FORMULATION & EVALUATION OF SHAMPOO

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Shampoos, contd...

Outline

- Introduction
- Product Ingredients
- Manufacturing Process
- Evaluation of Shampoos
- Myths about shampoo usage
- References

A shampoo is a preparation of a surfactant (i.e. surface active material) in a suitable form – liquid, solid or powder – which when used under the specified conditions will remove surface grease, dirt, and skin debris from the hair shaft and scalp without adversely affecting the user.

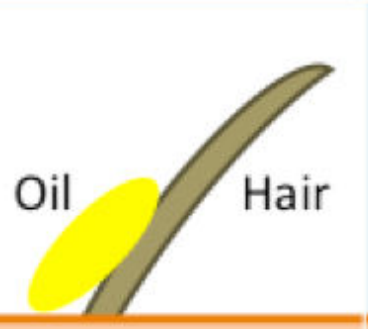
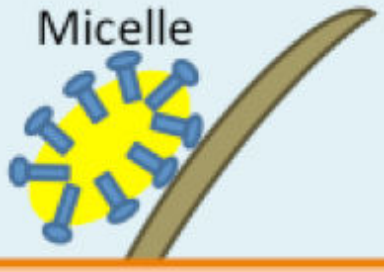
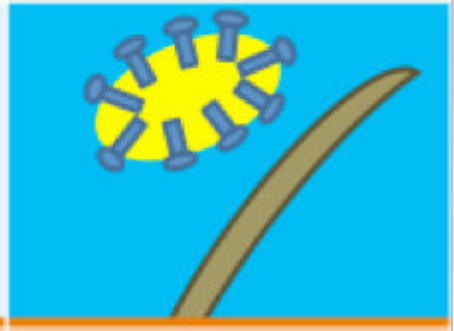
Introduction, contd...

Why Shampoos are needed???

1. Completely remove dirt
2. Protect the hair
3. Soothe the scalp skin
4. Treat dandruff, lice or other scalp problems

Introduction, contd...

How Shampoos work??

Before	Shampooing	Mode of Action	Rinse
			
Skin	Skin	Skin	Skin
Oil and dirt are attached to the skin and hair	The surfactant lowers the surface tension of the water	The surfactant creates micelles around the dirt and oil that are removed from the skin and hair	The micelles with the oil, dirt and surfactant are eliminated with the water during rinse

Formulation Parameters

Shampoo

- viscous liquids
- clear or opaque
- Containing 20–40% solids
- pH 5.5
- viscosities 500–1500 centipoise

Formulation Ingredients

Raw Materials

- **a) Water**
- **b)Surfactants (Foam Boosters and Stabilizers)**

Formulation Ingredients

Raw Materials

- c) pH adjusters
- d) Viscosity modifiers
- e) Sequestering Agents

Formulation Ingredients

Raw Materials

- f)Opacifiers
- g)Conditioning Agents
- h) Anti-dandruff Agents

Formulation Ingredients

Formulation Ingredients, contd...

Water

This is the main ingredient in all shampoo preparations, comprising about 60-80% of the solution. It aids in diluting the cleaning agents, thereby reducing irritation. It makes the shampoo formula easier to spread on the hair and scalp.

Formulation Ingredients, contd...

Surfactants

Surfactants are compounds that lower the interfacial tension of a between two phases. These are molecules that possess both hydrophillic and lipophillic moieties in their structure. they get adsorbed on the interface and helps the phases to misciblize.

1. Principal surfactants: Provide detergency and foam.
2. Secondary surfactants: Improve detergency, foam and hair condition.

Formulation Ingredients, contd...

Surfactants

- **Anionic surfactants** are mostly used (good foaming properties). The hydrophilic portion carries a negative charge which results in superior foaming, cleaning and end result attributes.
- **Non-ionic surfactants** have good cleansing properties but do not have sufficient foaming power.
- **Cationic surfactants** are toxic and are hence not used. However, they may be used in low concentration in hair conditioners.
- **Ampholytics,** being expensive, are generally not used. However, they are mainly used as secondary surfactants and good hair conditioners.

Formulation Ingredients, contd...

