

Plant based natural surfactants

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■ **ABSTRACT** : Increased environmental awareness with different important factors of life like food, clothing and housing concern with the efficient selection of good quality cleansing product for clothing and household articles. As a green alternatives of soap and some harmful detergent natural surfactant for cleansing purpose can be extracted from some plants and animals which contain saponin and sapogenin in their chemical structure. The study showed that the surfactant produced from some plants and animals are less harmful to the environment but a good scientific approach to preserve the quality of our life as well as our valuable fabric and clothing.

■ **KEY WORDS** : Surfactant, Saponin, Sapogenin

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The satisfaction from textile products depends not only on selection of articles well suited to its end use but also on the care given to the products. Keeping in mind that the physico-chemical properties given to the fabric would be long lasting, cleaning different apparel products as well as household linens always have the problem of deciding whether to use soap and detergent or other surfactants. Indian detergent market is fully saturated with a variety of products and they are advertised through different media and there are little scope of thinking about natural surfactants. The natural surfactants are abundantly found in nature, eco-friendly, cheaper, energy saving and easily biodegradable laundry product and it has no or little affect on dye and functional finishes applied on fabric. So, an attempt was made to review and to make aware of plant base surfactants for different purposes with special reference to textile processing and care.

What is natural surfactant ?

Natural surfactants are the naturally available substances present in plants and animal sources (star fish, sea cucumber) which can lower the surface tension of textile accompanied by foaming sudsing make water penetrate rapidly into the material to help cleaning action and able to alter the physico-chemical nature of substance.

The empirical formula for surfactant is $C_{26}H_{31}O_{10}$. It is

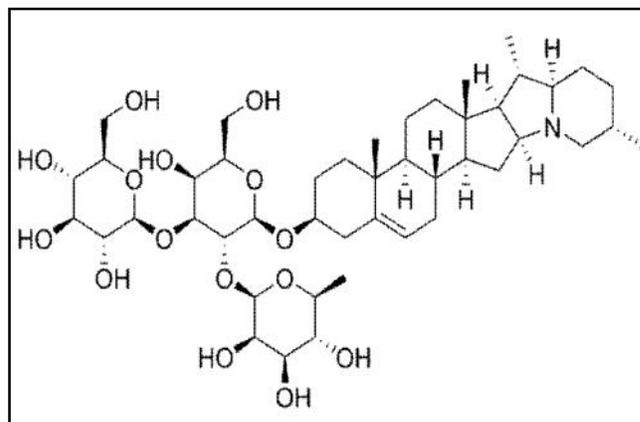
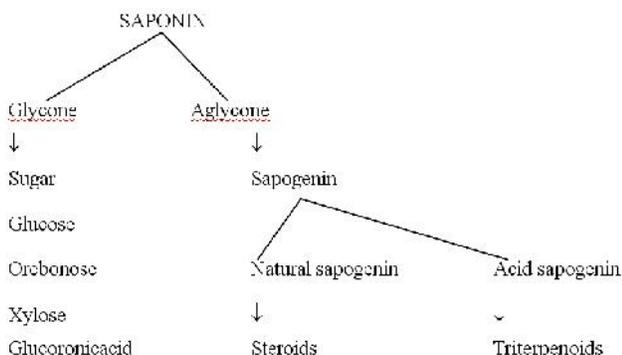
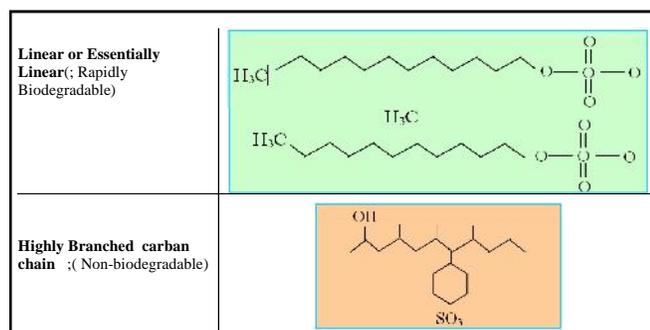


Fig. 1: Chemical structure of natural surfactant

mainly glycoside. The glycosidic structure of surfactant molecule has two ends-hydrophilic end that attract water and hydrophobic end that repel water. Because of this nature, while water hating end repel water, it get attracted to oily and greasy dirt and water loving end attract the water molecules. Thus, two opposite forces loosen the dirt from cloths allowed to carry away water. Chemically the natural surfactant property is due to the presence of 'Saponin' which is a Latin word means the plants consist of foaming agents. The saponin has two parts-glycone and aglycone (sapogenin).



The carbon chains of natural surfactants are always linear and even numbered and it is rapidly biodegradable. But the synthetic surfactant may have branched carbon chains and contain even or odd number of carbon atoms and it is not biodegradable.



