



SHAMPOOS BASED ON SYNTHETIC INGREDIENTS VIS-A-VIS SHAMPOOS BASED ON HERBAL INGREDIENTS: A REVIEW

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ABSTRACT

A shampoo is a cleaning aid for the hair and is counted among the foremost beauty products. Today's shampoo formulations are beyond the stage of pure cleaning of the hair. Additional benefits are expected, e.g, conditioning, smoothing of the hair surface, good health of hair, i.e, hair free of dandruff, dirt, grease and lice and, above all, its safety benefits are expected. As the scalp is one of the most absorbent part of the body, products applied to the scalp go directly to the blood, without being filtered in any way. So it is very important to know and understand the effects of ingredients used in shampoo formulations. In the present review the shampoos based on synthetic ingredients and herbal ingredients are compared for their effectiveness and safety.

Keywords: Shampoos, Synthetic shampoos, Herbal shampoos, Cosmetics, Formulations.

INTRODUCTION

Hair is one of the vital parts of the body derived from ectoderm of the skin and is protective appendages on the body and considered accessory structure of the integument along with sebaceous glands, sweat glands and nails.¹ They are also known as epidermal derivatives as they originate from the epidermis during embryological development. Hair is an important part of the overall appeal of the human body.^{2,3} The hair of the head has historically been associated with beauty and social distinction. Innumerable instances from all the art forms can be cited supporting the special prominence accorded to the hair by people of virtually all times and cultures.⁴ Whereas the hair has been trimmed, shaped and even coloured since the most ancient times, relatively little emphasis has been placed on the process of cleaning it. Only in this century has a real technology in the cleaning of the hair and scalp developed. First came the mass distribution of cake soap and sanitary facilities to make bodily cleanliness and personal hygiene practice. Next came the specialization of branded shampoo products for the hair and scalp, offered in multiplicity of types and forms.⁵ Now, washing the hair and scalp with shampoo has become a nearly universal practice. Shampoos are probably the most widely used hair products today, based on synthetic ingredients as well as herbal ingredients.⁶

SHAMPOO

A Shampoo may be described as a cosmetic preparation meant for the washing of hair and scalp, packed in a form convenient for use. Its primary function is of cleansing the hair of accumulated sebum, scalp debris and residues of hair-grooming preparations. The added functions of shampoo include lubrication, conditioning, bodybuilding, prevention of static charge build up, medication and so

on. Finally, the complete shampoo formulation must be medically safe for long term usage.⁷

SHAMPOOS BASED ON SYNTHETIC INGREDIENTS

People often complaint about various brands of shampoo that have caused various conditions such as scalp irritation, hair loss and severe hair damage. Number of commercially available shampoos are loaded with chemicals that are hazardous to skin and health. Most people are unaware of the side effects associated with these harmful synthetic ingredients. Common to most synthetic ingredients based shampoos is an ingredient called a surfactant, which has ability to reduce surface tension of water. The result is that, as the hair is rinsed, the sebum is washed away. Lathering of chemical shampoo also is the result of the activity of surfactant. Some shampoos contain surfactant with strong lathering properties although they may not be ideal in terms of conditioning or irritant potential.

Sodium lauryl sulphate is known to most who have looked at the label of shampoo bottle, it is rather harsh detergent.⁸ A study done at Medical college of Georgia has shown that shampoos with SLS could retard healing of wounds in surface of cornea and can cause cataract in adults. SLS build up in heart, liver, lungs and brain can cause major problem in these areas. SLS causes skin to flake and causes substantial roughness on the skin, it actually corroded the hair follicle and impairs its ability to grow hair. SLS is routinely used in clinical studies to deliberately irritate the skin so that the effects of other substances can be tested.⁹ Wilhelm *et. al* (1994) has evaluated the irritation potential of diverse surfactants depended significantly on the feature (erythema vs hydration and Transepidermal water loss) measured. In this study SLS, Dodecyltriethylammonium (DTAB) and Potassium soap were used as model irritant.¹⁰



