Reetha and Shikakai as Natural Surfactants for Cleaning of Historic Textiles

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ABSTRACT *Historic textiles cannot be washed in a washing machine or with a commercial detergent. Washing of historic textiles in textile conservation is done after considering various factors such as condition of textile, age of textile, colour fastness of dyes, type of fibre and type of stain. Washing of historic textiles is done to remove unwanted materials such as dust, dirt, stains etc., which may be damaging to the textile object. Organic surfactants have been used in India as detergents and shampoos since ages. They have been widely used in the laundry industry and researched for their medicinal properties. Moreover, organic surfactants are easily available, cheap and eco-friendly. The aim of this study was to find out the main cleaning agent (saponin) present in reetha (sapindusmukorossi) and shikakai (acacia concinna) by GC-MS and to find out the potential of reetha and shikakai as natural surfactants for washing of historic textiles.*

Keywords: *reetha, shikakai, GC-MS, historic textiles*

INTRODUCTION

The earliest Indian textiles have been recorded in literature such as the Vedas and found in ancient sculptures. First archaeological evidences of cotton textiles were found in the Indus Valley Civilisation. Textiles play an important role in the socio-economic role in the society. They provide a platform for artistic and cultural developments. They come in various materials, shapes, designs and colours. With development in technology new manufacturing techniques and materials have also emerged. However, to preserve and conserve these ancient textiles, is a challenge. Since, historic textiles are organic in nature, they are fragile and more susceptible to deterioration than inorganic materials. Thus, conservation of historic textiles requires skilled and careful deliberations about materials used for conservation, dyes and display techniques suitable for historic textiles. Moreover, art conservation is a multi-disciplinary field. It borrows materials, techniques and knowledge from various fields such as fine arts, chemistry, carpentry, architecture etc. Since, it is a relatively small field, commercial materials required for conservation are not tailor made for the purpose of conservation. Conservators conduct tests and after many trial and errors a product is selected to be used for conservation. In textile conservation, conservators have been using use synthetic surfactants recommended by international organisations and institutions. Obtaining those conservation grade products is a costly affair. However, organic detergents are being preferred world over due to concern for the environment. Traditional soapnuts have been used as shampoos, detergents and for cleaning gold and silver jewellery for centuries in India. They are cheap, easily available and easy to use. They are organic in nature and have no harmful effects to the environment or humans. Moreover, reetha and shikakai have excellent cleansing properties.

In textile conservation there has been a search for a suitable biodegradable detergent for the wet cleaning of historic textiles. Studies have been conducted to find organic substitutes to synthetic detergents. Surprisingly, even though reetha and shikakai are easily available in India, they are not preferred as a cleaning agent for wet cleaning of historic textiles by textile conservators. Hence, this study was conducted as an investigation between reetha and shikakai as a potential organic surfactant for the textile conservation.

In discussing the environmental concerns of surfactants and their biodegradability, natural surfactants are proving to be a good alternative to synthetic surfactants (Muntaha & Khan, 2015, (Ghagi, Satpute, Chopade, & Banpurkar, 2011). Natural surfactants are biodegradable, less toxic, cost effective, biocompatible, easily available in bulk, effective in high temperatures, pH and salinity and environment friendly; which constitute as a 'good surfactant'. Natural surfactants may be plant or animal based called saponins and humic compounds respectively(Muntaha& Khan, 2015).

Saponins have been researched and used in textile conservation. Saponin is the main surface active agent responsible for foaming properties in plants belonging to the genus of Sapindaceae and family Sapindeae(Ghagi et al., 2011). A variety of saponin rich species have been reported such as, 'soapwort (Saponariaofficinalis), Sapindustrifoliatus, soapbark (Quillajasaponaria), Sapindusemarginatus, soap root (Chlorogalumpomeridianum), soapnut (Sapindusmukurossi) or soapberry (Sapindussaponaria)' (Muntaha & Khan, 2015). In India two species of soapnuts or reetha are found; Sapindusmukurossi in the north and Sapindustrifoliatus in the south. Types of saponins found in the soapnuts fruit are triterpenoid-type and, steroid. (Babbar-Sebens, Li, Song, & Xie, 2013). Shikakai (Acacia Concinna Linn. (Leguminosae) is a plant whose pods also contain saponins based on acacic acid (Khanpara & Harisha, 2015). Lalan, (1982) washed brocaded textiles with reetha and shikakai.

