Tripolitana Medical Journal; 2025, Vol. 14, No. II, pp. 37 - 47

Research Article

ISSN 2077-5628

Evaluation and Comparison Study of Various Antidandruff Shampoos in Tripoli Libya

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Received 11 July 2025/ Accepted 24 July 2025; Published 5th August 2025

ABSTRACT

Shampoo is a hair care product used for the removal of oils, dirt, skin particles, dandruff, environmental pollutants and other contaminant particles that gradually build up in hair. Dandruff is a common disorder affecting the scalp, causing a major problem in many peoples nowadays, it is a clinical condition caused by *Malassezia* species which is of great cosmetic concern all over the world. Dandruff cannot be completely eliminated but can only be controlled by fungistatic ingredients in anti-dandruff shampoos. Many antidandruff shampoos in Tripoli markets available from various sources, imported from different countries, whether medicated or non-medicated marketed to combat the problem of dandruff. The aim of the present study was to evaluate different medicated and non-medicated anti-dandruff activity of shampoo on the bases of scientifically measurable properties to judge their safety and efficacy. Twelve shampoos were randomly collected and purchased from different markets in Tripoli and were compared and evaluated according to their physicochemical properties including organoleptic characterization by visual inspection, determination of pH, assurance of solid content, viscosity, surface tension measurement, foam stability, dirt dispersion, cleansing efficiency, wetting time determination. Additionally, antimicrobial activity, skin irritation tests, and evaluation of label information on the package were conducted. Stability testing was also performed under different temperature and humidity conditions.

The evaluated shampoos were visually attractive in color, with pleasant fragrances, smooth consistency with no aggregation, and good froth ability, detergency, good cleansing, and low surface tension. The pH range was from 6.14 to 8.88, The percentage of solid contents ranges from 15.5% to 38.5%, viscosity was in range of 0.9238-1.7199 CST, surface tension was found to be 27-33 mN/m, and foam volume range from 110 - 190 ml. cleaning action range from 35.5% - 68%, wetting time range from 13 to16.9 second. The antimicrobial activity to investigate antibacterial and antifungal activities was done using cup plate method against *Staphylococcus aureus*, *Malassezia furfur*, *Candida albican* and the zone of inhibition was observed all the selected shampoos were proved affective against antibacterial but remarkable result against fungi and has shown 12-26 mm inhibitory action, the highest zone of inhibition was obtained by shampoo number 6 against *Candida albican*. Stability and acceptability of formulations during the storage for three months in 4 and 45 °C did not markedly affect the characteristic of shampoo so indicated physical and chemical stability.

All these are the ideal characters for good quality of shampoo to be used in daily life. The study indicates that medicated anti-dandruff shampoos were proved to be more effective compered to non-medicated shampoos.

Keywords- *Shampoo; Antidandruff; Shampoo evaluation; Antidandruff efficacy.*

INTRODUCTION

Shampoos are probably the most widely used cosmetic products for daily cleansing of the hair and scalp.[1] A shampoo may be described as a cosmetic product for washing of the hair and scalp, leaving the hair soft, lustrous, and manageable. However, there are some specialty shampoos that contain special ingredients with unusual properties, such as antidandruff, nutrition, etc.[2]

Cleanliness of hair and scalp are among the most important personal life consideration today.[3] Dandruff is clinical condition caused by *Malassezia* (*Pityrosporum*) species is of great cosmetic concern all over the world. *Pityrosporium ovale* is strongly suspected to play a role in the manifestation of seborrheic dermatitis.[4] Dandruff is known to be controlled by fungistatic ingredients in antidandruff shampoos. Herbal formulations have growing demand in the world market.[5] The natural remedies are more acceptable in market due to their safety and fewer side effects. Antidandruff shampoos, nutritional shampoos containing vitamin, aminoacids and proteins hydrolysate.[6] Currently available treatment of dandruff includes therapeutic use of zinc pyrithione, salicylic acid, imidazole derivatives, glycolic acid, steroids, and sulphur and coal tar derivatives.[7] However, these agents

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showcertain limitations, either due to poor clinical efficacy or due to the compliance issues. Furthermore, these drugs are unable to prevent recurrence.