Vozmediana *et al* (2000) has evaluated the irritant capacity of decyl polyglucoside. In this study some of the surfactants most frequently used in shampoos including SLS were selected for testing. It was deduced from the results obtained that the decyl polyglucoside was showing lowest irritant potency where as SLS was showing maximum irritant potency.¹¹

Cocamidopropyl betaine is an amphoteric surfactant which is frequently used in cosmetic products especially shampoos. Cases of contact allergy due to it are reported increasingly. Groot *et.al* (1998) described 20 cases of cosmetic allergy to cocamidopropyl betaine, all were caused by shampoo or shower gel.¹² In another study, Militello *et. al* (2006) has reported presence of cocamidopropyl betain in 'no tears shampoos' for children. It is concluded in this study that the documented rates of allergic contact dermatitis in children are on the rise. This increased prevalence may be due to increased chemical exposures in this age group.¹³

Diethanolamine or DEA is a common ingredient in bath products. DEA and any combinations of DEA, including the widely used cocamide DEA has been found to pose a serious health risk to consumers. The ill effects of DEA were reported in which Dr. Samuel Epstein, M.D of the University of Illinois and one of the world's foremost toxicologist testified about the results of his study in which he found that DEA is a potential carcinogen, and that in even small doses, repeated use of DEA increases the risk of cancer.¹⁴

Soga *et.al* (2003) has reported a case of 65-year old woman who had a 3 years history of recurrent pruritic erythema on her scalp, face and neck. Her symptoms gradually worsened inspite of topical corticosteroid application. Patch testing was performed with the cosmetics and shampoo that she had used. She showed positive reactions to a cosmetic lotion, cream and shampoo at days 2 and 3. Subsequently, she was patch tested with the ingredients of the shampoo. Only disodium ethylenediamine tetraacetic acid (EDTA) was positive on days 2 and 3. All three positive cosmetic products were found to contain disodium EDTA. The skin eruption rapidly improved and did not reoccur after discontinuing the use of cosmetics that contained disodium EDTA.¹⁵ Although EDTA is widely used, it is a rare sensitizer. Infact, only few cases of contact dermatitis due to salts of EDTA have been reported.¹⁶⁻¹⁹ It should be kept in mind, however that EDTA is still capable of inducing contact dermatitis.

N-nitrosodiethanolamine (NDELA) is a recognized carcinogen. It is reported that when SLS comes into contact with alkanonamides it becomes contaminated with NDELA. Schothorst *et.al* (2001) had determined the NDELA content of 25 cosmetics including shampoos and gels. NDELA content above the limit of quantification was measured in seven out of 25 sampled and analysed cosmetics.²⁰

Formaldehyde is used as a preservative in many shampoos. However, shampoos manufacturers are not required to list 'formaldehyde' as an ingredient. Rather, it is labled as 'Quaternium – 15'. It is known for its carcinogenic effects.⁹ In most hair shampoos commercially available in Western Germany, formaldehyde or formaldehyde liberating substances serve as efficient preservative specially in shampoos of the lower price group. Allergic contact dermatitis due to formaldehyde in shampoo is reported in 15 years old patient.²¹

Selenium sulfide is an ingredient in anti-dandruff shampoos used in concentration of 1% in products sold over the counter and 2.5 % in products which are available by prescription. A bioassay of selenium sulphide for possible carcinogenicity was conducted by administering it to rats and mice. Under the conditions of the bioassay, selenium sulphide was carcinogenic for rats and female mice. Level of evidence of carcinogenicity was positive for male rats, female rats and female mice but negative in male mice.²² In another study, popular shampoos were screened for their contents in trace elements, using Inductively Coupled Plasma Mass Spectroscopy (ICP-MS) detection in a semi quantitative mode. Hair samples from volunteers were analyzed before and after hair washing with selected shampoos to demonstrate the effect of the contamination and the impact on occupational medicine. A shampoo formulated with Selenium sulphide was found to seriously contaminate the hair.²³

