in distilled water were evaluated using a pH meter (at a room temperature of 25 ± 2 °C).[2]

Surface tension measurement:

Measurements were carried out with a 10% shampoo dilution in distilled water at room temperature using drop-number Method by using stalagmometer.[9]

Then surface tension is calculated using equation given below:

$$\textbf{Surface tension } (\gamma_2) = \frac{\rho_1 \, n1}{\rho_1 \, n2} \times \gamma_1$$

ρ_1= Density of water (g/ml) ρ_2: Density of sample (g/ml) γ_1 = Surface tension of water (dyne/cm) γ_2 = Surface tension of sample (dyne/cm) n_1 = Number of Drops of water from A to B n_2 = Number of Drops of Liquid sample (from A to B)

Detergency Power:

Thompson et al. used hair tresses soiled with artificial sebum for evaluating detergency. The results were evaluated by gas chromatography. We have used the Thompson method in our laboratory, except that the results were evaluated gravimetrically.

The actual formula for the artificial sebum used in our study was given in table 1 the hair swatch (3 g) was suspended in 20 ml of a 10% sebum Solution in hexane for 15 min with Intermittent shaking. The swatch 'was removed, the solvent evaporated at room temperature and the hair swatch weighed to determine the sebum load. Fifteen swatches were treated similarly and the soil levels were found to range from 9.96 to 11.05%. Each swatch was then split into two equal samples of 1.5 g each: one for the shampoo treatment and the other to act as an internal control to overcome the tress-to-tress variation in soil levels. The control swatch was left untreated. The test swatch was washed with 0.1 ml of a 10% shampoo solution using the finger method described by Thompson et al. It was then dried using a hair at room temperature dryer and further dried in an oven at 60 °C for 4 h to ensure uniform moisture content. The sebum remaining in the test swatch alter shampooing and that in the unwashed control swatch was then extracted, using 20 ml hexane in a stoppered flask for 30 min by shaking. The hexane solution was then evaporated to dryness and the sebum extracted from the test and control swatches was weighed.

Detergency was evaluated as percentage of sebum removed after shampooing.[10]

(DP) =100(1-T/C)

Where;

T = weight of sebum in test swatch

C = weight of sebum in control swatch

Wetting time:

The canvas was cut into 1-inch diameter discs having an average weight of 0.44 g. The disc was immersed just below the surface of a 1% shampoo solution and the stopwatch started. The time required for the disc to begin to sink was noted as the wetting time.[10]

Foaming ability and foam stability:

The cylinder shake method is the most widely used method for determining foaming ability at room temperature, 1% of 50 mL of the shampoo solution was put into a 250-mL graduated cylinder, which was then covered by hand and shaken ten times. The total volume of the foam content after 1.0 min of shaking was recorded. Foam stability up to 4minutes was noted.[2]

Dirt dispersion:

Two drops of shampoo were added in a large test tube contain 10 ml of distilled water. 1 drop of India ink was added; the test tube was stoppered and shakes it ten times. The amount of ink in the foam was estimated as None, Light, Moderate, or Heavy.[2]

Relative Viscosity:

Viscosity was measured using Ostwald's viscometer. 10%w/w shampoo solution was made in Distilled water.[9]

The relative viscosity coefficient is calculated from the expression:

$$(\eta_2) = \frac{\rho_1 t_1}{\rho_1 t_1} \times \eta_2$$

p_1 = Density of water (g/ml) p_2= Density of test sample (g/ml) η_1= Viscosity of water (p) η_2= Viscosity of test sample (p) t_1 = Mean Time of flow of water from A to B

t_2 = Mean Time of flow of test sample from A to B

Method of assay by UV-spectroscopy:

Calibration curve was drawn for ketoconazole in 0.1M Methanolic HCl.

Sample and standard solution was prepared & absorbance was measured at about 230nm.[11,12]

Calculation:

$$\frac{\text{Abs of Sp}}{\text{Abs of Std}} \times \frac{\text{Wt Std}}{\text{Wt of Sp}} \div \%\text{Potency}$$

RESULTS AND DISCUSSION

Microbiological evaluation of commercial shampoos:

Table 1: Microbiological evaluation of sample

Microbiological evaluation of sample:						
Sample	**S1**	**S2**	**S3**	**S4**	**S5**	**S6**
1.Total microbial count	0	0	0	0	0	$9.7x10^5$cfu/ml
2.Total yeast & mold count	0	0	0	0	0	0

No microbial growth was observed during the study in shampoo formulation indicating S1-S4 were intact & contamination free. (Campana et al; 2006) studied 8 brands of shampoo in Italy; contamination were relatively uncommon during its sale but seen at in use and ending product.[13] The investigated formulations S6 can be considered as out of specifications ($9.7x10^5$cfu/ml) according to the Bureau of Indian Stanadard (BIS) for shampoos.[14]The biochemical test conforms presence of *Enterobacter species*. Past study recovered *Enterobacter species* from three products.[15] For prevention of microbial contaminants at the point of sale need of good (GMP) by the manufacturer with adequate preservation system.