Saponins are made up of glycosides and terpenoid. Based on their structure saponins are of two types- triterpene and steroid aglycone (sapogenin). Since, the structure of saponins contain both hydrophobic aglycone and hydrophilic sugar chain(s) (amphiphilic nature), they have excellent emulsifying, foaming and detergency properties (Netala, Ghosh, Bobbu, Anitha, & Tartte, 2015). Triterpenoidsaponin is a naturally occurring surface active glycosides of triterpenes(Garai, 2014). Triterpenoids are classified into three groups: acyclic, tetracyclic and pentacyclic. The pentacyclictriterpenes are further divided into three main classes: oleanane, ursane and lupine. The most common type of triterpene being oleanane;; oleanolic acid being the most common aglycone(Alqahtani et al., 2013). The presence of one or two carboxyl groups in the aglycone and/or sugar, causes the acidic nature in many pentacylictriterpenoids.

METHOD

Reetha and Shikakai fruits were purchased from an export company and verified by a botanist. The samples were cleaned and seeds were removed. The pericarp (flesh) was crushed into a fine powder and was used for extraction with methanol. The extraction was done by soaking the reethasoapnuts and shikakai pods in 1ml methanol for 24 hours each and filtered to be used as a sample for analysis with GC-MS instrument. The GC-MS analysis was done by GC-MS-QP-2010 Plus Ultra (Shimadzu company). Helium gas was used as a carrier gas at a constant flow of 16.3 mL/min with the injection volume of 1ml. The Column Oven Temp was at 60.0 °C and Injection Temp at 260.00 °C. The total GC-MS running time was 45 min. The interpretation of mass-spectrum was done using the National Institute Standard and Technology (NIST) and Wiley library database. The structure of the compounds along with name and molecular weight were established as well.

RESULTS

Compounds found in Reetha (SapindusMukorossi) were as follows- The compound [3R-(3α,3aβ,6α,7β,8aα)]- octahydro- 3,6,8,8- tetramethyl- 1H- 3a,7- methanoazulene-known as Cedrane was found in reetha sample which is a triterpenoidsaponin fundamental parent; having a molecular formula of $C_{15}H_{26}$. Another triterpenoidsaponin compound was found (6E,10E,14E,18E)- 2,6,10,15,19,23- hexamethyltetracosa- 2,6,10,14,18,22- hexaene known as squalene with a molecular formula of $C_{30}H_{50}$. A third triterpenoidsaponin compound 1-oxo-3β-hydroxyolean-18-ene was detected which is a pentacyclictriterpenoidsaponin having a molecular formula of $C_{30}H_{48}O_2$. Oleic acid and steric acid were also detected which are among the main chemical constituents of saponins. Compounds found in Shikakai (Acacia Cocinna) were – squalene, a triterpene compound (6E, 10E, 14E, 18E)- 2,6,10,15,19,23 hexamethyltetracosa- 2,6,10,14,18,22- hexaene, was found in shikakai as well with molecular formula of $C_{30}H_{50}$. Naturally occurring betulin which is a pentacyclictriterpenoid was detected (3β)-lup-20(29)-ene-3, 28-diol. Its molecular formula is $C_{30}H_{50}O_2$.

CONCLUSION

The GC-MS results show that both reetha and shikakai have saponins present in them. Saponin is the main cleaning agent responsible for cleansing properties. While reetha has more types of saponins than shikakai. Since, both reetha and shikakai have cleansing properties, they may be suitable for washing of historic textiles. Moreover, being acidic in nature they are suitable for washing protein fibres as well. Since, alkaline solutions damage protein fibres.

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When you can't change the direction of the wind — adjust your sails.

~ H. Jackson Brown