# A STUDY ON APPLICATION OF MICROENCAPSULATED FRAGRANCE OILS ON COTTON AND BAMBOO COTTON FABRICS

## 1.1. INTRODUCTION

Textile is a challenging industry in the world with its diversified and continuously developed new products. Textiles play a central role in estimating the human culture by being at the lead of both technological and artistic developments. The success of the textile industry is based on the fashionable and colourful textiles matching the demand of the consumers.

Cotton is a natural fibre. It is a soft and cool fibre and also cellulosic fibre. It is an enormously important commodity throughout the world and cheapest fibre. Cotton is one of the fabrics which are more predominantly used in medical field.

Bamboo fabric has many excellent properties for soft and light and it is silky in nature. It's breathable and cool to wear. It has an anti-bacterial property that is maintained in fabric. Bamboo fibre is one of the most suitable fibre in medical textiles.

The teak tree grows well in hilly and dry areas. It requires a dry tropical climate for its growth. It flowers in the month of February and March. Teak also holds the medicinal value. The bark is bitter tonic and is considered useful in fever. It is also useful in headache and stomach problems, digestion may be enhanced by the teak wood (or) bark. Its wood contains scented oil which acts as repellent to insects. The bark and leaves yield the dye which is used to colour the clothes and are edible.

The essential oils are the aromatic, natural compounds extracted from various parts of plants like leaves, flowers, steams, roots and bark etc. The essential oils have aromatic fragrant molecules that can actually pass right through the blood/ brain barrier having a direct effect on the areas of our brain in charge of controlling feelings of stress and even panic and depression, blood pressure, breathing problems and immune functions. It can react without side effects. It can be used to impact the limbic systems for natural cleaning and the emotions. Which are supports health and wellness efforts of stress relief.

Bergamot oil extract got from citrus fruit peel is acquired from Citrus Bergamla tree. Therapeutic properties are Analgesic, antidepressant, antiseptic, antiviral, carminative, cicatrising, deodorant, digestive febrifuge, and sedative, vulnerary. Bergamot oil reduces both work related stress and pre-operative stress.

The marjoram plant, Organism majorana, is an herbaceous perennial that is a member of the Lamiaceac family. This plant can grow to be one to two feet in height. Its leaves are grey-green in colour and tiny, tubular flowers are white (or) pale pink in colour. It blends well with Bergamot, Cypress, Lavender and Rosemary essential oils when diffused. Marjoram oil extract is extracted from flower. Its properties act as an analgesic, antispasmodic, anti-septic, anti-viral, bactericidal, carminative, cordial, diaphoretic digestive, diuretic, fungicidal, hypertensive, sedative, and stomachic. Marjoram can be taken internally to help support a healthy cardiovascular and immune system. Applying marjoram oil finish to the fabric provides calming properties that help relax emotions during stressful moments and helping peaceful sleeping.

Frankincense oil is sourced from resin of the Boswellia carters or Boswellia sacra tree. Boswellia sacra tree is commonly grown in Somalia and it is grown in very little soil at dry and desolate conditions. This tree native to India found to have strong anti- inflammatory and potentially anti-cancer effects.Frankincense oil is used by inhaling the oil to cure the problems of limbic systems and to reduce high blood pressure and it has anti-anxiety, depression and reducing abilities. Textile industry introducing encapsulated products are used in between 1980s and 1990s. During the last ten years, the micro-encapsulated process has been widely used by the agricultural, food, cosmetics and textile industries. Micro-encapsulation is a process of enclosed in microscopic particles by formulation of thin coatings of wall materials, which may be enclosed by solids, liquids and gasses.

There are many positive benefits to apply micro-encapsulation for smoothly release fragrance. The fragrance with β cyclodextrin including were formed by mixture solutions of alcohol and distilled (water1:3). The solution was emulsified with a high-speed mixer; this emulsified system was transferred into a flask. The fragrance alcohol solution was added into the emulsified and stirred well at temperature and the fragrance inclusions were fixed into fabrics. Cyclodextrins are the best regarding safety to human body because β cyclodextrin has no skin irritation.