Antidandruff shampoos may contain active ingredients like zinc pyrithione, ketoconazole and selenium sulfide which are responsible for antibacterial and antifungal activities. In addition to type and concentration of active ingredient, the efficacy of a shampoo is also influenced by formulation.[8=11]Various natural plant extracts are known for their antidandruff activity; studies evaluating antifungal effect of essential oils have also been reported.[12]

Common hair problems include hair fall, premature graying, dandruff, and split ends. The main causes of these issues are stress, scalp infections, hormonal imbalances, poor nutrition, and excessive use of chemical-based shampoos. In this context, antidandruff shampoos are often used as multipurpose products for hair treatment, offering effective results with fewer side effects for daily use.

Various synthetic, herbal, medicated and non-medicated shampoos are available in local market, making it essential to assess their performance, quality, and effectiveness. Shampoo evaluation involves quality control tests, including visual assessment and measurement of physicochemical properties aimed to evaluate several antidandruff shampoos available in local market in Tripoli Libya, based on scientifically measurable physiochemical properties. To evaluate the formulations, quality control tests were performed; including visual assessment and measurement of physicochemical properties such as pH, viscosity, surface tension, foam volume, and wetting ability were performed. Additionally, to assess product quality, specific tests were conducted for shampoos formulations including determination of percentage of solid content and wetting ability, foam stability, surface tension, skin and eye irritation test, thermal and mechanical stability, antimicrobial activity and detergency tests. Furthermore, the accuracy of label information was also evaluated.

MATERIALS AND METHODS

A group of twelve antidandruff shampoos from different manufacturing brands containing different materials according to the country of manufacture were collected randomly and purchased from the local markets in Tripoli to conduct several tests for their quality by different methods of analysis. The general information of each marketed shampoos was listed in Table 1 and ingredients of each shampoo were listed in Table 2. The collected antidandruff shampoos were numbered and evaluated regardless of the names and sources according to the standard specifications, for their physicochemical properties including organoleptic characterization, pH measurement, and viscosity were performed. Also, to assure the quality of the products, specific tests for shampoos including determination of percentage of solid content, wetting time, foam stability, surface tension, skin and eye irritation test, thermal and mechanical stability, antimicrobial activity and detergency tests as well as label information were carried out. All tests were conducted three times for all parameter measured. Material used include distilled water, litmus paper, measuring cylinder 250 ml, wool yarn, Vaseline, Indian ink, Sabouraud dextrose agar, Blood agar media, and filter paper.

Table 1: General information on anti-dandruff shampoos used during the research work

No.	Name of anti -dandruff shampoo		Active Ingredients	Man. & Exp. Date	Manufacturer	Country	Price LYD
1	Ketovid		Ketoconazole	01/21 05/24	Hovid Bhd	Malaysia	14
2	Nizoral		Ketoconazole	08/21 07/23	Janssen Pharmaceutica	Belgium	32
3	Floslek		-	E 04/24	Laboratonium kosmetyczne	Poland	65
4	Vavo		Ketoconazole	11/20 11/23	Tabuk Pharmaceutical Mfg	Saudi Arabia	18

No.	Name of anti -dandruff shampoo		Active Ingredients	Man. & Exp. Date	Manufacturer	Country	Price LYD
5	Seba med		Piroctone Olamine	06/21 06/24	Sepa pharm	Germany	54
6	Ducray		Piroctone Olamine	03/22 03/25	Laboratories Dermatology Ducray	France	74
7	Sunsilk		Pyrithione zinc	02/22 02/25	Unilever	Tunisia	9
8	Vatika		Pyrithione zinc Climbazole	09/21 08/23	Naturella LLC	UAE	10
9	Head & Shoulder		Piroctone Olamine	05/22 04/25	Ismail Abu Dawood Company	Saudi Arabia	10
10	Clear		Pyrithione zinc	-	Unilever	-	9
11	Life bouy		Pyrithione zinc	07/21 12/23	Unilever	India	8
12	Souplesse		Pyrithione zinc	03/22 03/25	Schwarzkopf & Henkel	Tunisia	11

Table 2: Listed ingredients of the selected shampoos

NO.	Ingredients
1	Ketoconazole 2% w/w, preservatives: phenoxyethanol and parabens 0.25% w/w.
2	Ketoconazole 20mg/g.
3	Not present
4	Ketoconazole.
5	Piroctone olamine.
6	Water, sodium laureth sulfate, glycerine, decyl glucoside, undecylenaidoprpyl betaine, lauryl betaine, ethylhexylglycerin, fragrance, glycolic acid, guanidine carbonate, piroctone olamine, polyquaternium-10, sodium chloride, sodium hydroxide, tocopherol, trisodium ethylenediamine disuccinate.

