

**A comparative study on Microencapsulated and Ultrasonic finishes  
with selected natural sources.**

**By**

**YANSI GLORIYA. L**

**(20PTF023)**

**A Thesis submitted to the**

**Avinashilingam Institute for Home Science and Higher**

**Education for Women Coimbatore -641043**

**IN PARTIAL FULFILMENT OF THE REQUIREMENT FOR THE**

**DEGREE OF MASTER OF SCIENCE IN**

**TEXTILES AND FASHION APPAREL**

**MAY 2022**

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**Certified as Bonafide Research Work**

  
Signature of the Head of the Department

  
Signature of the Supervisor

## DECLARATION

I declare that the dissertation entitled "A comparative study on Microencapsulated and Ultrasonic finishes with selected natural sources." submitted by me for the degree of Master of science (M.Sc.) is the record of work carried out by me during the period from 2021 to 2022 under the guidance of Dr. S. AMSAMANI, M.Sc., M.Phil., Ph.D., Professor, Department of Textiles and Clothing, Avinashilingam Institute for Home Science Higher Education for Women, Coimbatore-642 043 and has not formed the basis for the award of any Degree, Diploma, Associate ship, Fellowship, Titles in this University or any other similar institution of higher learning.

  
Signature of the Candidate

## CERTIFICATE FROM THE SUPERVISOR

I certify that dissertation entitled "A comparative study on Microencapsulated and Ultrasonic finishes with selected natural sources." submitted for the degree of Master of science (M.Sc.) Textiles and Fashion Apparel by Yansi Gloriya. L is the record of project work carried out by her during the academic year 2021 to 2022 under my guidance and supervision and this work has not formed the basis for the award of any Degree, Diploma, Associate ship, Fellowship, Titles in this University or any other similar institution of higher learning.

  
Signature of the HOD

  
Signature of the Supervisor with Designation

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## 1.INTRODUCTION

Finishing are the final part of the construction or manufacturing process of fabric and forming the final of an element to the fabric. Textile finishes are important because they help to improve the appearance of the fabric and they also make the fabric more useful and suitable for an end use (Chopra, 2022). Fabric after the loom or knitting machine it is not readily useable. It's called grey cloth at this stage, it contains natural and added impurities. It can also processed at fiber or yarn stages of textile manufacturing. Grey fiber or yarn or fabric will go through processes such as wet processing and finishing. Finishing is a broad range of physical and chemical processes or treatments that complete one stage of textile manufacturing and preparing for the next step. And makes the product more receptive to the next stage of manufacturing. Finishing adds value to the product and makes it more attractive, useful, and functional for the end-user. Improving surface feel, aesthetics, and addition of advanced chemical finishes are some examples of textile finishing.

Textile processing is the most polluting manufacturing industries which are a heavy burden nowadays. Textile production requires large amount of energy, water and chemicals for the processing of textiles. These processes generate water, air and soil pollution. In consequence ecological restrictions over the synthetic chemicals and toxic finishing agents there has been an immense motivation for the use of natural products for different textile modifications. Therefore, it is necessary that the finishes are ecofriendly, biodegradable & non-toxic (Joshi, 2009). The textile industry is a big consumer of nanomaterials and there has been significant development in the use of nanomaterials in textiles finishing. They offer several functionalities such as flame retardancy, self-cleaning effect, UV protection, antcrease, antistatic, and antibacterial properties. Herbal finishes and the cheapest way of extraction technology of colorants. Intensive pharmacological studies about medicinal plants are undertaken. Many of the plants used for extraction are classified as medicinal and some of them possess remarkable antimicrobial activities. Finishing helps to improve the fabric but chemicals are used in this textile finishing process. The chemical substances such as waxes, chrome complexes, silicones and fluorochemicals. Out of all **types of chemical finishing process**, water repellent is the most common one. It might be danger so natural sources are replaced for it (Sathish, 2022).

Turmeric is a flowering plant. It is a perennial, rhizomatous, herbaceous plant native to the subcontinent of India and Southeast Asia that requires temperatures between 20 and

30 °C (68 and 86 °F) and a considerable amount of annual rainfall to thrive. Plants are gathered each year for their rhizomes. Turmeric powder has a warm, bitter, black pepper-like flavor and earthy, mustard-like aroma. Curcumin, a bright yellow chemical produced by the turmeric plant, is approved as a food additive by the World Health Organization. Although long used in Ayurvedic medicine, where it is also known as *haridra*, there is no high-quality clinical evidence that consuming turmeric or curcumin is effective for treating any disease. Turmeric is the ground root of *Curcuma longa* and its active compound is curcumin. Turmeric has antimicrobial, antioxidant, anti-inflammatory, and anticancer activities. It inhibits lipoxygenase and cyclooxygenase, thereby reducing levels of leukotrienes, thromboxanes, and prostaglandins. Topical turmeric has been evaluated for psoriasis and wound healing, but color and odour limit its use. Turmeric has been used for centuries in Chinese and Ayurvedic medicine for the treatment of dyspepsia and epigastric pain (Janani, 2022).