Considering these aspects in mind the investigator has chosen the study on "A study on application of microencapsulated fragrance oils on cotton and bamboo cotton fabrics" with the following objectives:

- To procure cotton and bamboo with cotton fabric for the study
- To subject cotton and bamboo with cotton fabric for pre-treatment processes
- To select fragrance oils for the study and there by its extractive process
- To microencapsulate the selected fabrics with fragrance oils and apply on bed linens

To assess the microencapsulated finished fabrics for subjective and objective evaluation

## 2.1. EXPERIEMNTAL PROCEDURE

### SELECTION OF MATERIAL

Cotton and Bamboo Cotton were selected for the study. For this study, the investigator has purchased 15 metres of each fabric with 30's count and with bamboo cotton fabric with 70:30 percentage blend ratio

**PREPARING PRE-TREATMENT PROCESS**

Gray fabric contains various added and natural impurities which in subsequent process, coloration and finishing therefore removal of these impurities assume greater importance to avoid rejection of the final product. With regarding to the pre treatments, the following sequence is followed in this study for pre treatment.

Singeing —› Scouring — › Bleaching

**SINGEING PROCESS**

Gas singeing was done to burn the protruding fibres using gas flames. Both the samples were passed for gas singeing to obtain smoothness in texture.

**SCOURING**

The bath, was prepared with pint temperature and 500 grams of caustic soda and 50 grams of natural soap were added and dissolved thoroughly. The cotton and bamboo cotton fabrics in the prepared were immersed at 140° c and the temperature was maintained for two hour or until it seemed thoroughly cleaned.

The fabrics were washed well in fresh warm water to remove all impurities and the fabrics were dried.

**BLEACHING**

The scouring sample was weighed and the bleaching solution was prepared as following, the chemicals hydrogen peroxide, sodium silicate, agent were mixed in a bath and required amount of water was added to the mixture. The temperature was raised to the boiling point and kept for 30 minutes. Then the sample was taken out and rinsed thoroughly and dried under direct sun. The procedure was repeated for all the two samples.

**SELECTION OF FRAGRANCE OILS**

The health benefits of the Frankincense, Bergamot and Marjoram oils can be attributed to properties like antiseptic, stress relief, disinfectant, anti bacterial and astringent etc. Considering the beneficial properties of the above, the three oils were selected for this study. The botanical names of fragrance oil and also the parts from which the extract is taken from these sources are shown in the following table.

**TABLE-I**

| COMMON NAME | BOTANICAL NAME | PART USED |
|---|---|---|
| Frankincense | Boswellias sacara | Resin |
| Bergamot | Citrus bergamia | Fruit peel |
| Marjoram | Origanum majorana | Leaves |

**SELECTION OF DYE**

Teak dye is taken from its bark and the dye is thought to have many medical properties and mostly used in Asia and India. It is also used as an antibacterial agent and for getting a light brown shade. The botanical name of Teak wood tree is, "Lamiaceae". In this process, the freshly prepared dye concentration solution was applied on cotton and bamboo cotton fabrics. Onion skin and Alum powder was used as mordant for dyeing process with post mordanting technique.

Initially, 10 kilograms of teak wood bark was collected and dried in closed atmosphere and the bark was grounded into powder. The dye powder was put in a dye bath and 1 to 2 gallons of water was added and allowed to boil. Further 500 grams of natural onion skin and alum mordant were added stirred thoroughly. The solution was maintained at the lesser temperature for an hour, stirred thoroughly and filtered. The fabric was soaked in the dye vessel and boiled to 80℃-90℃ for an hour. Finally the samples were rinsed thoroughly and dried in shaded place.

**SELECTION OF FINISHING METHOD**

Microencapsulation is a process in which tiny particles are surrounded by a coating to give capsules with the useful properties. There are many microencapsulation techniques including Complex Coacervation, Polymer-Polymer Incompatibility, Interfacial Polymerisation and In Situ Polymerisation, Spray Drying, Centrifugal Extrusion, Air Suspension Coating, Pan Coating, Emulsion Hardening Process and Co-precipitation method.