NO.	Ingredients
7	Water, sodium laureth sulfate, cocamidopropyl betaine, dimethiconol, sodium chloride, dimethycone, phenoxy ethanol, cariomer, zinc pyrithione, parfum, citric acid, sodium hydroxide, sodium salicylate, guar hydroxypropyltrimonium chloride, TEA-dodecylbenzenesulfonate, zinc sulfate, TEA-zinc sulfate, laureth-23, poloxamer407, sodium benzoate, polypropylene glycol-9, laureth-4, polynaphthalene glycol-4, xanthan gum, cellulose gum, potassium sorbate, caprylyl glycol, banthenol oil, ascorbic acid, tocopheryl acetate, niacinamide, biotin, citronellol, hexyl cinnamal, limonene, linalool.
8	Water, sodium laureth sulfate, cocamide MEA, dimethiconol, sodium chloride, cocamidopropyl betaine, glycol distearate, zinc pyrithione, citrus limon oil, melaeuca alternifolia oil, rosmarinus officinalis oil,menthe piperita oil, yogurt filtrate, parfum, climbazole, guar hydroxypropyltrimonium chlorid, amodimthicone trideceth-12, cetrimonium chloride, sodium hydroxide, carbomer, panthenol, glycerin, sodium benzoate, potassium sorbate, lactic acid, TEA-dodecylbenzenesulfonate, magnesium chloride, magnesium nitrate, methylchloroisothiazolinone, amyl cinnamal, butyl phenyl methylpropional, limonene, linalool.
9	Water, sodium laureth sulfate, sodium lauryl sulfate, sodium xylenesulfonate, cocamidopropyl betaine, glycol distearate, sodium citrate, sodium chloride, parfum, , piroctone olamine, dimethiconol, menthol, citric acid, dimethicone, sodium benzoate, guar hydroxypropyltrimonium chloride, TEA-dodecylbenzenesulfonate, tetrasodium EDTA, sodium hydroxide, trideceth-10, hexyl cinnamal, linalool, magnesium nitrate, methylchloroisothiazolinone, propylene glycol, triethylene glycol, magnesium chloride, Cl 42090, methylisothiazolinone.
10	Water, sodium laureth sulfate, dimethiconol, cocamidopropyl betaine, dimethicone, , sodium chloride, parfum, zinc pyrithione, phenoxyethanol, , carbomer, sodium salicylate, sodium hydroxide,citric acid, guar hydroxypropyltrimonium chloride, TEA-dodecylbenzenesulfonate, tea-sulfate, zinc sulfate, glycerin, sodium benzoate, poloxamer 407, laureth-23, cyclotetraasiloxane, sodium polynaphtholenesulfonate, helianthus annuus (sunflower)seed oil, laureth-4, niacinamide, glycine, PEG-4, cellulose gum, DMDM hydontoin, potassium sorbate, xanthan gum, butylene glycol, methylchloroisothiazolinone, iodopropyl butylcarbamate, zingiber officinale root extract, trideceth-9, PEG-40 hydrogenated castor oil.
11	Water, sodium laureth sulfate, cocamidopropyl betaine, dimethiconol, parfum, sodium chloride, phenoxyethanol, zinc pyrithione, carbomer, sodium salicylate, guar hydroxypropyltrimonium chloride, TEA-dodecylbenzenesulfonate, citric acid, sodium hydroxide, tea-sulfate, zinc sulfate, cyclotetrasiloxone, sodium benzoate, helianthus annuus (sunflower)seed oil, sodium polynaphtholenesulfonate, cellulose gum, DMDM hydontoin, panthenol, lysine hcl, hydrolyzed milk protein, iodopropynyl butylcarbamate, methylisothiazolinone, sodium sulfate, alpha-isomethyl lonone, benzyl benzoate, benzyl salicylate, citronellol, coumarin, geraniol, hexyl cinnamal, linalool, Cl 42090, Cl 47005.
12	Water, sodium laureth sulfate, cocamidopropyl betaine, sodium chloride, PEG-7 glyceryl cocoate, zinc pyrithione, hydrolyzed soy protein, niacinamide, magnesium chloride, sodium benzoate, citric acid, hydrogenated castor oil, fragrance, guar hydroxypropyltrimonium chloride, sodium polynaphthalenesulfonate, limonene, linalool, phenoxyethanol, propylene glycol.

