OIL INFUSED SHAMPOO: CURRENT HAIR CARE TREND

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A B S T R A C T

Regular use of synthetic hair-care products & overexposure to grooming devices leads to dry & lifeless hair. An attempt was made to formulate oil infused shampoo with sunflower oil using Miracare SLB. The nutrient rich, weightless oil imparted good conditioning and smoothness to rough hair surface indicated by SEM studies of treated hair with shampoo containing 3% oil. Formulated shampoo was found to be comparable in cleansing and foaming properties with marketed shampoo. Subjective analysis showed 75% of approval rate for easy rinse off and cleansing performance whereas 80% approval rate for conditioning attributes without leaving hair oily.

Keywords: Oil-infused shampoo, Miracare SLB-365, Liquid crystal structure , Conditioning, Sunflower oil

1. Introduction

Today's hectic lifestyle, increased pollution level and overexposure to grooming devices and harsh synthetic ingredients used for modifying hair has lead to frizzy, dry, damaged and lifeless hair. Also frequent cleansing action of the shampoo removes the protective layer of oil that surrounds the hair. This usually needs to be replenished which is achieved by use of conditioning agent like natural oil. A major function of conditioner is to protect hair's structural elements, especially the cuticle, from chipping and fragmenting due to grooming habits and chemical exposure (Schuller & Romanowski, 2017). Consumers are always in search of 2-in-1 product that will clean, condition and nourish hair simultaneously. Hair tonic and conditioners are being formulated as shampoos and constitutes large market share of hair care products (Wu *et al.*, 2010). Conditioning shampoo cleans the hair surface, at the same time ensures smooth, manageable and shiny hair. During the past few decades, there has been a dramatic increase in the use of natural ingredients in cosmetic products (Arora, Nanda & Karan, 2011). There is plethora of natural materials, like lanolin ethoxylated derivatives, liquid paraffin, sunflower oil and sesame oil which are being used as conditioning agent. These materials get deposited in the hair's keratin and achieve surface lubrication (Evans, 2017). SFO is the second most utilized base oil in hair care industry due to its non-freezing, light and non-greasy nature (Rele & Mohile, 2003). It is obtained from the flowering plant of *Helianthus annuus L.* belonging to family *Asteraceae.*—Sunflower oil is rich in polyunsaturated fatty acids, stabilized polyphenols, vitamins like A, B, C and E and minerals like iron, potassium and calcium (Orsavova *et al.*, 2015). Its protective and reparative effect on hair and skin is attributed to its high content of triglycerides of linoleic acid (Putt & Carson, 1969). Being exceptionally light and non-greasy, SFO becomes promising agent for oil infused hair care formulation. Incorporation of vegetable oil into shampoo formulation is achieved using high performance surfactant system, Miracare SLB. It is a blend of anionic and amphoteric foaming surfactant and also acts as structuring agent. It is unique liquid structured system, which form liquid crystal structures in cleansing formulations and stabilizes high levels of conditioning oils in formulations (Solvay (Zhenjiang) Chemicals). Hence in present study, an attempt was made to formulate conditioning shampoo using sunflower oil which is incorporated into the formulation with the help of structured liquid system. The formulated shampoo was evaluated for its stability, performance and physicochemical properties using standard

methods.

2. Experimental

Oil sample and chemical ingredients required for formulation were acquired from assured suppliers of pharmaceutical grade chemicals. Miracare SLB-365/G and Jaguar C17 were gift samples from Solvay Chemicals Co., Ltd., China. Marketed shampoo (Dove Shampoo® Unilever) was purchased from local market.

2.1 Formulation of oil infused shampoo

2.1.1 Formulation

Before proceeding for formulation, sunflower oil sample was evaluated for acid value and saponification value to check purity level of the sample. Then aqueous solution of Jaguar C-17, cationic quaternary ammonium derivative of guar gum, (0.35%) was added to Miracare SLB-365/G (40%) under moderate agitation (150 rpm). Conditioning oil (1%-3%) with BHT (0.05%) was emulsified at 300 rpm with surfactant system. Finally Sodium Chloride, Citric acid, preservative, color and perfume were added to the shampoo (Mottram, 1996). Natural oil, SFO (1%-3%) was used as conditioning agent in shampoo. Table 1 shows desirable shampoo base formulation with 3% oil incorporated in it.

Table 1 Composition of formulated oil infused shampoo

Ingredients	Quantity (%)
Miracare SLB-365/G	40.0
Sunflower oil	3.0
Jaguar C-17	0.35
BHT	0.05
Sodium Chloride	2.0
Sodium Benzoate	0.5
Citric acid	2.0
Perfume	0.5
Color	0.3
Aqua	Up to 100

2.1.2 Scanning Electron Microscopy (SEM)

Surface morphology of the hair treated with oil infused shampoo was examined by Scanning Electron Microscopy (Leo 430, Leo Electron Microscopy Ltd., England) (Kumar & Mali, 2010). The hair samples were mounted directly on the SEM sample stub. The micrographs were taken at magnification 1000x**.** The photomicrographs were taken for untreated and test shampoo (1%-3%) treated hair samples. SEM studies showed satisfactory conditioning effect with shampoo containing 3% sunflower oil, so this was further subjected to various standard tests for evaluation of product.