*Aloe vera* is a succulent plant species of the genus *Aloe*. It has more than 500 species, *Aloe* is widely distributed, and is considered an invasive species in the world. It grows wild in tropical, semi-tropical, and arid climates around the world. It is cultivated for commercial products, as a topical treatment used over centuries (Sahdeo, 2021). The species is attractive for decorative purposes, and succeeds indoors as a potted plant. It is used in many consumer products, including beverages, skin lotion, cosmetics and ointments or in the form of gel for minor burns and sunburns. There is little clinical evidence for the effectiveness or safety of *Aloe vera* extract as a cosmetic or topical drug. The name derives from Latin as *aloe* and *vera*. Glucomannan, a mannose-rich polysaccharide, and gibberellin, a growth hormone, interacts with growth factor receptors on the fibroblast, thereby stimulating its activity and proliferation, which in turn significantly increases collagen synthesis after topical and oral *Aloe vera*. *Aloe* gel not only increased collagen content of the wound but also changed collagen composition and increased the degree of collagen cross linking. As it accelerated wound contraction and increased the breaking strength of resulting scar tissue. An increased synthesis of hyaluronic acid and dermatan sulfate in the granulation tissue of a healing wound (Harper, 2021).

Finishing techniques such as bleaching and dyeing are applied to yarn and others are applied to the grey cloth directly after it is woven or knitted. These techniques or processes of textiles finishing are broadly classified as preparatory processes, stabilizing processes, and textural processes. preparatory processes is the unfinished fabric or the gray good may contain

many impurities such as dirt, soil, sizing, oils and other additives. As they need to be cleaned before proceeding towards finishing of the textiles so singeing, gassing and bleaching are applied. Stabilizing processes are required for improving properties such as strength, luster, and other qualities of the fiber so mercerization, ammoniating, shrinking, tentering, decating, enzyme washing is applied. Textural processes are meant for improving the texture of the fabric such as stiffness, smoothness, weight or strength so temporary stiffening, permanent stiffening, weight, calendaring, glazing, embossing, moireing, beelting, raising, sanding, napping, giggering, tigering, shearing and crepe & crinkled effect are applied ([www.textileschool.com/164/cotton-fibers-and-its-properties/](http://www.textileschool.com/164/cotton-fibers-and-its-properties/))

Cotton is a soft, fluffy staple fiber grows in a boll, or a protective case, around the seeds of the cotton plants of the genus *Gossypium* in the mallow family Malvaceae. Nearly 90% of the cotton fibers are cellulose. All plants consist of cellulose, but to varying extents. Bast fibers, such as flax, jute, ramie and kenaf, from the stalks of the plants are about three-quarters cellulose. Wood, both coniferous and deciduous, contains 40–50% cellulose, whereas other plant species or parts contain much less cellulose. The cellulose in cotton fibers is also of the highest molecular weight among all plant fibers and highest structural order, i.e., highly crystalline, oriented and fibrillar (Mishra et al., 2012). Cotton, with this high quantity and structural order of the most abundant natural polymer, is, not surprisingly, viewed as a premier fiber and biomass. Cotton fibers can hold water 24–27 times their own weight. They are strong, dye absorbent and can stand up against abrasion wear and high temperature. In one word, cotton is comfortable. Since cotton wrinkles, mixing it with polyester or applying some permanent finish gives the proper properties to cotton garments. Cotton fibers are often blended with other fibers such as nylon, linen, wool, and polyester, to achieve the best properties of each fiber. The plant is a shrub native to tropical and subtropical regions around the world, including the Americas, Africa, Egypt and India. The greatest diversity of wild cotton species is found in Mexico, followed by Australia and Africa. Cotton was independently domesticated in the Old and New Worlds. The fiber is most often spun into yarn or thread and used to make a soft, breathable, and durable textile (Novakovic et al., 2020).

Considering all these points and views, the investigator has planned to carry out a project entitled “A Comparative Study on Microencapsulated and Ultrasonic Finishes with natural Sources” with the following objectives,

- to select suitable natural sources for finishing,
- to select fabric for finishing,
- to incorporate the natural extract into the fabric using microencapsulation and ultrasonic methods and
- to analyse and compare the microencapsulated and ultrasonic finishes with fabric.