SLES is preferred over SLS

Sodium Lauryl Sulfate (SLS) and Sodium Lauryl Ether Sulfate (SLES) play similar role in shampoos. SLS is a skin, eye and respiratory tract irritant (Environmemt Canada has categorized it as **inherently toxic to aquatic organisms**). To make it less irritating, it is ethoxylated (by adding ethylene oxide), resulting in SLES.

Formulation Ingredients, contd...

Foaming Agents

- These agents are used to introduce gas bubbles into the water. The foam, also known as lather, is important, as it functions to spread the detergent over the hair and scalp, but it does not participate in cleaning.
- It is true that a shampoo applied to dirty hair will not foam as much as the same shampoo applied to clean hair. This is due to the sebum inhibiting bubble formation. Thus, a shampoo will foam less on the first shampooing and more on the second shampooing.
- Some of the prescription corticosteroid shampoos do not foam as much as cosmetic shampoos, but this does not mean their cleaning is inadequate.
- Examples: Lauroyl monoethanolamide, sarcosinates

Formulation Ingredients, contd...

pH Adjusters

These agents are used to prevent the hair shaft from alkalinization. Most detergents are having alkaline pH, which causes hair shaft swelling. This swelling loosens the protective cuticle predisposing the hair shaft to demage.

Example: Citric acid, Glycollic acid

Formulation Ingredients, contd...

Thickening Agents

These agents are used shampoo thick and creamy. Thickening may be achieved by adding salts or gums. Gums improve viscosity because of their gel-like properties.

Eg:Tragacanth gum, Gum Karaya, Carboxy methyl cellulose.

Formulation Ingredients, contd...

How salt act as thickening agent for shampoos containing anionic surfactant

- The viscosity of the shampoo solution depends on the size and packing structure of micelles (tiny vesicles of surfactants).
- In general, higher charge density causes the micelles to repel and result in a thinner solution.
- The sodium ions from the salt lower the charge density of the micelle surface. This makes them more able to pack closer together and creates a thicker solution.

Formulation Ingredients, contd...

Sequestering Agents

These are the agents to chelate magnesium and calcium ions, present in hard water, preventing formation of insoluble soaps (scum). This scum film will make hairs look dull and may contribute to itching and symptoms of seborrheic dermititis.

Eg:EDTA

Formulation Ingredients, contd...

Opacifying Agents

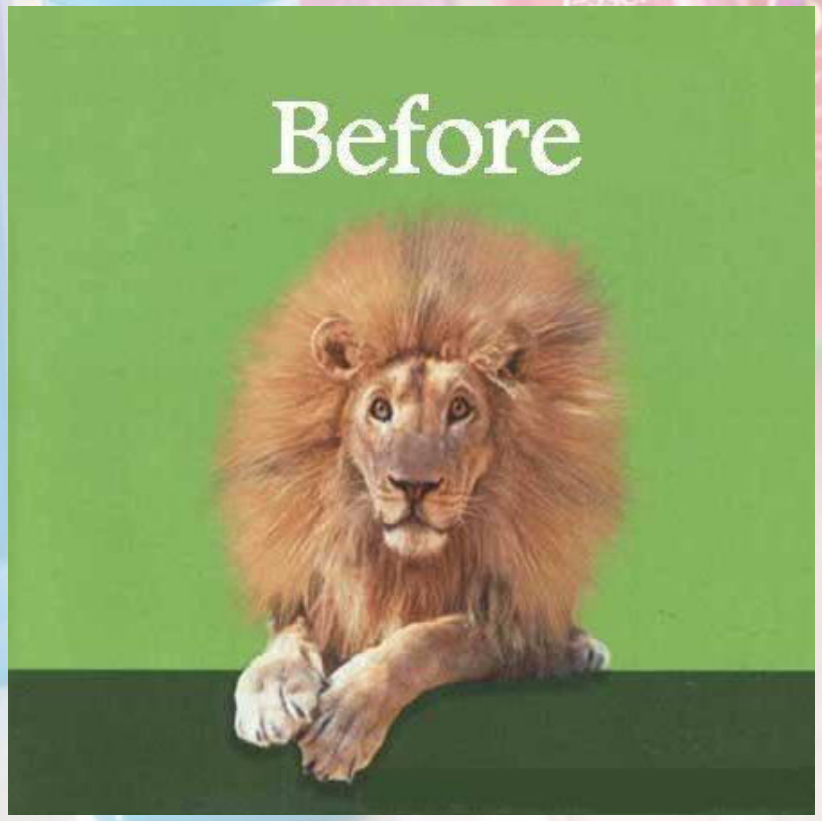
- Chemical agents added to the preparation to make it opaque, so that light does not pass through. These are usually added to give pearly shine, which offers no improved cleansing. It provides only optical effect.
- Eg: Spermaceti, Alkanolamides of higher fatty acids, propylene glycol, Mg, Ca and Zn salts of stearic acid etc