Dandruff is a common embarrassing scalp disorder affecting a large chunk of population. Currently available treatment options for the management of dandruff include therapeutic use of antidandruff shampoos containing Zinc pyrithione, Selenium sulphide, Salicylic acid, Imidazole derivatives, Sulphur Coal tar, etc. However, these agents have certain limitations, either due to poor clinical efficiency or due to compliance issues. Furthermore, these drugs are unable to prevent reoccurrence of dandruff which is the commonest problem.²⁴ Continuous use of these shampoos make hair brittle and causes dryness of the scalp. So, use of good conditioner after application of antidandruff shampoo is recommended. It is also reported that continuous use of one product looses the effectiveness over time. Coal tar based shampoos which are used to control dandruff not only stain coloured or grey hair and make the scalp more sun-sensitive but are also carcinogenic. There is also an evidence that coal tar itself is mutagenic, carcinogenic in animals and phototoxic as reviewed by the WHO's International Agency for research on cancer.²⁵

SHAMPOOS BASED ON HERBAL INGREDIENTS

Herbal drugs or their formulations are viable alternative to synthetic drugs. During the past few decades, there has been a dramatic increase in the use of natural products in cosmetics. Natural botanicals may be used in their crude form or they may be extracted, purified or derivatized to



render them more suitable for use in cosmetic. A wide range of active principles of various plants including vitamins, hormones, phyto-hormones, bioflavonoids, enzymes, tannic acid, fruit acids, amino acids, sugars, glycosides and essential oils, are being considered useful in cosmetic formulations. The awareness and need for cosmetics with herbs is on the rise, primarily because it is believed that these products are safe and free from side

effects. Now-a-days, many herbal shampoos are available in the market which contains herbal ingredients such as plant extracts and essential oils. There are large numbers of plants which are reported to have beneficial effects on hair and are commonly used in shampoos. A list of plants which are commonly used in shampoos is given in Table 1 along with their common names and reported functions/uses.