2.2 Evaluation of Oil-infused Shampoo

The formulated conditioning shampoo with oil infused into it was evaluated as per IS 7884:1992 (BIS, 2004) using various quality control tests. Formulated shampoo was compared with marketed
shampoo for physicochemical parameters. Formulated oil infused shampoo was subjected to stability studies and subjective analysis.

2.2.1 Determination of pH

The pH of 10% solution of formulated and marketed shampoo in distilled water was measured using pH meter (MIFA system) at room temperature (Tarun *et al.*, 2014).

2.2.2 Determination of % solid content

The shampoo (4 g) was placed in a previously clean, dry and weighed evaporating dish. The dish and shampoo was weighed again to confirm the exact weight of the shampoo. The liquid portion of the shampoo was evaporated by placing the evaporating dish on the hot plate. The weight and thus % of the solid contents of shampoo left after complete drying was calculated (BIS, 2004). The same procedure was employed for formulated and marketed shampoo.

2.2.3 Surface tension measurement

Surface tension of 10% w/v of formulated and marketed shampoo was determined using stalagmometer at room temperature (Gaud & Gupta, 2001).

2.2.4 Determination of foam volume and stability

Foam volume and stability of shampoo under study and marketed shampoo was determined by using cylinder shake method. 50 mL of the 1% shampoo solution was placed into a 250 mL graduated cylinder and 10 upside down complete shakes were given with one hand covered on it. 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 (Klein, 2004).

2.2.5 Determination of detergency and cleansing action

Cleansing power is evaluated by the method of Thompson (Mainkar & Jolly, 2000). Briefly, hair switches were washed with a 5% Sodium lauryl sulfate solution, dried and then divided into 3g weight groups. The mixture of n-hexane containing 10% artificial sebum and hair switches (3g) was shaken for 15 minutes at room temperature. Then hair samples were removed dried at room temperature by evaporating the solvent and their sebum content was determined. Hair sample was divided into two equal parts, one washed with 0.1 ml of the 10% test shampoo and the other considered as the negative control. After washing and drying, the sebum remained on hair samples was extracted with 20 ml n-hexane and weighed and eventually the percentage of detergency power was calculated.

2.2.6 Preliminary Stability studies

The stability, organoleptic properties (color, odor & pH) and rheological stability (viscosity) of formulated oil-infused shampoo was studied. The formulated oil infused shampoo sample was placed at 4^0C, Room Temperature and 45^0C to assess accelerated stability study for a period of 3 months. Changes in physical parameters like colour, odour and pH and viscosity were observed at 1 month interval. Viscosity was determined using Brookfield viscometer (Brookfield Engineering Laboratories Inc. (USA), spindle no.6 at 10 rpm (Ishii *et al.*, 1997).

2.2.7 Consumer Testing

Twenty-five healthy female respondents, ages 18-50 participated in this study. Each respondent was given a sample of formulated oil infused shampoo and was asked to shampoo at least three times a week for 3 consecutive weeks. At the end of three weeks, they were probed on shampoo performance and conditioning attributes in the form of agreement or non agreement (Rizer, Sigler & Miller, 2017).