**CENTRIFUGAL EXTRUSION TREATMENT**

The centrifugal extrusion treatment is excellent for forming particles 400-2,000µm (16-79 miles) in diameter. The drops are formed by the breakup of a liquid jet, the process is only suitable for liquid or slurries. A high production can be achieved in this microencapsulation method. Hence the investigator has selected centrifugal extrusion method of microencapsulation treatment.

The microencapsulation process was carried out with the following specifications;

- $C_6H_9\ NaO_7$: Molecular Weight (216.121 To 234.14 g/mol), preparation at
- $CH_2$ –COOH : Molar Mass:104.o615,Molecular Weight:74.079 g/mol
- $H_2O$: Molecular Weight: 18.015 g/mol, mineral water.

The temperature was gradually increased from 0° to 60° c. $C_6H_9\ NaO_7$ and (-$CH_2$-COOH) was dissolved fully inside the water. Slowly the required amount of fragrance oil was added. Continuous stirring was done by magnetic stirrer/soxlet for 20-30 minutes. $Na_2So_4$ was used as buffer to the solution. The $_{pH}$ was raised from 8-9.5 and $CH_2O$ was added to harden the walls. The dyed materials such as cotton and bamboo cotton fabrics were soaked in the above solution and the samples were exposed to the microencapsulation treatment with fragrance oil for required time intervals (20 minutes). Further the samples were dried. Finally the samples were subjected to evaluation.

**NOMENCLATURE OF SAMPLES**

The following table indicates the nomenclature of samples for the study.

**TABLE**

| S.NO. | SAMPLE CODE | SPECIFICATION |
|---|---|---|
| 1. | UC | Untreated cotton |
| 2. | BC | Bergamot cotton |
| 3. | MC | Marjoram cotton |

| | | |
|---|---|---|
| 4. | FC | Frankincense cotton |
| 5. | UBC | Untreated bamboo cotton |
| 6. | BBC | Bergamot bamboo cotton |
| 7. | MBC | Marjoram bamboo cotton |
| 8. | FBC | Frankincense bamboo cotton |

The above samples were named according to the first letter of the samples and process.

### 3.1. RESULTS AND DISCUSSION

### SUBJECTIVE EVALUATION

**Sensorial evaluation of scent intensity**

A sensorial evaluation of result was reacted by scent intensity in insulated booths where the fabrics were kept on a table at open room temperature and smelled every five days in order to sense that treated material. (Plates 1-3).

**PLATE -1**
**BED LINENS-BC and BBC**

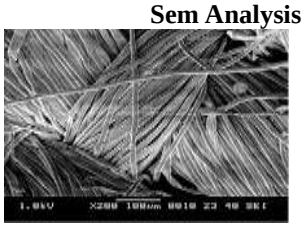
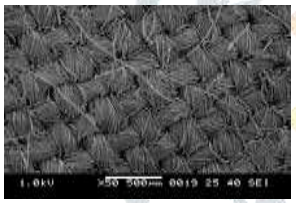

**PLATE-2**
**BED LINENS-MC and MBC**


**PLATE-3**
**BED LINENS-FC and FBC**

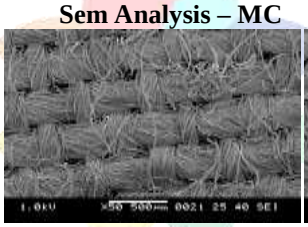
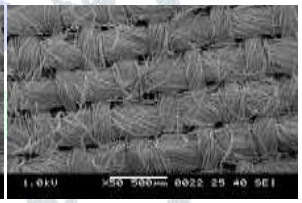

**SEM ANALYSIS**

The scanning electron microscope (SEM) is a type of electron microscope that images the sample surface by scanning it with a high-energy beam of electrons in a raster scan pattern. The presence, binding and availability of treated herbals on the fabric were analysed using scanning electron microscopy.

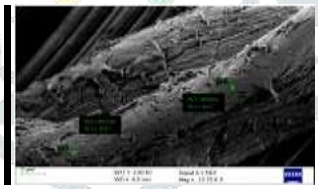
**Sem Analysis – BC**

**Sem Analysis – MC**

**Sem Analysis – FC**

**SENSORIAL EVALUATION OF SCENT INTENSITY**

The results of sensorial evaluation of scent intensity inspection are given the table.