As consumers are becoming more eco-conscious and aware about to preserve the qualities of value added costly fabrics use of harmful synthetic product is sure to be changed. Creating awareness and explore about the sources natural surfactant, is most essential part of textile field. India, Nepal, South East Asia, Europe and America are the treasure houses of trees containing such green alternatives to commercial detergent (Borthakur, 1978; Datta, 1985).

Test for presence of natural surfactant in plants :

Mainly two tests are used for the presence of saponin in plants and animals.

–Persistent foam test in acidic solution.

–Blood hemolytic test.

Both tests are done by TLC (Thin layer chromatography) and PC (Paper chromatography) methods of separation (Harborne, 1973).

Formation of foam :

The formation of persistent foam during plant extraction is the reliable evidence for presence of saponin. 1ml. of water extract or alcoholic extract separate with 2ml.

Table 1 : Commonly available sources of natural surfactants

Common name	Botanical name
Agave (Som) Century plant	<i>Agave americana</i>
Alfalfa	<i>Medicago sativa</i>
Aloe barbadensis	<i>Aloe vera</i>
Amarantha	<i>Amaranthus spinosus</i>
Asparagus (fern)	<i>Asparagus officinalis</i>
Balloon flower	<i>Platycodon granditonem</i>
Bonponial	<i>Miliusa roxburchiana</i>
Broom weed	<i>Gulierrezia sp.</i>
Ber	<i>Ziziphus jujuba</i>
Chalkonari	<i>Thevetin paraviann</i>
China rose	<i>Hibiscus rosa sinesis</i>
Christmas rose	<i>Helleborus niger</i>
Corn cockle	<i>Agrostemma githago</i>
Cow cockle	<i>Saponaria vaccaria</i>
Daisy	<i>Bellis perennis</i>
Desert date	Balanities
Dhatura	<i>Datura stramonium</i>
Fagaceae (Korash)	<i>Castanopsis armata</i> (Spach)
Fenugreek	<i>Trigonelia foenum graecum</i>
Figwort	<i>Scrophuloria nodosa</i>
Ginseng	<i>Panax araliaceae</i>
Horse chestnut	<i>Aesculus hippocastanum</i>
Jarmoni bon	<i>Chromolaena odorata</i>
Keharaj	<i>Eclipta alba</i>
Maple	Aceraceae
Oat	<i>Avena sativa</i>
Chickpea	<i>Cicer arientinum</i>
Peppers	<i>Piper nigrum</i>
Red onion	<i>Allium cepa</i> L. var. <i>tropea</i>
Safed musli	<i>Chlorophyllum borvillianum</i>
Shikakai herb	<i>Acacia concinna</i>
Snake venom	<i>Arstolochina sp.</i>
Soapbark	<i>Quillaja saponaria</i>
Soapnut/ soap herry	<i>Sapindus mukorossi</i>
Soapwort	<i>Saponaria officinalis</i>
Spinach	<i>Spinacea oleracea</i>
Tea	<i>Camellia ossamica</i>
Tomato	<i>Lycopersicon esculentum</i>
Wild yam	<i>Dioscorea sp.</i>
Yucca	<i>Yucca schidigera</i>

of distilled water. Shake it for 15 min. One centimeter layer of foam indicates saponins.

Hemolytic test :

In a glass slide one drop of blood is placed and then plant extract is added. If hemolytic zone is appeared it will prove the presence of natural saponin.

Test for saponin :

Dried tissue should be hydrolyzed with molar HCL for 2-6 hours. Neutralized the said matter dried and extracted with petroleum. The extract is taken for dryness and the residue dissolved in chloroform and the IR (relative retention time) spectrum is determined. The same solution is then concentrated and subjected to TLC or silicon gel in solvents such as acetone hexane, chloroform, carbon tetrachloride. Saponin is then detected as pink to purple spot by spraying the plate with antimony chloride in conc HCL and heating at 100°C for ten minutes. For separation of different types of saponin, it is necessary to carry out continuous development with methylene dichloride-USEther for 8 hours.

Use of natural surfactant :

Industrial use :

Cosmetic product, herbal product, mining industry, photography, Household cleaning (Laundry detergent, cleaning jewelry, washing car, kitchen and bathroom cleaning, fire extinguisher and emulsifying agent). Foaming agent (Beverage, soap, shampoos) Odour control (Ammonia and faecal odour of animal-pig, poultry etc.) As anti pastin (In agricultural plants - mites control, aphids control, beetles control, various pests control).