Formulation Ingredients, contd...

Conditioners

- The conditioner functions to impart manageability, gloss, and antistatic properties to the hair. These are usually fatty alcohols, fatty esters, vegetable oils, mineral oils, or humectants. Commonly used conditioning substances include hydrolyzed animal protein, glycerin, dimethicone, simethicone, polyvinylpyrrolidone, propylene glycol etc.
- Protein-derived substances are popular conditioners for damaged hair, as they can temporarily mend split ends. Split ends arise when the protective cuticle has been lost from the distal hair shaft and the exposed cortex splits. The protein-derived substances holds the cortex fragments together until the next shampooing occurs.

Conditioners



Formulation Ingredients, contd...

Anti-dandruff Agents

- Medicated shampoos contain small amount of these actives, which are in contact with the scalp for only a short time. In order to be effective the active ingredient must work in the oil-water environment of the scalp and must be readily substantive to the scalp for continuing activity.
- Ex: Selenium sulfide, zinc pyrithone, salicylic acid.

Formulation Ingredients, contd...

Perfumes

Shampoos include perfumes that are mostly concentrated.

Example: Fruit fragrance

Formulation Ingredients, contd...

Colors

Used to impart color, different colors are used.

Formulation Ingredients, contd...

Preservatives

Shampoo formula containing water has the potential to be contaminated by pathogens. For this reason it is essential to include preservatives among shampoo ingredients, to prevent the growth of molds. Preservatives usually comprise only 0.1 – 0.5% of the formulation.

Manufacturing Procedure

- Some agents are waxy solids at ambient temperature and require melting in a drum oven or similar before use.
- Demineralised water is most commonly used in order to minimize contamination of the product.
- No further processing is required after blending, and the product may be packed off directly from the mixing vessel.

Quality Control

Foam Stability: Cylinder shake method is used for determining foaming ability. 50ml of the 1% shampoo solution is put in 250ml graduated cylinder, cover the cylinder with hand and shake for 10 times. The total volumes of the foam contents after 1 minute shaking is recorded. The foam volume is calculated. Foam should retain for atleast 5mins.

Foam Stability = V2-V1

Quality Control, contd...

Wetting Action

Canvas disk is used to determine wetting action. It is one inch in diameter. It floats on the surface of a solution. The time required for it to sink is measured accurately.

Quality Control, contd...

Dirt Dispersion

Put two drops of shampoo in a large test tube. Add 10ml dirt water and one drop of Indian Ink. Close the Test tube and shake for 5min.

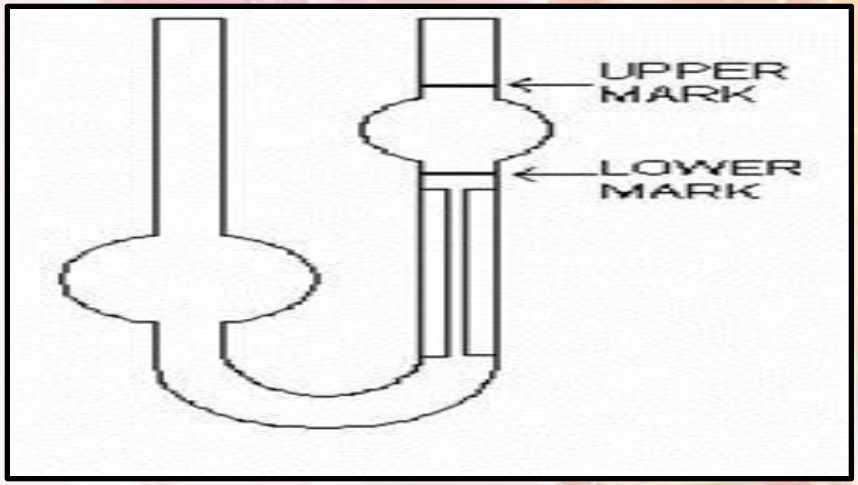
Estimate the amount of Ink in the foam.