**SENSORIAL EVALUATION OF SCENT INTENSITY**

| S. No. | Fragrance Substance | Scent intensity in cotton & bamboo cotton fabric | | | | | |
|---|---|---|---|---|---|---|---|
| | | 5 days | 10 days | 15 days | 20 days | 25 days | 30 days |
| 1 | BC | +++++ | +++++ | +++ | +++ | +++ | ++ |
| 2 | MC | +++++ | +++++ | +++ | +++ | +++ | ++ |
| 3 | FC | +++++ | +++++ | ++++ | ++++ | ++++ | ++++ |
| 4 | BBC | +++++ | +++++ | ++++ | ++++ | ++++ | ++++ |
| 5 | MBC | +++++ | ++++ | +++ | ++ | ++ | ++ |
| 6 | FBC | +++++ | +++ | +++ | ++ | ++ | ++ |

**+++++express every strong, ++++express strong, +++express common, ++ express weak, + express very weak.**

From the result of the sensorial evaluation, it is evident that all the samples, both conventionally treated and microencapsulation fragrance oil treated are rated as good regarding general Appearance by majority of the judges. The lustre was found to be almost similar in all the samples. The only difference was found regarding the texture of the sample. The microencapsulation fragrance oil treated sample namely BC, MC, FC and BBC, MBC, FBC are found to have better texture than the untreated samples.

**LABORATORY TESTS**

**FABRIC WEIGHT**

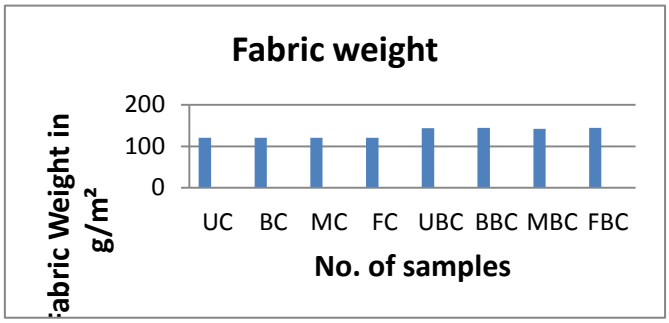



**FIGURE NO.1**

It is clear that all the treated cotton samples has gained fabric weight among which MC has gained highest weight. When compared to the untreated bamboo cotton samples, BBC and FBC has gained fabric weight.

**FABRIC THICKNESS**

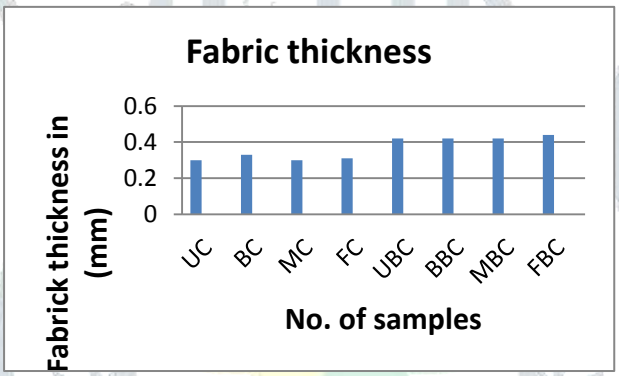



**FIGURE NO. 2**

The fabric thickness has been increased in the samples BC and FC when compared to UC. Further the fabric thickness remains the same in the samples BBC and MBC where as the sample FBC has thickness has shown a reduction. When analyzed, among the three oils, Bergamot oil gained fabric thickness in both the samples.

**EVALUATION OF COLOR FASTNESS THROUGH CROCKING**

The following table shows colour fastness of the fabric through crocking method.