3. Results & Discussion

3.1 Formulation of Oil infused shampoo

Human hair becomes soiled due to contact with the surrounding atmosphere and from sebum secreted by the scalp. This creates necessity of shampooing hair with frequent regularity. Shampoo cleans hair by removing excess soil and sebum. However, frequent shampooing can result in several after-shampoo problems like hair become dry, tangled and results in loss of lustre, due to removal of natural oils or other hair moisturizing materials. There has been observed increased level of static and fly-away on drying of hair. To alleviate these issues, separate hair conditioners or conditioning shampoos are used. Conditioning Shampoo is a 2-in-1 approach with both cleaning and conditioning effect and thus more preferred by consumers. Hence an attempt was made to formulate a conditioning shampoo with a natural conditioning agent that is sunflower oil infused into it. Sunflower oil is rich in essential polyunsaturated fatty acids like oleic acid (28.7%) and linoleic acid (60%) (Lee *et al.*, 2004) and thus has moisturizing and lubricating effect on hair. SFO sample was checked for Saponification value (191) and acid value (4.8) and was found to be in the range of standard values (SAP value-188-194, Acid value –Not more than 6) (BIS, 2002). Infusion of oil in shampoo was achieved by Miracare SLB-365, which delivers oil to hair surface, stabilizes the product and provides dense and rich foam, even in presence of oil. It is desirable to have a shampoo capable of depositing conditioning aid on hair surface. To achieve this, a water soluble quaternary ammonium derivative of guar gum, Jaguar C-17, was added in minimum proportion in shampoo formulation which is known to improve deposition of functional ingredient, SFO, on hair surface (Wells & Johnson, 2005) and improves rheological properties of product (Harusawa *et al.*, 1991). Thus a shampoo base incorporated with SFO in the range of 1% to 3% yielded an acceptable formulation. Scanning Electron Microscopy provides dramatic illustrations of hair surfaces. So, surface morphology of the hair treated with Oil infused shampoo (1-3%) was examined by SEM. SEM studies of untreated hair revealed rough surface due to damaged and uplifted cuticles. SEM of hair samples treated with SFO infused shampoo (1% to 3%) showed flattening of cuticles with considerable smooth hair surface. Conditioning effect on cuticle cells overlapping in telescopic fashion found to be increasing from 1% to 3%. Satisfactory conditioning effect indicated by flat lying of cuticles and maximum smooth surface of hair was seen with 3% oil concentration. So, 3% SFO infused shampoo was selected for

further evaluation and compared with marketed products for physicochemical parameters.

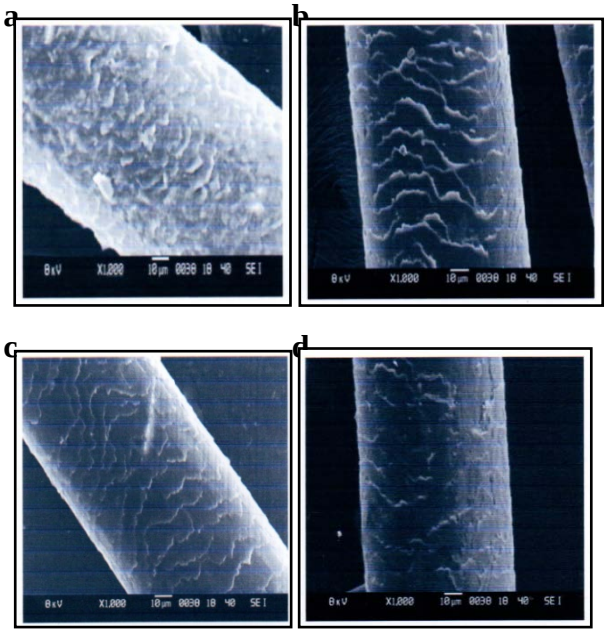

Fig 1 SEM photographs of hair samples- a) Untreated; b)1% SFO infused shampoo; c)2% SFO infused shampoo; d)3% SFO infused shampoo

3.2 Evaluation of Oil-infused Shampoo

3.2.1 Determination of pH

The pH balance of the shampoo is important for improving and enhancing the qualities of hair, minimizing irritation to the eyes and stabilizing the ecological balance of the scalp (Hart & De Gorge, 1980). The pH of the SFO infused shampoo was found to be 5.6 (pH range as per BIS: 4.0-9.0), which is comparable with pH level of marketed shampoo. (Table 2)

3.2.2 Determination of % solid content

The percentage range of solid contents of well formulated shampoo is 20-30 % (Sekar & Noordin, 2016). Maintaining solid content in the given range helps product to be well applied and well washed off of the hair. The formulated shampoo was found to have 22.22% solid content whereas % solid content for marketed shampoo was found to be 24.51%.

3.2.3 Surface tension measurement

Surface tension reduction is one of the sign for good detergency. A shampoo is considered to have good cleansing property if it reduces the surface tension of pure water from 72.28 dyne/cm to about 40 dyne/cm (Ali & Kadhim, 2014). The surface tension of SFO infused shampoo was found to be comparable with the marketed one indicating good cleansing efficacy. Results are shown in Table 2.

3.2.4 Determination of foam volume and stability

High foam produced by a shampoo has positive psychological effect on consumers as foaming or lathering is directly correlated to cleansing power of a hair cleansing preparations (Noudeh *et al.*, 2015). Therefore, it is considered as an important parameter in evaluation of shampoo. The foam volume of oil infused shampoo, determined by cylinder shake method, was found to be 165mL. The foam generated by formulated oil infused shampoo remained unchanged within the 5-minute time slot, thus suggesting good foam stability. Good foaming ability and stable foam of oil infused shampoo assures that sebum and dirt remains caught in foam and do not resettle on hair surface Presence of oil in shampoo had not adversely affected foaming ability due to presence of an anionic and amphoteric surfactant blend. Foaming ability was observed to be in well comparison with the marketed product (172 mL).