1. *Physical appearance / Visual inspection*

The sample marketed preparations were evaluated in terms of their clarity, colour, odour, and texture.[13]

2. *Determination of pH*

The pH of 1% or 10% v/v shampoo solution in distilled water was measured by using digital pH meter at room temperature 25 ± 2 °C.[14]

3. *Determine percent of solid content*

A clean, dry evaporating dish was weighed, and 4 grams of shampoo sample were accurately transferred into it. The dish and shampoo were weighed together. The exact weight of the shampoo was calculated and the evaporating dish with the shampoo was placed on a hot plate until the liquid portion evaporated. The weight of the shampoo (solids) after drying was calculated.

4. *Dirt dispersion test*

A 1% solution of each shampoo (1 g of sample in 100 ml of water) was prepared and one drop of India ink was added and the test tube was stoppered and shaken ten times.

The amount of ink in the foam was estimated as none, light, moderate, or heavy. Shampoos that cause the ink to

concentrate in the foam are considered poor quality. The dirt particles should remain in the aqueous phase. Dirt that remains in the foam will be difficult to rinse away and will be re-deposited onto the hair.[15]

5. *Wetting time test*

Wetting time was calculated by noting the time required by the canvas paper to sink. The canvas was cut into 1 inch diameter discs having an average weight of 0.44 gram. The disc was floated on the surface of shampoo solution of 1% w/v and the stopwatch started. The time required for disc to begin to sink was noted down as wetting time.[13]

6. *Foam stability test*

Foaming ability was assessed using cylinder shake method. Briefly, 50 mL of the 1% shampoo solution was transferred into a 250 ml graduated cylinder; which was then covered with one hand and shaken 10 times. The total volume of the foam content after 1 min of shaking was recorded.

Foam stability was evaluated by recording the foam volume after 5 min. 10 min and 15 min of shake test.[16]

7. *Surface tension measurement*

Surface tension measurements were carried out using a solution of 10% shampoo diluted in distilled water at room temperature.

The heart of the instrument is a torsion wire which is connected to the measuring ring. The ring is immersed in the sample and slowly pulled out by lowering the liquid. The surface tension (SFT) causes the wire to twist, the deflection of which is shown on a calibrated scale by means of a drag pointer. The pointer moves up to the maximum force and stops after the lamella has been torn off the ring so that the SFT can be read.[17]

8. *Viscosity measurement*

Falling Ball Viscometer uses the simple but precise Höppler principle to measure the viscosity of Newtonian liquids by measuring the time required for a ball to fall under gravity through a sample-filled tube. The tube is mounted on a pivot, allowing it to be rotated 180° for immediate repeat measurements.

Three replicate measurements were recorded and the average time it takes for the ball to fall is the result. A conversion formula turns the time reading into a final viscosity value.

9. *Cleaning action*

Five grams of wool yarn were placed in grease, after that it was placed in 200 ml water containing 1 gram of shampoo in a flask. Temperature of water was maintained at 30±2°C. The flask was shaken for 4 minutes at the rate of 50 times a minute.

The solution was removed and sample was taken out, dried and weighed. The amount of grease removed was calculated

10. *Skin irritation test*

A 1% v/v shampoo solution was constituted in distilled water and applied over the skin. The application was allowed to remain in contact for 2 hr.[18]

11. *Antimicrobial test*

The antifungal activity of different shampoos on *Malassezia furfur* was investigated where the agar is poured into a petri dish and allowed to cool and then the organism was spread uniformly over the agar surface. Wells were punched aseptically with cork borer round the margin of the plates equidistantly (3cm apart). In to each of these wells 50 microliters of sample solutions were placed carefully. The plates were allowed to undergo diffusion for 30 minutes followed by incubation at 37˚C for 72 hrs. Zones of inhibition were observed in all cases, with the diameter of the each zone providing a rough indication of the relative activities of different anti-microbial substances.