Physiochemical properties of shampoos:

pH : Management of pH in shampoos has significant effects on the hair and scalp qualities and prevents eye irritation.[3] The acceptable pH range for shampoo is 5- 7.[2] The pH values of 1%w/w and 10% w/w of different brands of shampoo were found to be within the range of 5.81 – 8.25 as shown in **Table: 2** which is considered to be ideal for hair & scalp. The pH range of most commercial shampoos in Brazil was reported to be 5.5–7 by Diass et.al.[16]

Surface tension: The well formulated shampoo should be able to reduce the surface tension of purified water from 72.8 dynes/cm to range of 30-40 dynes/ cm to 40 dynes/cm.[3]The lowest surface tension indicated the strongest detergency of shampoo. In our study, the commercial sample showed a good reduction in surface tension to 32.5-37.04 dynes/ cm which indicated its good cleaning and detergent action. While medicated sample exhibit 37-40.7dyn/cm was relatively higher.

Table 2: Evaluation of physiochemical parameters

Sample	S1	S2	S3	S4	S5	S6
pH 1%w/w	6.74± 0.01	6.35± 0.01	6.61±0.015	6.60± 0.05	8.25± 0.04	6.92±0.13
pH 10%w/w	6.53±0.01	5.81±0.005	6.33±0.13	6.27±0.005	8.02±0.03	7±0
Surface tension	32.5±1.83	37.04±1.76	33.96±0.94	31.6±2.7	40.7±1.41	37.0±2.24
Detergency power	71.49±2.21	72.4±2.21	72.10±2.74	70.299±3.37	61.21±19.95	59.39±18.57
Wetting time	1.81±0.10	2.81±0.10	1.94±0.03	2.85±0.02	3.02±0.05	3.05±0.02
Dirt dispersion	None	None	None	None	None	None
Foaming ability	108±10.58	146.6±6.11	127.3±6.42	123.3±15.27	103.3±5.77	106.6±25.16
Viscosity	1.31±0.02	2.31±0.02	1.49±0.02	1.62±0.07	1.233±0.01	1.37±0.05
Percentage of solid content	15.6±2.97	16.6±2.97	20.3±0.85	21.10±3.48	20.2±1.56	22.2±3.6
Assay percentage of medicated sample by UV-spectrophotometer					102.60%	103.60%

Detergency power: A high amount of detergents dries the hair by eliminating natural oil .[3]There is no real standard, the amount of soil a shampoo should ideally remove. The normal hair shampoo needs normal detergency. Highest surface tension indicates lowest detergency power (DP). [17] The DP varied from 70-72% from our study **Table: 2.** (Fazlolahzadeh & Masoudi, (2015); Mainkar and Jolly, 2000) found DP 62-80% & 61-80% respectively. [10,17] Medicated sample have lowest detergency power (DP) 59-61.21%.

Wetting time: Wetting phenomena are complex and depend upon several processes and factors such as diffusion, surface tension, concentration, and the nature of the surface being wetted. Each wetting agent has to reduce surface tension. As in **Table: 2** the wetting time ranged 1.81-2.85 min for commercial indicating minimum concentration of detergent while 3.02-3.05 min for medicated sample. The wetting time reported by (Mainkar and Jolly, 2000) (2.65-3.8min) by canvas disc method & we also obtained similar result.[10]

Dirt dispersion: Dirt dispersion is an important criterion for evaluation the cleansing action of shampoos. Shampoos that cause the ink to concentrate in the foam are considered of poor quality because ink or dirt that stays in foam is difficult to rinse away and gets redeposit on the hair.[3]Therefore, dirt should remain in the water portion to achieve better cleansing action. None of the sample showed dirt in foam indicating good cleansing action as in **Table: 2**.

Foaming ability and stability: Although foam generation has no correlation with the cleansing ability consumer believe higher the foaming better the quality of shampoo. **Table: 2** showed the foaming ability of tested shampoos with accepted foam formation. All tested shampoos had quite similar foam volume for 4 min showing that their foam has good stability (should be 100 mL or more) .[2] The highest foam was obtained for S2 & lowest for S1 (AlQuadeib et al., 2018) reported foam to be above 100ml for the tested sample.[2]

Relative viscosity: The consumer expects the shampoo to have high viscosity. [3]The ideal rheological characteristics of shampoo are effective on shelf life, package consistency, flow ability, spreading, and clarity.[3] As we can see sample S2 had the highest viscosity (2.31 poise) & lowest for S1 (1.31poise).Relative viscosity of different shampoo collected from Pakistan by (Ur Rehman et.al 2017) was (1.09-2.532 poise) which coincides with our study performed by using Ostwald's viscometer.[18] However the medicated sample have relatively low viscosity.

Percentage of solid content: Good shampoos usually have 20–30% of solid content, which enables it to be easily applied and rinsed out from the hair.[2] Shampoos with low amount of solid content can be washed off quickly, and conversely, high amount of solid content in shampoo makes it harder to wash off.[3]

The % of solid content for commercial sample ranged 16-21% & only S1 & S2 were out of range. In past study (16-26%)[2] (15-23 %)[17] solid content was reported which coincide with the (AlQuadeib et al., 2018) (Fazlolahzadeh & Masoudi, 2015). For medicated sample percentage of the solid contents was found to be in range 20–22% indicating easy to wash from hair.