3.2.5 Determination of detergency and cleansing action

Cleaning is the primary aim of shampoo, (Marshall Sorkin, 1966) so detergency and cleansing action of oil infused shampoo was assessed using soiled human hair switches and compared for its cleansing action with leading market brand. The formulated shampoo showed 72% detergency and cleansing which is comparable to cleansing power of marketed brand. (Table 2) This effective cleansing ability of oil infused shampoo shows successful inclusion of sunflower oil in onions formed by liquid structure surfactant blend which do not hamper the foaming and cleansing power of the shampoo.

3.2.6 Preliminary stability studies

SFO infused shampoo was studied for accelerated stability at 4^0C, Room temperature and 45^0C. The shampoo was found to be stable at all the three temperatures with respect to colour, odor and pH and showed very slight decrease in viscosity at 45^0C at the end of 3 months. This suggests good stability of the shampoo base incorporated with SFO throughout its shelf life.

Table 2 Physicochemical evaluation of formulated oil infused shampoo and marketed shampoo

Tests	Oil-infused shampoo	Marketed shampoo
pH	5.6	5.5
%Solid content	22.22%	24.51%
Foam volume	165 ml	172 ml
Detergency & Cleansing (%soil removed)	72%	76%
Surface Tension (dyne/cm)	36.22	32.43

3.2.7 Consumer Testing

SFO infused shampoo was given to respondents and their views in the form of agreement and non-agreement were collected regarding cleansing ability, easy rinse off and foaming property as well as conditioning performance. The data is graphically represented by Fig 2. It was found that 68% respondents were in agreement for easy rinse off of the shampoo whereas 80% were in agreement for cleansing ability and rich lather. Data for conditioning attributes like fly-away, manageability, shine and smooth feel were represented in Fig.3. Graph shows that average 80% of subjects were in agreement that shampoo application helps in avoiding fly-away and imparts shine and smooth feel to hair. Around 75% subjects were not in agreement with the fact that application of 2-in-1 shampoo with natural oil as conditioning agent leaves hair oily. This suggests that conditioning by lubrication desired by presence of SFO does not leave hair with any sensorial negatives like greasiness.

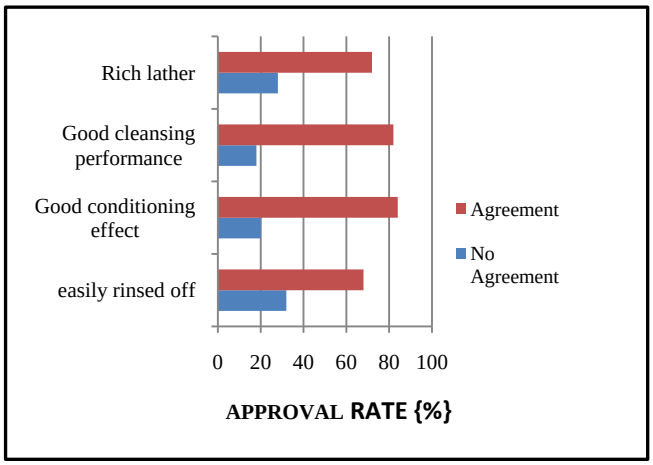

Fig 2 Consumer Views for Shampoo Performance

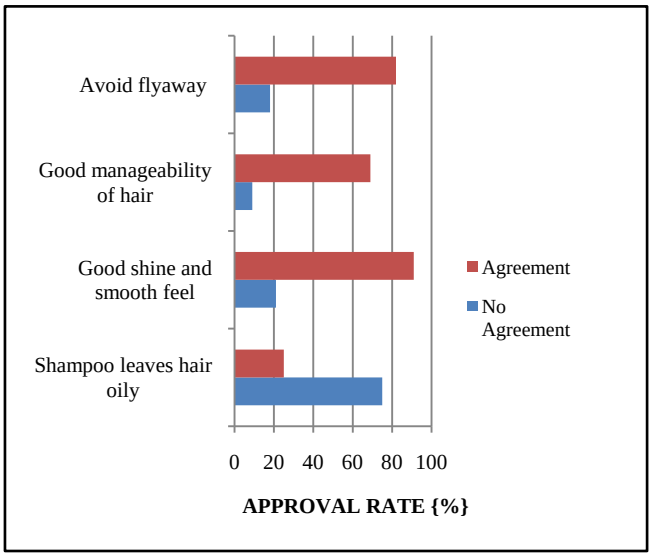

Fig. 3 Consumer view for Conditioning Performance

4. Conclusion

The aim of the present study was to formulate hair conditioning shampoo with sunflower oil as natural conditioner without negatively affecting viscosity, foaming and cleansing properties. The formulated shampoo was found to be at par with the shampoo available in market with respect to all physicochemical parameters. The shampoo exhibited pronounced conditioning effects on hair as well as good cleansing and lathering ability as revealed by SEM studies and consumer testing.

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