Candida albicans were employed for testing antifungal activity using the cup-plate method. The culture was maintained on sabouraud's agar slants. 20 ml of melted sabouraud's agar medium was inoculated with 0.2 ml of 72 hour old suspension of *Candida albicans* and poured in to a petri dish. he cups (10 mm diameter) were punched in the petri dishes and filled with 0.05ml of a solution of the sample dissolved in DMSO (10 ml of shampoo in 100 ml of DMSO). The plates were kept for diffusion at 40˚C for one hour and incubated at 300˚C for 48 hours. After the completion of incubation period, the inhibition zones in millimeter were measured.[19, 20]

Anti-bacterial activity was investigated by taken the loopful culture of *staphylococcus aureus* (ATCC6532) aseptically and transfer to sterilized and cooled 100 ml SCDM (broth). Mix well then incubate the broth at 37˚C for 24 hrs. Sterilized SCD agar (100 ml) is cooled to 40°C and mixed with 5 ml of 24 hrs old pre inoculated culture. The wells are dig on agar plates with sterilized well digger aseptically. Take 0.5 ml of 1% sample, add to well aseptically. Incubate the plates at 37˚C for 24 hrs to 48 hrs. Observe the effectiveness of sample on culture growing on the agar plate and the zone of inhibition around each well containing can be observed on different sample.[19,20]

12. *Stability studies*

Thermal stability of the shampoo formulations was evaluated by storing samples in glass tubes under controlled conditions: at 45 °C with 75% relative humidity in a humidity chamber, at 4 °C in a refrigerator, and comparing them to the same shampoos kept at a room temperature of 25˚C.

Their appearance and physical stability were inspected for a period of 3 months at interval of one month. Parameters such as physical appearance, pH, viscosity, percentage of cleaning action, and foam stability were measured during this period

RESULTS

Table 3: Evaluation for Physical appearance / Visual inspection

No	Color	Odor	Consistency	Clarity	Foam Producing
1	Pink	Rose	Smooth	Not clear No aggregation	+ve
2	Red	Characteristic	Smooth	Clear No aggregation	+ve
3	Yellow	Characteristic	Smooth	Clear No aggregation	+ve
4	Orange	Characteristic	Smooth	Clear No aggregation	+ve
5	White	Characteristic	Smooth	Clear No aggregation	+ve
6	Colorless	Baby powder	Smooth	Clear No aggregation	+ve
7	White	Fruity	Smooth	Not clear No aggregation	+ve
8	Pale Yellow	Lemon	Smooth	Not clear No aggregation	+ve
9	Gray	Mint	Smooth	Not clear No aggregation	+ve
10	White	Characteristic	Smooth	Not clear No aggregation	+ve
11	Pale Blue	Baby powder	Smooth	Not clear No aggregation	+ve
12	White	Characteristic	Smooth	Not clear No aggregation	+ve

Table 4: Evaluation of the tested shampoos for physicochemical and performance parameters, including pH, solid content, dirt dispersion, wetting time, surface tension, viscosity, and cleaning efficiency

No	pH	Solid content %	Ink concentration in foam	Wetting time (sec)	Surface tension (mN/m)	Viscosity of shampoo	Cleaning action %
1	7.69	%23.75	Moderate	16.32 ± 1.00	32	1.1287	57.2%
2	8.88	%21.75	Moderate	16.90± 1.00	32	1.648	67%
3	6.43	%29.25	Moderate	15.54 ± 1.00	30	1.7199	62.7%
4	8.11	%27.00	Moderate	14.50 ± 1.00	30	1.6353	63.5%
5	6.74	%15.75	Fast	15.40 ± 1.00	33	1.6956	46.7%
6	7.92	%15.50	Moderate	14.30 ± 1.00	27	1.4845	68%
7	7.63	%27.75	Fast	15.60 ± 1.00	32.5	1.2172	51.3%
8	8.42	%25.50	Moderate	16.40 ± 1.00	31.5	1.2235	49.5%