Table 1: Plants commonly used in herbal shampoos

Botanical name	Common name	Reported functions/uses.
<i>Berberis vulgaris</i>	Barberry	Used in shampoos and hair rinses for hair growth.
<i>Symphytum officinale</i>	Comfrey	Used in shampoos, hair rinses, hair creams.
<i>Trigonella foenum-graecum</i>	Fenugreek	It is traditional component of hair care, used for its cleaning and softening activity.
<i>Eucalyptus sp.</i>	Eucalyptus	Used as antidandruff agent in shampoos.
<i>Larrea divaricata</i>	Creosote bush	Relieve itchy scalp and dandruff, also used as hair tonic.
<i>Lawsonia alba or Lawsonia inermis</i>	Henna	Conditioning agent, provide body and bounce to the hair, makes hair manageable.
<i>Pilocarpus jaborandi</i>	Jaborandi	Used in shampoos and herbal hair rinses, act as stimulant for hair growth.
<i>Citrus limon</i>	Lemon	Used in shampoo for antidandruff property, act as natural cleanser, used in herbal mixtures as decoction for normal to oily hair.
<i>Urtica dioica</i>	Nettles	Used in shampoos and hair rinses, stimulates growth of hair and improves the condition of scalp.
<i>Rosmarinus officinalis</i>	Rosemary	Used in shampoos, it is a good hair conditioner.
<i>Santalum album</i>	Sandalwood	Its oil is used in shampoos, act as antidandruff agent and anti microbial agent.
<i>Quillaja saponaria</i>	Soapbark	Used in shampoo, it is good for itchy scalp or dandruff.
<i>Saponaria officinalis</i>	Soapwort	Used in shampoo as it produces good detergent lather this is good for itchy scalp or dandruff.
<i>Artemisia abrotanum</i>	Southernwood	Used in herbal shampoos and hair rinses, it act as hair growth stimulant.
<i>Melaleuca alternifolia</i>	Tea tree	It's oil is effectively used in anti dandruff shampoos.
<i>Juglans nigra</i>	Walnut	Decoction of leaves is added to shampoo, used as black hair dye.
<i>Hamamelis Virginiana</i>	Witch haze	Used in shampoos as antidandruff agent.
<i>Achillea millefolium</i>	Yarrow	Used in shampoos and hair preparations. It is stated to stimulate hair growth.
<i>Arnica montana</i>	Arnica	Used in shampoos and hair rinses.
<i>Melissa officinalis</i>	Balm	Used in shampoos and hair rinses, used as hair growth stimulant.
<i>Phaseolus vulgaris</i>	Bean flower	Effectively used in shampoos and hair rinses.
<i>Nigella sativa</i>	Black cumin	Used in shampoos because of its good cleansing properties.
<i>Vetiveria zizanioides</i>	Ushir	Used in shampoos as coolant and antibacterial agent.
<i>Sapindus indica</i>	Soap nut	Used in shampoos, act as antidandruff agent, hair growth regulator and effective cleanser.
<i>Amaranthus Spinousus</i>	Velvet flower	Used in shampoos as hair conditioner.
<i>Schiechera oleosa</i>	Kusum tree	Used in shampoos as hair growth promoter.
<i>Eclipta alba</i>	Bhringaraja	Used in shampoos as hair darkener, checks hair loss and stimulates hair growth.
<i>Withania somnifera</i>	Aswagandha	Used in shampoos to improve circulation of the scalp, structure of the hair and act as antidandruff agent.
<i>Nelumbium speciosum</i>	Lotus	Hair vitalizer
<i>Eugenia jambos</i>	Rose apple	Stimulating the scalp and regeneration of damaged hair
<i>Melaleuca leucadendron</i>	Cajeput	Used in shampoos as antidandruff agent.
<i>Azadirachta indica</i>	Neem	Used in shampoos as antimicrobial agent.
<i>Ocimum sanctum</i>	Holy basil	Used in shampoo as antimicrobial agent.
<i>Cinnamomum camphora</i>	Camphor	Used in shampoos as antidandruff agent.
<i>Pyrus malus</i>	Apple cider vinegar	Antidandruff agent.
<i>Cedrus atlantica</i>	Cedar wood	Used in antidandruff shampoos and avoid hair loss.
<i>Juniperus communis</i>	Juniper berry	Cleanser and anti infective.
<i>Mentha piperita</i>	Peppermint oil	Used in shampoos for its cooling properties.
<i>Thymus vulgaris</i>	Thyme	Used in shampoos as antimicrobial agent.
<i>Phyllanthus emblica</i>	Amla	Promote hair growth, prevent premature graying and control dandruff.
<i>Anthemis nobilis flower</i>	Chamomile	It brighten, stimulate and strengthens blonde hair.
<i>Sesamum indicum</i>	Til	Hair tonic.
<i>Panax ginseng</i>	Ginseng	Used in shampoos, act as hair growth stimulator.



Cosmetic based on natural ingredients are generally associated with a healthy life style and their use is becoming increasingly popular. Investigations have been carried out recently to develop shampoos based on natural and naturally derived ingredients. Formulating cosmetics using completely natural raw material is a difficult task. The challenge lies in selecting material that can be rationally justified as natural and formulating them into cosmetics whose functionality is comparable with their synthetic counter parts.

Mainkar *et.al* (2001) had focused in their paper, the method of formulation of completely natural shampoos, their evaluation and comparison with commercial herbal shampoos. Attention is drawn to the fact that, due to ambiguous definition of the word 'Natural' several so called natural cosmetics are available in the Indian market. The authors emphasized on the fact that it is up to the cosmetic chemists themselves to promote and encourage the development and use of truly natural cosmetics.²⁶

In another study, Mainkar *et.al* (2000) focused on the evaluation of herbal shampoos using some of the test parameters such as foam test for detergency etc. In this study, commercial herbal shampoos were evaluated on the basis of these tests. The results of these tests gave an idea about what standards should be met by a shampoo formulated in the laboratory to be comparable with the commercial shampoos.²⁷

Nasrin *et.al* (2007) had formulated a herbal shampoo using total saponins of *Acanthophyllum squarrosum*. The main goal of this study was the elimination of synthetic materials like alkanolamides which are often used for the formation of stable foam, but because of producing nitrosamines they are potentially carcinogenic compounds. The formulation was evaluated for organoleptic, physicochemical, rheological properties and its stability. It was concluded that the formulation was chemically and physically stable.²⁸