## 2. REVIEW OF LITERATURE

The review of literature pertaining to this research work is carried out under the following headings:

### 2.1 Cotton

#### 2.1.1 History of Cotton

#### 2.1.2 Characteristics of Cotton

#### 2.1.3 Types of Cotton

#### 2.1.4 Uses of Cotton

#### 2.1.5 Properties of Cotton

### 2.2 *Curcuma Longa*

#### 2.2.1 Advantages of *Curcuma Longa*

#### 2.2.2 Disadvantages of *Curcuma Longa*

### 2.3 *Aloe Vera*

#### 2.3.1 Advantages of *Aloe Vera*

#### 2.3.2 Disadvantages of *Aloe Vera*

### 2.4 Finishing

#### 2.4.1 Microencapsulation

##### 2.4.1.1 Advantages of Microencapsulation

##### 2.4.1.2 Disadvantages of Microencapsulation

#### 2.4.2 Ultrasonic Atomizer

##### 2.4.2.1 Advantages of Ultrasonic Atomizer

##### 2.4.2.2 Disadvantages of Ultrasonic Atomizer

## **2.1 COTTON**

Cotton fabric is one of the most commonly used types of fabrics in the world. Cotton is called as the king of fiber. It is a seed fiber, which is derived from lint on the cotton seed. It is the most widely used apparel material because it does not transmit moisture and is a very good absorbent. It gives comfort to the wearer (Eren et al., 2009). This textile is chemically organic, which means that it does not contain any synthetic compounds. Cotton fabric is derived from the fibers surrounding the seeds of cotton plants, which emerge in a round, fluffy formation once the seeds are mature. Cotton (*Gossypium hirsutum* L.) is an important industrial crop with an indeterminate growth pattern. Excessive vegetative development has been a major factor limiting yield improvement, particularly in ecological zones with a short growth period. (Sathianarayanan et al., 2019)

### **2.1.1 History of Cotton**

*Gossypium arboreum* is a diploid species cultivated in the Old World. It was first domesticated near the Indus Valley before 6000 BC (Agriso, 2005). The primitive *Gossypium arboreum* was perennial, and was once considered to have evolved from the wild *Gossypium herbaceum* in Africa. More recently, Wendel et al. have presented evidence that *Gossypium arboreum* was independently domesticated from a different wild plant that gave rise to *Gossypium herbaceum* (Alappat and Awad, 2010). *Gossypium arboreum* lost photoperiod sensitivity when it spread from the West India to the North and East India. The annual types of *Gossypium arboreum* facilitated extension to larger areas and evolved tolerance to diseases, pest and frost. Furthermore, environmental conditions associated with geographic distribution and domestication resulted in the development of considerable variation, which has been classified into six races, soundanense, indicum, burmanicum, cernuum, bengalense, and sinense in different regions. *Gossypium arboreum* was introduced into China from various routes, and was domesticated as a local crop between the 7th and the 13th centuries. It was thought that two primary routes of importation were overland from Bengal-Assam to the Yellow River, and by sea from Indo-China to the Yangtze River Valley. In the south of the Five Ridges area, Hainan Island and Yunan, *Gossypium arboreum* was only grown as garden plants until an extremely early-fruited type which were developed from Indian and Indo-Chinese varieties (Mishra, 2000). After the new technology of weaving was brought to the Yangtze River Valley in the thirteenth century, various landraces were developed and widely cultivated in the area of the middle and lower Yangtze River Valley, then spread to Northern

China encouraged by Imperial edict in the fifteenth century. The three major growing regions of *Gossypium arboreum* including the Southwest region, the Yangtze River Valley, and the Northern region were gradually formed with the breeding of local varieties. Then, the most important type, race *sinense*, was developed in China, until it was completely replaced by Upland cotton (*Gossypium hirsutum* L.) in the 1950s. As the cultivated ‘Old World’ diploid cotton, *Gossypium arboreum* experienced from natural and artificial selection due to environmental stress, and evolved to possess favorable characters that the tetraploid cultivars lack, such as drought tolerance, disease resistance, and insect pest resistance which makes it well adapted to biotic and abiotic stresses (Beckert, 2014), spinnable fiber with various colors and high strength that are good for weaving (Agrios, 2005). These *Gossypium arboreum* landraces with adaptive features are important genetic resources for the improvement of tetraploid cotton, and can help to develop cultivars with invaluable genes for early maturity, stress tolerance, and high fiber strength in cotton-breeding programs (Mishra, 2000). Understanding the genetic relationships among the landraces of *Gossypium arboreum* would facilitate efficient use for developing superior cotton cultivars with favorable agronomic traits.