The dirt should stay in water portion.

Quality Control, contd...

Viscosity Determination

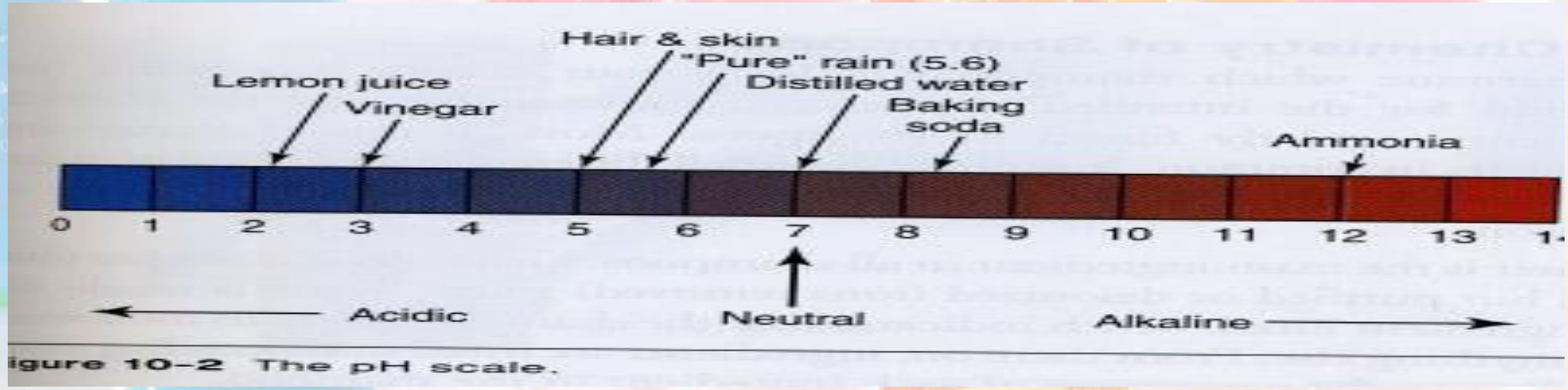
- Brookefield Viscometer is used to determine viscosity of shampoos. 100ml of shampoo is taken in a beaker and spindle is dipped in it for about 5min and then reading is taken.
- Ostwald viscometer may be used for thinner shampoos.



Quality Control, contd...

pH Determination

- Mix 1gram of shampoo with 9ml of water and determine the pH using pH meter at 27^{o} Celsius.
- pH paper may be used to determine pH.



igure 10–2 The pH scale.

Quality Control, contd...

Skin Irritability Test

Draize test is performed in albino rabbits. A set of six rabbits are used for testing each material. Shampoos should be tested only for a short duration, for not more than 4hours. These preparations are diluted between concentrations of 8 to 10%.

You need lather to know it's really working.

IS IT A MYTH ??

You need lather to know it's really working, contd...

Facts about usage of shampoos

Foaming occurs when surfactant molecules in the shampoo mix with air and create tons of tiny bubbles. Ideally, while shampooing hair, head should have only enough lather to lubricate the hair and scalp.

After a while, your hair gets used to your shampoo. That's why you need to switch to a new brand occasionally.

IS IT A MYTH ??

After a while, your hair gets used to your shampoo, contd...

Facts about usage of shampoos

MYTH.

Hair shaft is a dead structure. So it can't get used to anything. It's just perception of how your hair responds to a new formula.

The same shampoo used on the same hair under the same conditions produces the same results. If you are using the right shampoo for your hair texture, you will get the same great results.

CROWNING GLORY OF BEAUTIFUL HAIR IS DEPENDENT UPON USING A PARTICULAR HAIR CLEANSING PREPARATION

IS IT A MYTH ??