Ravichandran *et.al* (2004) had reported the clinical efficacy and safety of "Herbal Antidandruff Shampoo" in the management of dandruff. A polyherbal shampoo containing the extracts of *Rosmarinus officinalis*, *Vetiverla zizanioides*, *Nigella sativa*, *Santalum album*, *Ficus bengalensis*, *Citrus limon* and oil of *Melaleuca leucadendron* was used in the study. The study concluded that the test formulation is effective due to synergistic anti fungal, anti inflammatory and local immunostimulatory actions of its ingredients. The herbal antidandruff shampoo formulation was found to be effective and safe in the management of dandruff.²⁴

Sagar *et.al* (2005) had formulated anti-dandruff liquid cream shampoo, using active extract of *Tridax procumbens* which was compared with standard Ketoconazole shampoo. The formulation was evaluated using various parameters which prove its efficacy and safety. The toxicity studies of formulation did not show any toxic effect.²⁹

Mohamad *et.al* (2009) had formulated and evaluated herbal shampoo powder with antidandruff property using *Ocimum sanctum* and *Azadiracta indica* as antidandruff agents along with *Acacia concina*, *Trigonella foenum graecum*, *Lawsonia inermis*, *Hibiscus rosa sinesis*, *Sapindus laurifolia* as other ingredients of shampoo powder. The herbal shampoo powder was found to contain all good characters of an ideal shampoo and also it was found to be harmless, more effective and economic.³⁰

In another study Bellare. *et.al* (2001) had used the scanning electron microscope successfully to study the effects of toiletry treatment with shampoo on the microstructure of hair. This paper describes the use of SEM for comparing the conditioning effects of Herbal shampoos. For this study completely herbal shampoos were formulated in the laboratory and their conditioning effects were evaluated by comparing with commercially available shampoo. The micrographs were studied quantitatively using image analyzer software. The damage caused to the hair due to sodium lauryl sulphate (SLS) present in the commercial shampoo was visible in the micrograph. The laboratory formulations were found to be better than the commercially available products.³¹

Head lice infestation is a major public health problem particularly in rural and remote communities. Commonly used anti-lice products contain malathion, pyrethrins, piperonyl butoxide, permethrin, DDT, lindane etc. These are pesticides which causes harmful effects like asthma, allergic responses, skin diseases, nervous system damage etc. Most important drawback is that resistance develops after sometime for these chemicals. Mc Cage *et.al* (2002) had developed a herbal anti-lice shampoo. The shampoo is formulated by using standardized extract of *Paw Paw*, *thymol* and *tea tree* oil. All of these ingredients were selected for their ability to deplete ATP levels and thus, prevent ATP dependent pesticide resistance. The study concluded 100 % effectiveness and safety in removing head lice and nits.³²In one more study, Jorg *et.al* (2006) had evaluated a commercially available head lice treatment based on seed extract of *Azadirachta indica* (*neem* tree). The *neem* shampoo was compared with permethrin-based product. It was concluded that *neem* shampoo was more effective than the permethrin-based product. Author suggested that complex plant based compounds will replace the well defined chemical pediculicides if resistance to the commonly used products further increases.³³

Recently Mali R *et.al* (2010) had formulated and evaluated completely herbal shampoo from *Asparagus racemosus*, *Acacia concin*, *Sapindus mukorossi* as main ingredients along with other herbal ingredients. Authors had concluded that it is possible to formulate a completely herbal shampoo that is better than the synthetic ones. They had formulated self preserving shampoo to avoid the risk posed by chemical preservatives. They used *Aloe vera* gel and other plant extracts to provide the conditioning effects as these are



not only safer than the chemical conditioning agents but also reduce the protein loss during combing.³⁴⁻³⁵

Castor derivatives are good alternative option for hair care formulators. Castor derivative's high viscosity and outstanding lubricity can aid formulators in developing clear shampoos and conditioners. It reduces the irritation caused by Sodium lauryl sulfate in shampoos. Castor oil's hydroxyl group allows for the addition of ethylene oxide to the triglyceride structure. Depending on the number of moles of ethylene oxide, added to the hydroxyl group, castor oil can be transformed from oil to a water soluble surfactant. PEG-40 castor oil is an example of this type of surfactant.³⁶ It can be replaced for harsh chemical based surfactants used in shampoos.