No	pH	Solid content %	Ink concentration in foam	Wetting time (sec)	Surface tension (mN/m)	Viscosity of shampoo	Cleaning action %
9	7.15	%38.50	Moderate	13.00± 1.00	33	1.2163	35.5%
10	8.69	%23.25	Moderate	15.43 ± 1.00	32	0.9238	60%
11	7.83	%18.00	Moderate	14.90± 1.00	30	1.3315	58.1%
12	6.14	%26.75	Fast	15.00 ± 1.00	30.5	1.4925	52.9%

Table 5: Evaluation of foam stability of tested shampoos

No	0 min	5 min	10 min	15 min	Foam stability
1	110	110	100	90	Stable
2	110	110	100	100	Stable
3	160	150	140	140	Stable
4	160	160	150	140	Stable
5	130	120	110	100	**Not stable**
6	170	170	160	140	**Not stable**
7	140	140	130	120	Stable
8	130	130	130	120	Stable
9	190	190	190	180	Stable
10	130	110	95	80	**Not stable**
11	150	150	140	130	Stable
12	140	140	130	125	Stable

Table 6: Evaluation of antimicrobial activity shows the inhibition zones in mm of tested shampoos

Shampoo no.	*Staphylococcus aureus*	*Malassezia furfur*	*Candida albican*
1	12 mm	19 mm	20 mm
2	16 mm	20 mm	18 mm
3	14 mm	22 mm	16 mm
4	18 mm	21 mm	23 mm
5	18 mm	20 mm	15 mm
6	23 mm	15 mm	26 mm
7	12 mm	17 mm	15 mm
8	25 mm	16 mm	24 mm
9	15 mm	18 mm	20 mm
10	12 mm	15 mm	14 mm
11	15 mm	15 mm	16 mm
12	20 mm	19 mm	24 mm

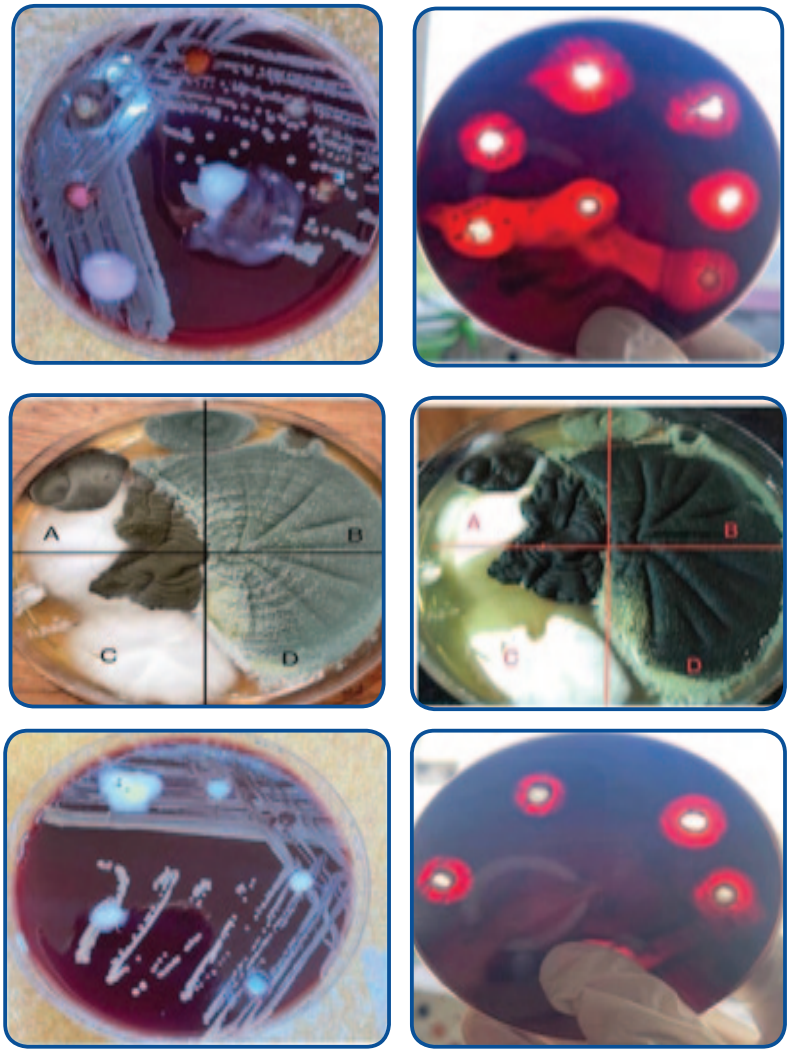


Figure 1: Antimicrobial activity of different shampoos under investigation showed zones of inhibition