Facts about usage of shampoos

- Hair shaft consists of three layers, namely cuticle, cortex and medulla. Cuticle the outermost layer is made up of 7-10 layers of hard keratin. The Cortex, made up of hard keratin, constitutes approx 80% of hairs total mass. It is a complicated structure of parallel twisted fibre (polypeptide chains); the appearance is similar to a rope, , hydrogen and di-sulphide bond. The medulla is found in the center of the hair shaft. Not every hair has a medulla.

Facts about usage of shampoos

- The hair follicle is a pocket in the skin from where the hair grows. The follicle grows through the epidermis and into the dermis. There are three main parts of the follicle: Papilla, The Germinal Matrix and The Hair Bulb.
- The papilla is found at the bottom of the follicle in the dermis. This is where the blood capillaries pass nutrients (food) and oxygen into the cells of the germinal matrix. New cells start the process of keratinization at hair bulb.
- Thus, hair shaft is a dead structure. it gets nutrition from the dermis. Hair cleansing preparations helps to make hairs look better but does not provide nutrition.

Frequent shampooing dries your hair.

IS IT A MYTH ??

Frequent shampooing dries your hair, contd…

Facts about usage of shampoos

It is quite the contrary! Shampooing, if done correctly and with the right products, actually remoisturizes. The natural oils produced by your scalp simply sit on top of your hair shaft and do not penetrate it. It's moisture (i.e water) that does this, and also a well formulated conditioner.

Washing every day can be bad for your hair.

IS IT A MYTH ??

Washing every day can be bad for your hair, contd…

Facts about usage of shampoos

MOSTLY MYTH. If you have oily hair, it's fine to wash every day--but even oily types should use a gentle formula (one with moisturizing ingredients, like silicones, shea butter, or panthenol). People with coarse or dry hair might want to be more conservative and wash every other day. No matter what kind of hair you have, as long as you stay away from harsh formulas that strip natural oils and treat your strands with conditioner, regular shampooing won't do any harm.

Frequent shampooing makes hair oilier.

IS IT A MYTH ??

Frequent shampooing makes hair oilier, contd...

Facts about usage of shampoos

- Myth.
- Clean clothes show dirt immediately. Similarly, clean hair shows grease faster than hair that is already oily. It is a matter of individual perception. Things that actually can increase oil production are hormones and stress.

Frequent shampooing makes hair fall out.

IS IT A MYTH ??

Frequent shampooing makes hair fall out, contd...

Facts about usage of shampoos

- No. It is natural to lose up to 100 hairs a day and a percentage of this comes out when you shampoo. The act of shampooing simply dislodges hairs that have already become detached from the follicle's base are ready to come out.
- However, on a day you don't shampoo, while some of those strands will come out when you brush and style, some of them will also remain sitting loosely in the hair follicle. This means that the more days you leave between shampooing, the more you will see in the drain.

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ANIONIC SURFACTANTS

CLASS	EXAMPLE	COMMENT
Alkyl benzene sulfonates	Sodium dodecyl benzene sulfonate	Tend to yield an “airy” or low density foam and often are drying to the hair
Primary alkyl sulfates	Lauric acid, stearic acid and their salts	Good lathering effect in hard water, free from rancidity, easy to wash.
Secondary alcohol sulfates	Sodium *sec*-lauryl sulfate	Low cost, dispersing and emulsifying action, **dissapointing** as detergets and shampoo components
Alkyl benzene polyoxyethylene sulfonates	Triton X200	Stable in acid or alkaline solution, excellent emulsifier, detergent and wetting agent; extremely stable at pH of skin
Sulfated monoglycerides	Lauric monoglyceride ammonium sulfate	Stable in hard water
Alkyl ether sulfates	Derivatives of lauryl alcohol ether with PEG	Good cleansers, act as solvents for non polar additives
Sarcosines	Lauroyl and cocoyl sarcosines	Excellent foaming and conditioning action
Sulfosuccinates	Aerosol OT	Less irritating to skin and eye (baby shampoo)
Maypon	Protalbinic and lysalbinic acid derivatives (maypon 4C)	Hydrolysation product of proteins with fatty acid chlorides in presence of alkali