CONCLUSION

The awareness and need for cosmetics with herbs in on the rise, as it is strongly believed that these products are safe and free from side effects. It is seen that many products making natural claims are still based extensively on synthetic functional ingredients to which natural raw materials or extracts are added. Investigations have been carried out recently to develop totally herbal shampoos.⁽²⁶⁻³⁵⁾ These studies have produced promising results. It is suggested that shampoo manufacturers / formulators must refer and follow the specifications given by Bureau of Indian Standards in SI 4011:1997 "Methods of test for safety evaluation of cosmetic," second revision³⁷ and also refer the "General Guidelines for Herbal Cosmetics" by Bureau of Indian Standards.³⁸ The development of all natural products will be a major area of growth in the cosmetic and toiletry industry during the next coming years.

REFERENCES

- Ebling F.I.G, The biology of hair, Clinical Dermatology 5, 1987, 467-481
- Cash T.F, The Psychology of hair loss and its implication for patient care, Clinical Dermatology, 19, 2001, 161-166
- Messenger A. G, Medical management of male pattern hair loss, International Journal of Dermatology, 39, 2000, 585-586
- Stough D. K, Habar R, Parsley W.M, Vogel J.E, Whiting D.A, Washenik K. Psychological effect, pathophysiology and management of androgenetic alopecia in men, Mayo Clinic Proceedings, 80 (10), 2005, 1316-1322
- Balsam M. S and Sagarin Edward, Cosmetic Science and Technology, second Edition, Vol-2, Willey Inter Science Publishers, New York, 1972, 73-113
- Poucher's E.J. Mottram and Lces C.E, Perfumes, Cosmetics and Soaps, 10th edition, Kluwer Academic Publishers, Great Britain, 2000, 289-306
- Nanda Sanju, Nanda Arun, Khar Roop. K, Cosmetic Technology, 1st. edition. Birla publications Pvt. Ltd, Delhi, 2006
- Boutique Health - Shampoo - the hidden dangers. [http://www.boutiquehealth.co.nz/pages/shampoo - the hidden dangers](http://www.boutiquehealth.co.nz/pages/shampoo-the-hidden-dangers). Accessed on 5/2/2008
- Noxious shampoos: <http://www.rapunzelsdelight.com/healthtopics/noxious-shampoos.htm>. Accessed on Dec. 17, 2007
- Klaus-P. Wilhelm, Gunter Freitag, Helmut H. Wolff, Surfactant induced skin irritation and skin repair, Journal of the American Academy of Dermatology, 30 (6), 1994, 944-949
- Vozmediano J.M, Carbajo J.M, Franco R, Milan V.J, Padilla M, Sarmiento C. Evaluation of the irritant capacity of decylpolyglucoside. International Journal of cosmetic science, 22 (1), 2000, 73-81
- Anto C.de Groot, Derk P. Bruyzneel, Jan D. Bos, The Allergens in cosmetics, Archives of Dermatology, 124, 1998, 1525-1529
- Militello G, Jacob S.E, Crawford G.H, Allergic contact dermatitis in children, Current Opinion in Pediatrics, 18 (4), 2006, 385-90
- Zoltan Rona, Health Naturally Magazine, Feb/March 1997, Page 2021
- Fujika Soga, Kaori Izawa, Tomoka Inoue, Norito Katoh, Saburo Kishimoto, Contact dermatitis due to disodium EDTA in cosmetics and shampoo, Contact Dermatitis, 49 (2), 2003, 105
- Raymond J.Z, Gross P.R, EDTA preservative dermatitis, Archives of Dermatology, 100, 1969, 436-440
- De Groot A.C, Contact allergy to EDTA in a topical corticosteriod preparation, Contact Dermatitis, 15, 1986, 250-251
- Bhushan M, Beck M.H, Allergic contact dermatitis from disodium EDTA in a local anaesthetic, Contact Dermatitis, 38, 1998, 183
- Kimura M, Kawada A, Contact dermatitis due to EDTA in a cosmetic lotion, Contact Dermatitis, 41, 1999, 341
- Schothorst R.C, Stephany R.W, Occurrence of N-nitrosodiethanolomine (NDELA) in cosmetics from Dutch Market, International Journal of Cosmetic Science, 23 (2), 2001, 109-114
- Bork K, Heise D, Rosinus A, Formaladehyde in hair shampoos, Derm Berut Umwelt, 27 (1), 1979, 2-10
- Bioassay of Selenium Sulfide for possible Carcinogenicity (Case No. 7446-34-6) National Toxicology Program, Tech Rep Ser, 1980, 194