### **2.1.2 Characteristics of Cotton**

Characteristics of Cotton Presently, plant-based products are widely used in textile industry for their low toxicity, biocompatibility, availability along with their environmentally friendly nature. In addition to that fabric offering comfort along with other advanced properties are of huge demand. Cotton is one among the most widely used textile fiber in the world. It is a soft, fluffy fiber that grows inside a protective case around the seeds of the cotton plant and it characterizes purest form of cellulose containing more than 90% of this polysaccharide. (Chequer., 2013)

### **2.1.3 Types of Cotton**

There are four commercially grown species of cotton, all domesticated in antiquity: *Gossypium hirsutum* is a upland cotton and native to Central America, Mexico, the Caribbean and southern Florida (90% of world production). *Gossypium barbadense* is known as extra-long staple cotton and native to tropical South America (8% of world production). *Gossypium arboreum* is a tree cotton and native to India and Pakistan (less than 2%). *Gossypium herbaceum* is a Levant cotton and native to southern Africa and the Arabian Peninsula (less than 2%). (Cintra et al., 2005)

Hybrid varieties are also cultivated. The two New World cotton species account for the vast majority of modern cotton production, but the two Old World species were widely used before the 1900s. While cotton fibers occur naturally in colors of white, brown, pink and green, fears of contaminating the genetics of white cotton have led many cotton-growing locations to ban the growing of colored cotton varieties. (Cheethaparambil et al., 2013)

#### **2.1.4 Uses of Cotton**

The use of cotton for fabric is known to date to prehistoric times; fragments of cotton fabric dated to the fifth millennium BC have been found in the Indus Valley Civilization, as well as fabric remnants dated back to 6000 BC in Peru. Although cultivated since antiquity, it was the invention of the cotton gin that lowered the cost of production that led to its widespread use, and it is the most widely used natural fiber cloth in clothing today (Chen et al., 2000). Current estimates for world production are about 25 million tonnes or 110 million bales annually, accounting for 2.5% of the world's arable land. India is the world's largest producer of cotton. The United States has been the largest exporter for many years ((PDF) Cotton: An Introduction (researchgate.net)).

#### **2.1.5 Properties of Cotton**

There are many properties for cotton in that generally it is classified into two that is physical and chemical properties. The physical properties of cotton are color of the fiber could be white, creamy white, bluish white, yellowish white or grey (Debjit, 2009). Cotton is moderately strong fiber. It has a tenacity of 3-5 gm/den. Moisture affects the strength of cotton greatly when the wet strength of cotton is 20% which is higher than the dry strength. Cotton does not stress easily. It has an elongation at break of 5-10%. Cotton is inelastic and rigid fiber. Specific gravity of cotton fiber is 1.54. standard moisture regain of cotton fiber is 8.5. cotton has an excellent resistance to degradation by heat. There is a gradual loss of strength when cotton exposes to sun light and the fiber turn yellow. The sun causes much of damage by UV – light and by the shorten weaves of visible light (Bairagi et al., 2005). Cotton shows a small loss of strength when stored carefully. The chemical properties of cotton are cotton is attacked by the hot dilute acids or cold concentrated acids which it disintegrates (Duke, 2007). It is not affected by acids. Cotton has as excellent resistance to alkalis. It swells in caustic alkalis but it does not damaged. Cotton has high resistance to normal cleaning solvents. It is not attacked by moth -grubs or beetles. Cotton is attacked by fungi and bacteria. Mildews will feed on cotton

fabric, rotting and weakening the materials ([www.textileschool.com/164/cotton-fibers-and-its-properties/](http://www.textileschool.com/164/cotton-fibers-and-its-properties/)).

## **2.2 *Curcuma Longa***

Turmeric is a flowering plant. The plant is a perennial, rhizomatous, herbaceous plant native to the Indian subcontinent and Southeast Asia that requires temperatures between 20 and 30 °C (68 and 86 °F) and a considerable amount of annual rainfall to thrive. The rhizomes are used fresh or boiled in water and dried, after which they are ground into a deep orange-yellow powder commonly used as a coloring and flavoring agent in many dishes, especially for curries, as well as for dyeing, characteristics imparted by the principal turmeric constituent, curcumin (Kew Science et al., 2018). Turmeric powder has a warm, bitter, black pepper-like flavor and earthy, mustard-like aroma. Curcumin, a bright yellow chemical produced by the turmeric plant, is approved as a food additive by the World Health Organization. Although long used in Ayurvedic medicine, where it is also known as *haridra*, there is no high-quality clinical evidence that consuming turmeric or curcumin is effective for treating any disease (Chandran, 2012). Turmeric, sometimes called Indian saffron or the golden spice, is a tall plant that grows in Asia and Central America. The turmeric that we see on shelves and in spice cabinets is made of the ground roots of the plant. The bright yellow color of processed turmeric has inspired many cultures to use it as a dye. Ground turmeric is also a major ingredient in curry powder. Capsules, teas, powders, and extracts are some of the turmeric products available commercially. Curcumin is the active ingredient in turmeric, and it has powerful biological properties. Ayurvedic medicine, a traditional Indian system of treatment, recommends turmeric for a variety of health conditions. These include chronic pain and inflammation (Nair, 2013). Western medicine has begun to study turmeric as a pain reliever and healing agent.