Table 7: Availability of information on the label of the shampoo brands

No.	Name and Volume	Contents	Instruction	Warning	Batch	Exp. date	Man. Date	Storage conditions
1	Present	Present	Present	Present	Present	Present	Present	Present
2	Present	Without additives	Present	Present	Present	Present	Present	Present
3	Present	No	Present	Present	No	Present	No	No
4	Present	Without additives	No	Present	Present	Present	Present	Present
5	Present	Without additives	Present	Present	Present	Present	Present	Present
6	Present	Present	Present	Present	Present	Present	Present	No
7	Present	Present	Present	Present	Present	Present	Present	Present
8	Present	Present	Present	Present	Present	Present	Present	Present
9	Present	Present	Present	Present	Present	Present	Present	No
10	Present	Present	Present	No	Present	No	No	No
11	Present	Present	Present	Present	Present	Present	Present	Present
12	Present	Present	Present	Present	Present	Present	Present	Present

Table 8: Stability study of shampoos under investigation

Parameters	1 month 45C^0	3 month 45C^0	1 month 4C^0	3 month 4C^0
Color	No change	No change	No change	No change
Odor	No change	No change	No change	No change
Consistency	1,3,9	1,3,9	1	1
Clarity	No change	No change	No change	No change
Foam production	No change	No change	No change	No change
pH	No change	No change	No change	No change
Viscosity	No change	No change	No change	No change
Foam stability	5,6,10	5,6,10	5,6,10	5,6,10,11
Cleansing activity	No change	No change	No change	No change

DISCUSSION

The results of visual inspection of selected marketed shampoos were listed in Table 3. As can be seen, all samples with various color were smooth, characteristic smell, transparent with no aggregation and had good characteristic with respect to foaming.

The pH of shampoos has been showed to be important for improving and enhancing the qualities of hair, also helps in minimizing irritation to the eyes. Most shampoos are formulated as either neutral or slightly alkaline to minimize the damage to hair. As seen from Table 4, all the shampoos were had pH range between 6.14 and 8.8 near to the skin pH. Thus shampoo number 2, 4, 8 and 10 were considered slight alkaline.

Good shampoos usually have 20%-30% solid content as it is easy to be applied and rinse out from the hair. If it doesn't have enough solid it will be too watery and wash away quickly, similarly too many solids will be hard to work into the hair or too hard to wash out. The percentage solid contents of the tested shampoos were tabulated in Table 4, and were found within the range and are expected to wash out easily except shampoo number 5,6,11 with less solid and number 9 more solid.

Dirt dispersion is an important parameter for evaluating the cleansing efficiency of shampoos. Shampoos that allow ink to concentrate in the foam are considered substandard, as such dirt is difficult to rinse off and may redeposit onto the hair and scalp. Effective shampoos retain the ink in the aqueous phase, facilitating its removal. In this study, all shampoo samples demonstrated satisfactory dirt dispersion, with ink remaining in the water layer and absent from the foam. This indicates good cleansing performance and reduces the risk of conditions such as seborrheic dermatitis. Furthermore, all tested samples exhibited comparable detergency power. The cleaning action was evaluated using wool yarn coated with grease, simulating the primary cleansing function of shampoos

The wetting ability of a surfactant is dependent on its concentration and is commonly used to test its efficacy. The canvas disc method is quick, efficient and reliable test to evaluate the wetting ability of a shampoo. From Table 4 it can be concluded that shampoo number 9 contains the maximum concentration of detergents because it has the least wetting time by contrast number 2 exhibited maximum wetting times so, it contains minimum concentration of detergents.

Surface tension indicates the amount of surfactant present in shampoo, the lower the surface tension, the greater the cleaning ability of the shampoo. All the tested shampoo showed similar reduction in surface tension ranging from 27 to 33, among all the shampoos tested number 6 has the lowest surface tension indicating that it has the strongest cleaning ability.