Medical use :

To improve immune system against diseases: decreases blood lipid, improve bone health, lower colon cancer risk, promote healing of skin injuries, enhance brain functions, inhibition of dental caries and platelet aggregation, treating malaria, to cure eczema, helpful in female reproductive health, synthesis of hormones, prevention of swine flu, cholesterol reduction, penetration of micro molecule through cell membrane etc.

Textile processing:

Natural surfactant is used to remove the impurities from raw material such as cotton, wool and silk. It is used as a lubricant, desizing agent, scouring agent, leveling agent, bleaching assistant. For dyeing purpose, natural surfactant is mostly need for - cellulose dyeing, polyester dyeing, acrylic fibre dyeing and as a dispersing agent.

Toxic effect of natural surfactant :

Toxic effect of surfactant is known as "Sapotoin".

Natural surfactants are poisonous for the animals like pig, poultry, swine, dog, fish, cattle, bacteria etc. Their poisonous effect on livestock show the following symptoms: - anorexia, weight loss, rough hair coat, gastroenteritis and diarrhea etc.

Natural surfactant in soapnut :

Out of the enlisted sources of natural surfactants, details information on soapnut which contain highest amount of saponin is given below-

The generic name is derived from the Latin word saponis-meaning soap and indicus -meaning the India. The number of species of soapnut available in India are :

- *Sapindus mukarossi* (East of the Himalaya)
- *Sapindus laurifolius* (Ritha, India)
- *Sapindus trifoliatus* (South India)
- *Sapindus delavayi* (China, South India)

A soapnut tree produces hundred kilos of berries each year. They are sometimes called wash berry or washnut. The dried nuts look like soft walnut. It contains highest amount of saponin (14%) having cleaning properties. They are naturally hypoallergic, odorless and do not damage the surface of any material. The small berry is approximately 2-2.5cm in diameter that are deseeded and shell is dried before used.

Common method of extraction of natural surfactant from soapnut :

Boil a few soap nuts (10-15 shells) for 5-10 min in a container of water. After it cools the soapnut shell is removed and poured it in a plastic or glass container and refrigerated it, without using any chemical. This liquid can be used to spray on plants for cleaning purpose, jewelry polish, as natural pesticides and to repel insect.

Laboratory method of extraction of natural surfactants:

Air dried plant powder is extracted with methanol in soxhlet apparatus set at 60°C for 24 hours. The solvent is evaporated at 50°C using rotary vacuum evaporator to obtain a semisolid extract and stored in a deep freezer at 180°C. The total methanolic extract is suspended in 1:1 ratio of water and methanol for period of six hours on a shaker. Methanol is evaporated at 70°C using rotary vacuum evaporator. This extract is air dried for 12 hours at room temperature. After concentration the methanolic extract is dissolved in minimum amount of distilled water and decant several times with n-butanol. The total natural saponin present is precipitated using diethyl ether and then filtered. The extract is then tested for the presence of natural surfactant. This liquid can be used to spray on plants for cleaning purpose, jewelry polish, as natural pesticides and to repel insect. Natural surfactant produced from soap nut by the above method is possibly the most significant green innovation in the history of every day household cleaning. A panel of

'Green expert' (University Professors, authors, scientists etc.) made the following statements on soap nut :

It contains 100% natural surfactant, ideal for sensitive skin, highest saponin content, light yellow fine powder 100 per cent water soluble, low agriculture chemical and foaming ability – 150 mm. Moreover, it preserves the colour and structure of valuable clothing longer than normal detergent. It is gentle to hand and body and no chemicals involved.

The emerging interest in natural product boosted the demand for natural surfactant containing sources. It can give a good performance in wash and safety to the consumer, help in conservation of petroleum stock and reduce waste and carbon di oxide emission. They found abundantly in nature and its use would not lead to any significant reduction in water or air emissions nor would it reduce energy consumption across the life cycle of the surfactant. Although, it is difficult to replace the use of synthetic soap and detergent with natural surfactant for cleansing purpose, we can diminish the use of it in our everyday life. We have to know that, natural surfactant is 60-70 per cent cheaper

than synthetic surfactant and beside cleansing, it has some medicinal value which is now highly recognized in China and in the Eastern countries. Thus, the natural surfactant not only support the local economy of a region but the antimicrobial and antibacterial properties against microorganisms made them an important part and partial of human life.

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■ REFERENCES

- Borthakur, N.** (1978). Chemical investigation of certain medicinal plant of Assam. Ph.D. Thesis, Guwahati University, Guwahati, ASSAM (INDIA) pp. 34.
- Dutta, A.C.** (1985). Dictionary of economic and medical plant G.H Road Cinnamora, Jorhat, Assam. pp-21, 66,100, 178,189,191.
- Harborne, J.B.** (1973). *Phytochemical method*. Chapman and Hall London, Toppan Company Limited Tokyo Japan, pp.116 125.

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