23. Alain Le. Blanc, Pierre Dunas, Lyse Lefebvre, Trace element content of commercial shampoos; impact on trace element levels in hair, *The Science of The Total Environment*, Vol 229 (2), 1999, 121-124
24. G. Ravichandran G, Shivaram Bharadwaj, Kolhapure S.A, Evaluation of the clinical efficacy and safety of "Anti Dandruff Shampoo" in the treatment of dandruff, *The Antiseptic*, 201 (1), 2004, 5-8
25. Polynuclear, Aromatic compounds, Party 4, Bitumens, Coal-tar and derived products, Vol-35, World Health Organization International Agency for Research on Cancer (IARC) January 1985
26. Mainkar A.R, Jolly C.I, Formulation of natural shampoos, *International Journal of cosmetic science*, 23 (1), 2001, 59-62
27. Mainkar A.R, Jolly C.I, Evaluation of Commercial herbal shampoo, *International Journal of cosmetic science*, 22 (5), 2000, 385-91
28. Nasrin Aghel, Eskandar Moghimipour, Azadeh Raies Dana, Formulation of a Herbal Shampoo using total Saponins of *Acanthophyllum squarrosum*, *Iranian Journal of Pharmaceutical Research*, 6 (3), 2007, 167-172
29. Sagar R, Dixit V.K, Gour H.S, Formulation and evaluation of herbal antidandruff shampoo, *Nigerian Journal of Natural Products and Medicine*, 9, 2005, 55-60
30. Mohamed Halith S, Abirami A, Jayaprakash S, Karthikeyini C, Kulathuran Pillai K, Mohamed Firthouse P.U, Effects of *Ocimum sanctum* and *Azadiracta indica* on the formulation of Antidandruff Herbal Shampoo Powder, *Der Pharmacia Lettre*, 1(2), 2009, 68-76
31. Bellare J, Iyer R, Mainkar A.R, Jolly C.I, A study on the conditioning effects of natural shampoos using the scanning electron microscope, *International Journal of cosmetic science*, 23 (3), 2001, 139-45
32. Mc Cage C.M, Ward S.M, Paling C.A, Fisher D.A, Flynn P.J, McLaughlin, Development of a Paw Herbal Shampoo for the removal of head lice, *Phytomedicine*, 9 (8), 2002, 743-748
33. Jorg Heukelbach, Fabiola A.S. Oliveira, Richard Speare, A new shampoo based on neem (*Azadirachta Indica*) against head lice *in vitro*, *Parasitology Research*, 99 (4), 2006, 353-356
34. Mali R, Kumar Ashok, Singh Atul Kumar, Talwar Amitabh, Formulation of Herbal Shampoos from *Asparagus racemosus*, *Acacia, concin, Sapindus Mukorossi*, *International Journal of Pharmaceutical sciences Review and Research*, 4(1), Sep-Oct 2010, 39-44
35. Kumar Ashok, Roshan Mali R, Evaluation of prepared Shampoo Formulation and to compare Formulated Shampoo with Marketed Shampoos, *International Journal of Pharmaceutical sciences Review and Research* 3(1), July-Aug 2010, 120-125
36. Hipius Shaw. A, Age-old ingredient Answers Today's Cosmetic Problems, *Soap Cosmetics Chemical Specialties*, 66 (7), 1990, 44-52
37. Bureau of Indian Standards, Methods of test for safety evaluation of cosmetics (second edition), IS 4011:1997, New Delhi
38. Bureau of Indian Standards, General Guidelines for Herbal Cosmetics, ICS. No. 71.100. 70, Cosmetic Sectional Committee, New Delhi.