For its flavouring and digestive characteristics, turmeric (*Curcuma longa*) is extensively consumed. Curcumin, a phenolic yellow pigment is the key active component of turmeric. It has been traditionally used for centuries as a remedy for various disorders including the common cold, wounds, ulcers and liver disease (Jana et al., 2008). Also a number of studies have found that it can offer substantial benefits in a number of diseases, including heart disorders, diabetes, rheumatoid arthritis, Alzheimer's disease, inflammatory bowel illness, liver fibrosis and cirrhosis, HIV, pancreatitis, malaria and it is also reported to be a safe

chemopreventive agent that are able to suppress cancer metastasis (Hewlings and Kalman, 2017; Joe et al., 2004).

A clinical trial, in which 600-mg turmeric root was administered five times daily to patients with PUD, reported ulcer resolution at 4 weeks and 12 weeks in 48% and 76% of patients, respectively. The same study also demonstrated that turmeric markedly improves symptoms of dyspepsia in 1 to 2 weeks. Turmeric and curcumin, a commercially available turmeric derivative, are known to have activity against *H. pylori* in vitro. A clinical trial failed to demonstrate turmeric's ability to eradicate *H. pylori* completely but did observe relief of dyspeptic symptoms. Turmeric has been found to have H<sub>2</sub>-blocking properties, which likely also explains much of its healing potential (Chattopadhyay et al., 2004).

### **2.2.1 Advantages of *Curcuma Longa***

- It's anti-inflammatory - Inflammation is a necessary process in the body, as it fights off harmful invaders and repairs damage caused by bacteria, viruses and injuries. However, long-term inflammation has been implicated in most chronic conditions such as heart disease and cancer, so must be controlled, which is where anti-inflammatory compounds come in. The curcumin in turmeric has proven, strong anti-inflammatory properties that block the action of inflammatory molecules in the body. Studies show positive effects of curcumin on people suffering from conditions such as rheumatoid arthritis and inflammatory bowel disease, amongst others (Chandran, 2012).
- It can relieve pain - Many people, including doctors, their own anecdotal experience with turmeric as a pain reliever. The spice is reputed to relieve arthritis pain as well (Wahbeh, 2013).
- It improves liver function - Turmeric has been getting attention recently because of its antioxidant abilities. The antioxidant effect of turmeric appears to be so powerful that liver from being damaged by toxins (Hadi, 2019).
- It may help reduce the risk of cancer - Curcumin shows promise as a cancer treatment. it has protective effects against pancreatic cancer, prostate cancer, and multiple myeloma. many have found that it can affect cancer formation, growth and development at a molecular level. it can reduce the spread of cancer and can

contribute to the death of cancerous cells in a variety of cancers, and can reduce the negative side effects of chemotherapy (Hadi, 2019).

- It can aid your digestion - Part of the reason that turmeric is in curry powder is because it adds an element of deliciousness to food. But turmeric can also play an important role in digesting that food (Cas and Ghidoni, 2019). Because of its antioxidant and anti-inflammatory properties, turmeric can contribute to healthy digestion. It's used in ayurvedic medicine as a digestive healing agent. Now Western medicine has begun to study Source how turmeric can help with gut inflammation and gut permeability, two measures of your digestive efficiency. Turmeric is even being explored Trusted Source as a treatment for irritable bowel syndrome (<https://www.medicalnewstoday.com/articles/318405#takeaway>).
- There is growing evidence that curcumin can cross the blood-brain barrier and may help to protect against Alzheimer's disease. It works to reduce inflammation as well as the build-up of protein plaques in the brain that are characteristic of Alzheimer's disease sufferers. There is some evidence that curcumin can help in depression and mood disorders. Turmeric supplements lowered depression and anxiety symptoms and depression scores in multiple trials. While most of the current research is being carried out in a lab or on animals, the results are encouraging, and this wonderful spice will continue to be investigated as a powerful tool in improving our health (Poli, 2020).