Percentage assay for two medicated sample: The percentage assay of S5 & S6 was found to be 102.69% and 103.65% which was within the limit of 90-110% as per IP. In the study carried by (Olga Popovaska, 2014) 2% KTZ shampoos were within their label claims by using UV spectrophotometer .[12]Thus the 2% concentration is effective as anti-dandruff shampoo.

CONCLUSION

The quality evaluation of six shampoo samples was conducted. One sample showed microbiological growth, while the others were within acceptable limits. Commercial shampoos exhibited better characteristics such as lower pH, surface tension, and solid content percentage,

while medicated shampoos had higher values in those areas. Commercial shampoos are more suitable for all hair types and enjoy greater consumer acceptability. Thus, not all of the samples met the specifications outlined in the standard journals, suggesting the need for improvement in certain areas.

Further detailed study of Antimicrobial preservative effectiveness test of shampoo. Dominance of foreign shampoo brands in Nepal is increasing so focusing on such brands. For reliable quality assay of medicated sample by HPLC is recommended.

Acknowledgment:

The authors gratefully acknowledged Manmohan Memorial Institute of Health Sciences and Department of Pharmacy for their encouragement and support.

Conflict of Interest:

Authors have no any conflict of interest.

REFERENCES

1. Malpani, T. Formulation and evaluation of Pomegranate based herbal shampoo. *J. Pharmacogn. Phytochem.* **9**, 1439–1444 (2020).
2. AlQuadeib, B. T., Eltahir, E. K. D., Banafa, R. A. & Al-Hadhairi, L. A. Pharmaceutical evaluation of different shampoo brands in local Saudi market. *Saudi Pharm. J.* **26**, 98–106 (2018).
3. Azadbakht Mohammad. Formulation and Evaluation of Licorice Shampoo in Comparison with Commercial Shampoo. *Asian J. Pharm. Clin. Res.* **10**, 208–215 (2017).
4. Nunes, A. *et al.* Sugar Surfactant-Based Shampoos. *J. Surfactants Deterg.* **23**, 809–819 (2020).
5. Trüeb, R. M. Shampoos: Ingredients, efficacy and adverse effects. *JDDG - J. Ger. Soc. Dermatology* **5**, 356–365 (2007).
6. Schwartz, J. R., Deangelis, Y. M. & Dawson, T. L. *Dandruff and Seborrheic Dermatitis: A Head Scratcher*.

7. Ibegbulam-Njoku, P. N. & Chijioke-Osuji, C. C. Microbiological evaluation of cosmetics products sourced in Aba city, Nigeria. *Int. J. Sci. Reports* **2**, 74 (2016).
8. Sumit, A. F., Sharmin, T. & Ahmed, T. Evaluation of the in vitro Antimicrobial Activity As well As Preservative Capacity of Several Popular Cosmetic Products Available in the Neighbouring Shops in Bangladesh. *Mymensingh Med. J.* **30**, 478–484 (2021).
9. Bahl Arjun, B. B. . . *Essentials of Physical Chemistry*. (S.Chand,New Delhi, 1999).
10. Mainkar, A. R. & Jolly, C. I. Evaluation of commercial herbal shampoos. *Int. J. Cosmet. Sci.* **22**, 385–391 (2000).
11. Welfare, I. M. of H. and F. & Commission, I. P. *Indian Pharmacopoeia*. (2007).
12. Popovska Olga. Development and Validation of UV Spectroscopic Method for Determination of Ketoconazole in Pharmaceutical Formulations. *Int. J. Pharm.* **4**, 95–101 (2014).
13. Campana, R., Scesa, C., Patrone, V., Vittoria, E. & Baffone, W. Microbiological study of cosmetic products during their use by consumers: Health risk and efficacy of preservative systems. *Lett. Appl. Microbiol.* **43**, 301–306 (2006).
14. Manak, B. Bureau of Indian Standards Act:Shampoo Specification. *PCD 19 Cosmet.* **4**, 1–9 (2020).
15. Shaqra, Q. A. Microbiological Quality and in Use Preservative Capacity of Shampoo Preparations Manufactured in Jordan. *Jordan Journal of Biological Sciences* vol. 4 113–118 (2011).
16. Dias, M. F. R. G., De Almeida, A. M., Cecato, P. M. R., Adriano, A. R. & Pichler, J. The shampoo pH can affect the hair: Myth or Reality? *Int. J. Trichology* **6**, 95–99 (2014).
17. Fazlolahzadeh, O. & Masoudi, A. Cosmetic Evaluation of Some Iranian Commercial Normal Hair Shampoos and Comparision With New Developed Formulation. *Int. J. Pharmacogn.* **2**, 259–265 (2015).
18. Ur Rehman, H. *et al.* Physiochemical Analysis of Different Soap and Shampoo Collected from the Different Local Market of District Karak, KP, Pakistan. *World Appl. Sci. J.* **35**, 2012–2014 (2017).