NON-IONIC SURFACTANTS

CLASS	EXAMPLE	COMMENTS
Fatty acid alkanolamides (should not be used > 15%)	Lauric monoethanolamide	Improves solubility of SLS
	Stearic ethanolamide	Pearlescent thickener
	Oleic ethanolamides	Hair conditioning agents
Polyalkoxylated derivatives	Ethoxylated fatty alcohols	Stable in wide range of pH; stabilizing emulsifying and opacifying properties
	Block polymers (pluronics)	Good rinsability, can be used in high %
	Sorbitol esters (TWEENS)	Solubilizers and emulsifiers, used in baby shampoos
Amine oxides	Coconut and dodecyl dimethyl amine oxides	Foam booster and anti-static agents

AMPHOTERIC SURFACTANTS

N-alkyl aminoacids	β – aminoacid derivatives	Foaming agents
	Aspargine derivatives	Compatible with both anionic and cationic surfactants
Betains	Amido betains	High foaming properties, mild.
Alkyl imidazoline	MIRANOL™	Baby shampoos

FORMULATIONS

POWDER SHAMPOO	
Henna powder	5%
Soap powder	50%
Sodium carbonate	22.5%
Potassium carbonate	7.5%
Borax	15%
Perfume	q.S

LOTION SHAMPOO	
TLS	35%
Glyceryl monostearate	2%
Magnesium stearate	1%
Water	Upto 100%
Color	q.s
Perfume, preservatives	q.s

LIQUID SHAMPOO	
SLS	40%
NaCl (to desired viscosity)	2-4%
Water	Upto 100%
Perfume, color, preservatives	q.s

FORMULATIONS

CREAM SHAMPOO	
SLS	38%
Cetyl alcohol	7%
Water	Upto 100%
Color, perfume	q.S
Preservative	q.s

AEROSOL SHAMPOO	
TLS	60%
Coconut diethanolamide	2%
Water	Upto 90%
Propellent	10%
Color, perfume, preservative	q,.s

JELLY SHAMPOOS	
Alkyl dimethyl benzalkonium chloride	15%
TLS (40%)	28%
Coconut ditethanolamide	7%
HPMC	1%
Water	Upto 100%
Color, perfume, preservative	q.s

FORMULATIONS

CONDITIONING SHAMPOOS	
Steryl dimethyl benzyl ammonium chloride	5.5%
Ethylene glycol monostearate	2%
Cetyl alcohol	2.5%
Water	Upto 100%
Color, perfume, preservative	q.s

TWO LAYER SHAMPOO	
SLS	27%
Cocamidopropylamine oxide	5%
Lauramine DEA	1%
Lactic acid (50%)	1%
Formaldehyde	0.1%

BABY SHAMPOO	
Magnesium lauryl sulfate (27.5%)	11%
Cocamidopropyl betaine (30%)	5%
Polysorbate 20	1%
PEG 600	3.5%
Perfume	q.S
Preservative	q.S
Citric acid	To pH 6
Color	q.S
Water (deionised); Aqua (INCI)	To 100%

FORMULATIONS

ANTI-DANDRUFF SHAMPOO	
Thymol	0.05%
Menthol	0.1%
Camphor	0.1%
TLS	55%
Water	upto 100
Color, perfume, preservative	q.s

ANTI-DANDRUFF SHAMPOO	
Selenium sulfide	2.5%
Bentonite	5%
SLS paste	35%
Water	upto 100
Color, perfume, preservative	q.s

FORMULATION

HERBAL SHAMPOO	
Natural essential oil blend	0.5%
Cyamopsis tetragonoloba (Guar Gum)	1%
Camellia sinensis (Green Tea) extract	2%
Glycerin	1%
Hydrolysed wheat protein	2.5%
Salvia officinalis (Sage) leaf extract	1.5%
Salvia officinalis (Sage)	1.5%
Glyceryl oleate	1%
Polysorbate 20	0.5%
Potassium sorbate	5%
Aloe barbadensis (Aloe vera) extract	0.5%
Arctium minus (Burdock) root extract	0.5%
Disodium coco-glucoside sulfosuccinate	0.5%
Preservatives	q.s.
Water	Upto 100%