### **2.2.2 Disadvantages of *Curcuma Longa***

- It can upset your stomach - The same agents in turmeric that support digestive health can cause irritation when taken in large amounts. Mild side effects include upset stomach, acid reflux, diarrhea, dizziness and headaches (Nelson et al., 2017).
- Consuming large doses of turmeric supplements can significantly increase the levels of urinary oxalate, increasing the risk of kidney stone formation.
- It may stimulate contractions - You may have heard that eating foods seasoned with curry can stimulate labor. Women who are pregnant or breastfeeding can eat food that contains turmeric as a spice but should avoid taking

turmeric supplements. These supplements may stimulate uterus contractions and cause complications.

- Immune health - It appears that there are health benefits to including turmeric in your diet. The golden spice supports immune health, helps relieve pain, and can aid in digestion, among other things. But because of some of its side effects, turmeric may not be worth taking for some people. It's important to use caution when deciding whether turmeric is something you need to try (<https://www.medicalnewstoday.com/articles/318405#takeaway>).
- It thins your blood - Turmeric's purifying properties may also make you bleed more easily. Since turmeric acts as a blood thinner, it should be avoided if you have a bleeding disorder. Turmeric can interact negatively with medications including blood thinners, antidepressants, antibiotics, antihistamines, cardiac medications and chemotherapy treatments. It can also interfere with diabetes medications and result in dangerously low blood sugar levels (Brennan, 2008).
- Turmeric can aggravate stomach problems, such as acid reflux and gallstones. Since turmeric limits iron absorption, you shouldn't take it if you are on iron supplements (Peter, 2008).

### **2.3 ALOE VERA**

Aloe vera is a succulent plant species of the genus Aloe. It has more than 500 species, Aloe is widely distributed, and is considered an invasive species in the world. It grows wild in tropical, semi-tropical, and arid climates around the world. (Cabi, 2019) It is cultivated for commercial products, as a topical treatment used over centuries. The species is attractive for decorative purposes, and succeeds indoors as a potted plant (Boudreau and Beland, 2006). It is used in many consumer products, including beverages, skin lotion, cosmetics and ointments or in the form of gel for minor burns and sunburns. There is little clinical evidence for the effectiveness or safety of Aloe vera extract as a cosmetic or topical drug. The name derives from Latin as aloe and vera. Aloe vera is a natural product that is now a day frequently used in the field of cosmetology. Though there are various indications for its use, controlled trials are needed to determine its real efficacy. The aloe vera plant, its properties, mechanism of action and clinical uses are briefly reviewed in this article (Perkins, 2016).

### **2.3.1 Advantages of *Aloe Vera***

In addition to having medicinal properties, *Aloe Vera* also has aesthetic advantages. The scalp is activated by *Aloe Vera*. It also eliminates dry scalp. It helps to reduce hair loss. For Shampoo, most brands also use *Aloe Vera*, conditioners, etc. It defends the skin of humans from harmful bacteria. When treating a variety of skin diseases, *Aloe Vera* is helpful. It is therefore used in lotions, creams and other gels by many cosmetic companies (Alyssa, 2018).

### **2.3.2 Disadvantages of *Aloe Vera***

If you have any kind of allergies, *Aloe Vera* should not be eaten. Rather than improving you, it will increase the allergy. *Aloe Vera*'s regular consumption will result in a decline in sugar levels (Kew, 2016). *Aloe Vera* can lead to dehydration and electrolyte imbalance in diabetic patients. If you have digestive problems, it will result in diarrhea with *Aloe Vera*. *Aloe Vera* has caused muscle weakness in some individuals. This is one of *Aloe Vera*'s common side effects. *Aloe Vera*'s raw intake will also result in Bloating Stomach. (<https://www.medicalnewstoday.com/articles/318405#takeaway>).

## **2.4 FINISHING**

Finishing is anything that is done on fibre, yarn or fabric before or after weaving, to change the appearance, feel, serviceability and durability (Sara, 2007). The term 'finishing' in the context of a textile process house encompasses several activities in its ambit, sometimes extends beyond the fabric stage to garment stage. Finish means any modifications of fabric or fabric surface to meet certain desired needs or specifications. Finishing is the final step of chemical process carried out to improve the aesthetic appeal of the ready to use product. Finishing is not only what catches the eye, but the feel and touch that the treated material imparts (David, 2005). It includes demand for more ecologically and toxicologically beneficial process and products. The aim of textile finishing is to render textile goods fit for their purpose or end use. Textiles enjoy a special status in society because of tradition and also due to the growing era of consumerism which is pushing the textile industry to higher limits (Tortora et al., 2013). Finishing operations enhance the fabric with a particular appearance, surface texture, covering faults, increasing weight or behavior characteristics like flame retardant, water repellent, stain repellent, antistatic, biocide, stiffening, shape, increase its serviceability,

retentive and wrinkle resistance. (Pickles et al, 2006) Buyers always expect a high degree of comfort and finishing plays an important role in achieving that. It adds attractiveness or desirability to the fabric and makes the fabric especially suitable for a particular purpose like antimicrobial and water proof finish. (Joshi et al, 2009).