The viscosity was in the range 0.9 to 1.7 which indicates the great fluidity, which makes formulation easy to apply on and easy to spread on hair. All shampoos did not show any skin or eye irritation on application showing the safety of the constituents present foam production and stability are important parameters influencing consumer acceptability and satisfaction; therefore, they are essential evaluation criteria for shampoo formulations. Shampoo number 1, 2 and 10 produce the foam volume exceeding 100 ml (110 ml each respectively) whereas shampoo number 9 generated the highest foam volume of 190 ml. The foam generated by most formulations was compact, uniform, dense and stable. However, the foam from Shampoos No. 5, 6, and 10 exhibited poor stability.

No skin irritation was found of all tested shampoo. However mild eye irritation was shown after 2 seconds by all formulation including marketed shampoos manifested as slight redness, stinging sensation disappeared after few minutes. These adverse reactions may occur due to fragrances or other additives in the formula.

CONCLUSION

In this study, twelve shampoo brands were evaluated in terms of their visual appearance, pH levels, foam formation, foam stability, viscosity, wetting time, surface tension, and dirt dispersion, cleaning action %, anti-microbial activity to assess the quality of these shampoos. The results indicate that all the tested shampoos met the requirements of the standards. Visual inspection confirmed favorable sensory attributes such as smooth consistency, characteristic odor, and absence of aggregation, with all formulations producing sufficient foam. pH values ranged from 6.14 to 8.88 with acceptable dermal tolerability. However shampoos number 2, 4, 8 and 10 were slightly alkaline and may require pH adjustment to minimize the risk of scalp irritation. Solid content analysis indicated that all but a few formulations number 5, 6 and 11 were within the desirable range 20-30%, contributing to optimal consistency and rinseability. Shampoo number 9 despite exhibiting superior foam volume and surface concentration indicated by shortest wetting time and highest solid content, demonstrated the lowest cleaning efficiency 35.5%, possibly due to excessive viscosity affecting spreadability and rinsing. All shampoos demonstrated favorable dirt dispersion and detergency, with ink retained in the aqueous phase and effective grease removal from wool yarns. Foam quality and stability were acceptable in most formulations. However, shampoos 5, 6 and 10 exhibited poor foam stability over time, which may negatively influence user perception despite their cleansing abilities. Surface tension values fell within the standard range 27-33mN/m. Shampoo number 6 had the lowest surface tension, indicative of high cleaning potential, which was consistent with its high cleaning action percentage 68%. Viscosity assessments confirmed good product fluidity, facilitating ease of application, while safety tests revealed no significant dermal or ocular irritation, except for transient eye discomfort in a few cases. Labeling compliance varied, with some brands missing critical information such as batch numbers, expiry dates or additives disclosure, emphasizing the need for regulatory enforcement. Antimicrobial studies demonstrated varying degree of efficacy against *Staphylococcus aureus, Malassezia furfur*, and *Candida albicancs*. Notably shampoos 4, 6, 8 and 12 exhibited broader and stronger antimicrobial activity, with inhibition zones exceeding 20mm in most cases. Accelerated and cold storage stability tests indicated that most formulations maintained their physicochemical integrity over 3 months. Nevertheless, formulations 5, 6 and 10 consistently exhibited poor foam stability, suggesting potential degradation of foaming agents or interaction with excipients under stressed conditions. However, there were slight differences between brands due to their various manufacturing processes, laboratory conditions, and other reasons.

It is difficult to determine which shampoo is the best amongst those tested because there is no formulation fared better than the others in all the performed tests. It is also difficult to rank the tests according to their importance, as each is important in its own right. It was observed that many characteristics of these shampoos were in the standard range, although some were out of range for some shampoos. Thus, it is clear that, all tested shampoos can be alternatives for each other since they had comparable results for the different tests.

Further long term studies may be recommended to prove safety, stability and efficacy of different types of shampoos. Additionally improvements in foam stability, pH optimization, and full compliance with labeling regulations are recommended to enhance product performance, consumer acceptance, and regulatory alignment to make it suitable as commercial products.

ACKNOWLEDGEMENT

The authors would like to thank the staff in Industrial Pharmacy laboratory in Tripoli University for the generous help, technical support and facilities provided.

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