**COLOR FASTNESS TO CROCKING – (ISO 105-X12)**

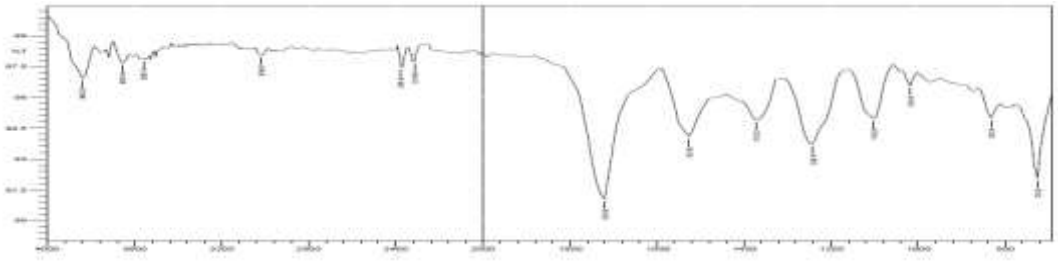
| S.No. | Sample code | Colour Fastness to dry crocking | Colour Fastness to wet crocking |
|---|---|---|---|
| 1. | BC | 4/5 | 3 |
| 2. | BBC | 5 | 2/3 |

It is evident from the above table that the samples MC, FC, BBC and FBC showed excellent colour fastness to dry crocking. When analyzing wet crocking, all the samples showed medium colour fastness with the rating of three except BBC with the rating of 2/3.

**Fourier Transform Infrared Spectra (FTIR) test for Cotton fabric**

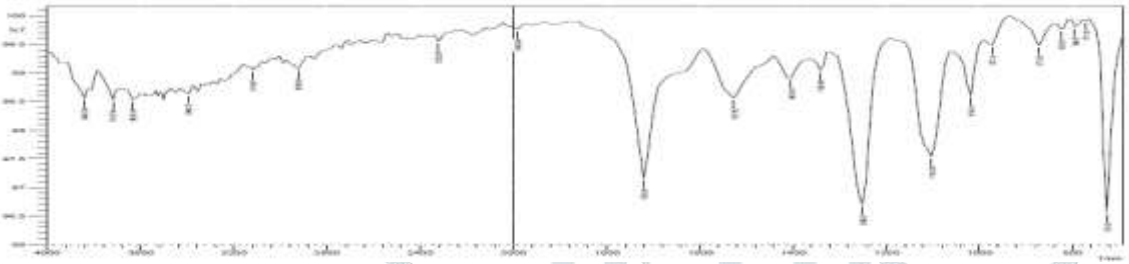
The result of the FTIR analysis are presented in the following figure.9-14

**FIGURE NO.9**



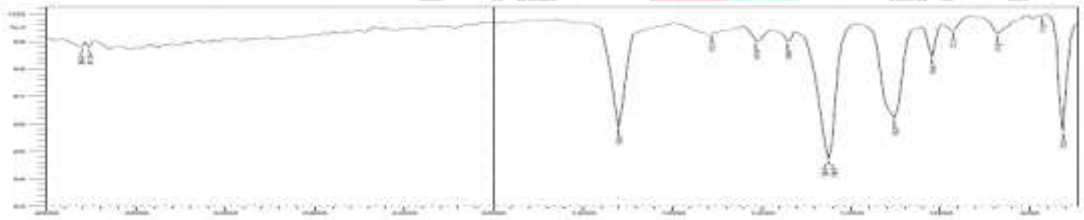
In Fig 9, Fourier Transform Infrared Spectroscopy of cotton woven fabric treated with Bergamot oil analysed. In that, a small absorbance shows the band at region 3500 $cm^{-1}$ was due to stretching vibration of O-H groups indicative of the alcohol and carboxylic acid groups. The band at 1720.50 $cm^{-1}$ was due to stretching vibration of C=O groups indicative of the carboxylic acid groups. The absorbance of sharp band at 1527.62 $cm^{-1}$ was due to C=C stretching of conjugated olefins and aromatic groups.