The textile processing finishes are classified as chemical and mechanical. Chemical finishes are those in which chemical reactions by the treatment of alkalis, acids, bleaches, starches and resins produce a permanent change in the fibre, these are referred to as wet finishes. Mechanical finishes cause a physical change only, they are done by copper plates, roller brushes, perforated cylinders, metal flames or any type of mechanical equipment and are known as dry finishes (Hauser, 2004). A finish adds minimal cost to the textile material but results in a much greater value addition. Finishing can also be categorized by why and how they are added. There are two large group of finishes, they are basic and functional finishes. Basic finishes which are also called as preparatory finishes are added at the beginning of the textile products process. In next generation functional finishes in the textile Industry will make textile material act by themselves. 31 In now a days the finishes methods are a combination of chemical & mechanical finishes which tends to attractive and render easy care for functional properties of textile. The consumer's demands are not only defined by aesthetic properties, but also by the functional properties, thus increasing market share. Finishes can be categorized by their degree of performance. It includes the permanent finishes, durable finishes, semi-durable finishes and temporary finishes. It is further classified as aesthetic finishes and functional finishes which modify the appearance and improve the performance of the fabric. Functional finishing processes include mechanical process, heat setting, chemical process and surface coating. High performance and value added finishes have become necessary for textiles in daily use. Functional or special finishes are applied to fabrics to make them better suited for specific uses. The emergence of functional textiles as mainstream materials is producing a sparking revolution in the fashion industry. Specialty textiles use some specific technologies in addition to the conventional technologies so that the product would add value to a specific attribute (Roy, 2017). Novel finishes add high value to apparel fabrics and home textiles. They are also greatly appreciated by a more, discerning and demanding consumer market (Tortora et al., 2013). Consumers demand more durability and functionality from their clothing. Apparel makers must respond with garments that are technically advanced yet soft and comfortable. Many times functional finishes may or may not be seen easily but they serve a significant

purpose in the overall performance or function of the fibre, yarn or fabric. Some of the functional finishes are antimicrobial finish, water repellent, stain repellent and fire proof.

#### **2.4.1 Microencapsulation**

Microencapsulation can be defined as a process in which tiny particles or droplets are surrounded by a coating, or embedded in a homogeneous or heterogeneous matrix, to give small capsules with many useful properties. It can provide a physical barrier between the core compound and the other components of the product. In the food field, microencapsulation is a technique by which liquid droplets, solid particles or gas compounds are entrapped into thin films of a food grade microencapsulating agent (Benita, 2005).

Pad dry cure is a method of applying a finish on to fabric. The agent that has to be finished onto the fabric is diluted using solvent and mixed with cross linking agents like citric acid to fix the agents into the fabric surface and also to enhance the durability of the finish (Chandrasekaran and Senthilkumar, 2018). The diluted mixture is taken and padded to the fabric using the fabric roll which is fixed to the rollers in the machine and it is left to run for the optimized time. During this period, temperature and concentration are maintained to get an even finishing, the general structure of microcapsule consists of two major components. First is the active ingredient is the substance that may be in the form of liquid or solid. It is also referred to as the core content, internal phase, active, encapsulate, payload or fill. The second component is a polymer coating that surrounds the active ingredients which may also be called the wall shell, external phase, membrane or matrix (Agrawal, 2022). The release mechanisms of the core contents vary depending on the selection of wall materials and more importantly its end uses. The core content may be released by friction, pressure, change of temperature, diffusion through the polymer wall, dissolution of the polymer wall coating or by biodegradation (Cheng, 2008). Microcapsules range in diameter from 1 to 1000 Capsules greater than 1000 Ftm can be called macro capsules and those smaller than one p.m are called nanocapsules (Holme, 2003). The technique of microencapsulation depends on the physical and chemical properties of the material to be encapsulated. The micro capsules are developed by using different methods like pan coating, air suspension coating, centrifugal extrusion, vibrational nozzle, pad soaking, spray drying methods (Rani, 2021). The factors can range from photo-oxidation of oils or to deliquesce of sweeteners due to heat and humidity (protection of hygroscopic materials from moisture) Additionally, dehydration of juices makes easier to handle the core material, both in shipping and storage, by converting liquids in to a solid form and promotes an