**FIGURE NO.10**



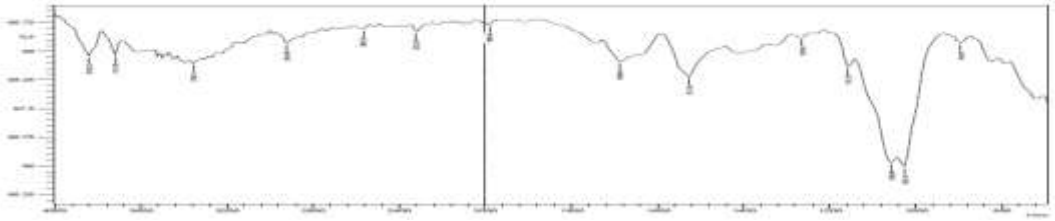
In Fig 10, Fourier Transform Infrared Spectroscopy of cotton woven fabric treated with Marjoram oil is analysed. In that, it shows the band at above 3300 $cm^{-1}$ was due to stretching vibration of O-H groups indicative of the alcohol and carboxylic acid groups. The absorbance of sharp band at 1527 $cm^{-1}$ was due to C=C stretching of conjugated olefins and aromatic groups.

**FIGURE NO.11**



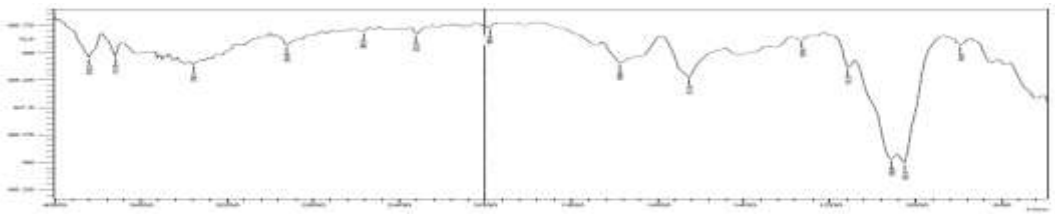
In Fig11, Fourier Transform Infrared Spectroscopy of cotton woven fabric treated with Frankincense oil is analysed. In that, it shows no characteristic peaks in the region 1800 $cm^{-1}$ to 4000 $cm^{-1}$. The band at 1720.50 $cm^{-1}$ was due to stretching vibration of C=O groups indicative of the carboxylic acid groups. The absorbance at 1249.87 $cm^{-1}$ was C-O stretching of Phenolic hydroxyl groups.

**FIGURE NO.12**



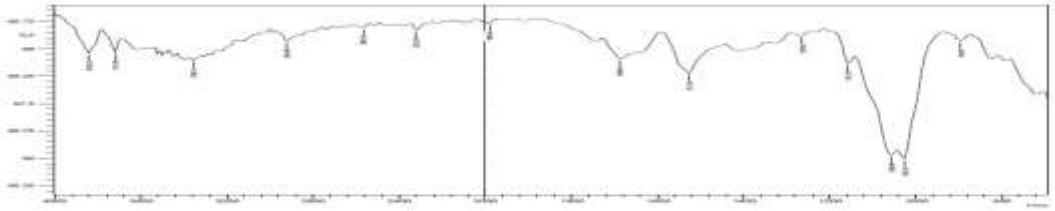
In Fig 12, Fourier Transform Infrared Spectroscopy of Bamboo Cotton woven fabric treated with Bergamot oil is analysed. In that, it shows there is no sharp peak is observed in that particular regions.

**FIGURE NO. 13**



In Fig 13,the Fourier Transform Infrared Spectroscopy of Raw Bamboo Cotton Fabric treated with Marjoram oil is analysed. It shows characteristic peaks in the region around 3500 $cm^{-1}$ due to stretching of O-H groups indicative of the alcohol's groups. The bands from1600 to 1450 $cm^{-1}$was due to aromatic skeletal vibration in lignin. Also the absorbance at 1370 $cm^{-1}$ was C-H bending of cellulose and that of 1230 $cm^{-1}$ was C-O stretching of Phenolic hydroxyl groups in the Lignin.

**FIGURE NO. 14**



In Fig 14,the Fourier Transform Infrared Spectroscopy of Raw Bamboo Cotton woven fabric treated with Frankincense oil is analysed. This result graph is very similar to sample-2. It shows characteristic peaks in the region around 3500 $cm^{-1}$ due to stretching of O-H groups indicative of the alcohol's groups. The bands from 1600 to 1450 $cm^{-1}$ were due to aromatic skeletal vibration in lignin. Also the absorbance at 1370 $cm^{-1}$ was C-H bending of cellulose and that of 1230 $cm^{-1}$ was C-O stretching of Phenolic hydroxyl groups in the Lignin.

Form the above figures, the Fourier Transform Infrared Spectra (FTIR) test for cotton fabric and bamboo cotton fabric test samples shows better coated effects in 40 washes. Results of MC and UBM samples are found to be good in the better coated effects when compared to all the samples.

## CONCLUSION

The application of newly innovated fragrance microencapsulated oil applied on 100% cotton and bamboo cotton fabrics are proved that they are equally good in all kinds of laboratory test. This microencapsulated fragrance oils are protected from bacteria and it shows greater protection from the bacterial and fungal infection. Further applications of such eco-friendly softening finishes provide enhance stress relief, skin disease and bacterial infections.

## REFERENCES


**[1]** AATTCC.,2008 "Technical Manual Of American Association Of Textile Chemist And Colorist Triangle Part Nc, AATCC,vol.10(Pp65,66). Arindam Basu(2005) "Textile Testing" , SITRA Coimbatore(Pp-337,350).

**[2]** "Bed sheet". Merriam-Webster.Retrieved 2012-Pp05-26.

**[3]** Julia Lawless,T he illustrated Encyclopedia of Essential oils: The complete Guide to the Use of Oils in Aromatherapy and Herbalism(ISBN 1852307218)1995.P-132

**[4]** Indian council of Forestry research and Education, Dehradum Teak (Forest Research Institution Agarwal A Goel A & Guptak.C textile dyers and printers, 25 (10),(1992), P-28.

**[5]** William Feinberg Burmese Teak: Trurning a new leaf East By South east Retrieved 20, Spetember 2015." Microencapsulation: A promising technique for controlled drug delivery". Research in pharmaceutical sciences 5(2):Pp 65-77

**[6]** "The Infracord double beam spectrophotometer" . Clinical science.16 (2) 1957.P-87

**[7]** Bansode SS Banarjee SK Gaikwad DD Jadhav SL Thorat R.M. Microencapsulation: a review march-april,2010,1,2 Article 008.Pp-34-90.

**[8]** Anthonys. Travis (1990) perkin's mauve Ancestory of the organic chemical industry. Technology and culture.31 (1): Pp(51,82).

**[9]** Groom Nigel (1981) Frankincense & Myrrh. A Study of the Arabian incense Trade. ISBN 0-86685-593-P-9.

**[10]** BIS2000Handbook Of Textile Testing, Published by Bureau Of Indian Standards Chandigarh,(p-89).

**[11]** Charanki (2007) Indias Place In The Global Cotton Market, Cotton Trade Seminar, Reinhert Publications Mumbai,(P-25).

**[12]** Gillow John and Sentance,.1999,"World Textile ", Thames Hudson Pvt Ltd, London,(Pp-158)

**[13]** Ghol and vilensky., 1983"Textile Science" CBS Publishers & Distributors Delhi,(Pp-48,50,120,122)

**[14]** Kothari V.K.1999"Testing and Quality Management "IFAL Publications Delhi,(p-106)

**[15]** Menachen., 2007,"Hand book Of Fibre Chemistry "Third Edition Taylor & Francis Group, LLC (Pp-656).

**[16]** ElberlingJ.,Linneberg A.,Johansen J.D.,Frolund L. Msdsen F., et al.Mucosal symtoms elicited by fragrance products in a population-based sample bronchial hyper- reactivity. Clin.Exp.Allergy 2005,Pp76,98.

**[17]** Barari M.Majidi R.F Madani .M (2009) Nanosci NanotechnologyPp 43-48.

**[18]** In – cosmetics (2007) Available at:www.in-cosmetics.com

**[19]** Ramya k.mahesh Wari V.(2014). Encapsulation techniques Internalional journal of pharamaceutics. Pp 245-55-62.

**[20]** Sheshachala. D.et al 2008" Comparative study of Bamboo and Cotton fabric" , Man Made Textile In India, September (Pp-300,301,302).