easy mixing of the core material (Bhutkar, 2022). Microencapsulation also protects material from evaporation. Microencapsulation techniques are divided into three classes: chemical, physical and physico-chemical methods (Jyothi et al, 2012). Chemical methods include in situ polymerization and use of liposomes; physical methods include spray drying and fluidized bed coating and physico-chemical methods include coacervation and sol-gel encapsulation. The microcapsules produced by each method are different (Tarun, 2011). Although many techniques have been developed to microencapsulate food ingredients, spray-drying is the most common technology used in food industry due to low cost and available equipment. Microencapsulation by spray-drying has been successfully used in the food industry for Formulation and Characterization of Microencapsulated Solanum Anguivi L. and Emblica Officinalis extract powder as a dietary supplement for Iron Deficiency Anemia 32 several decades (Jangra, 2017), and this process is one of the oldest encapsulation methods used since the 1930's to prepare the encapsulated flavors using gum acacia as wall material initially. Spray drying is a well-known industrial technology used extensively on a large scale for drying heat sensitive materials from liquid, into a dry particulate (powder, granules or agglomerate) with minimal negative impact on the product (Begum, 2018). Spray drying involves complex interactions of process, apparatus and feed parameters (inlet temperature, air flow rate, feed flow rate, atomizer speed, types of carrier agent and their concentration) which all have an influence on the final product which produce a good quality product with less weight and moisture content, resulting in easy storage and transportation (Agrawal, 2022).

#### **2.4.1.1 Advantages and Disadvantages of Microencapsulation**

Providing environmental protection to the encapsulated active agents or core materials. Liquids and gases can be changed into solid particles in the form of microcapsules. Surface as well as colloidal characteristics of various active agents can be changed (Yosuhito et al., 2022). modify and delayed drug release form different pharmaceutical dosage forms. Formulation of sustained controlled release dosage forms can be done by modifying or delaying release of encapsulated active agents or core materials. Expensive techniques. This causes reduction in shelf-life of hygroscopic agents. Microencapsulation coating may not be uniform and this can influence the release of encapsulated materials. (<https://www.fibre2fashion.com/industry-article/7221/development-of-cosmetic-textiles-using-microencapsulation-technology>).

#### **2.4.2 Ultrasonic Atomizer**

An ultrasonic atomizer is a device that converts a normal stream of liquid into a very fine mist. It consists of a generator and a probe. The generator creates vibrations and focuses them at the tip of the probe. As the liquid flows through the probe, it is converted into fine particles. The ultrasonic atomizer is often used in manufacturing applications, such as coating fabrics, adding moisture to a gas stream and injecting small amounts of a liquid into a reactor (Lozona et al., 2003).

The ultrasonic atomizer has a power supply that converts low-frequency electrical energy to high-frequency electrical energy. This electrical energy is then converted into mechanical vibrations by a piezoelectric transducer, which is typically made of ceramic. The vibration is sent back to the piezoelectric transducer after it has bounced off the tip of the probe. This increases the strength of the vibration and creates a pumping action that draws liquid toward the center of the probe (Pandit, 2006). The ultrasonic atomizer has several advantages over traditional methods used to disintegrate liquids. Since the ultrasonic atomizer can precisely deliver a uniform spray, manufacturers can efficiently use raw materials and reduce pollution. The probe typically doesn't clog and is easily cleaned. This allows for the atomizing of several types of liquids, without the risk of contamination or erosion of the probe. Liquids containing long chain polymers, however, are difficult to atomize because of their strong cohesive properties. Liquid is introduced to the probe through an inlet on the side, usually by gravity or a low-pressure pump. There are different probes for different applications. A flat tip probe, for example, can focus particles at a specific location. A wide dispersion probe has an extended spray range, making it ideal for coating applications, and a radial probe is typically used to spray the interior walls of bores. As liquid travels through the probe, it spreads out and becomes flat. The vibrations divide the liquid into individual droplets. The size of the droplet is dependent on the frequency of the electrical energy. The greater the electrical energy frequency is, the stronger the vibrations produced by the piezoelectric transducer are. Stronger vibrations produce smaller droplets (Keiji et al., 2011). when the droplets reach the tip of the probe, they are sprayed out. The flow rate of the spray is dependent on the viscosity of the liquid and the electrical energy frequency. The higher the frequency and viscosity, the lower the flow rate. (Barreras, 2002)

#### **2.4.2.1 Advantages of Ultrasonic Atomizer**

The spray pattern is easy to shape and is suitable for precise coating applications. Can spray any shape object, uniform micron thick coating. Ultrasonic atomized spraying reduces downtime in critical manufacturing processes. Ultrasonic atomization ultra-low flow capacity, can work intermittently or continuously (Guocheng, 2017). Highly controllable spray volume, more reliable spray quality. Low energy consumption, high atomization efficiency, less restriction on atomized liquid. Can reduce waste and air pollution caused by reverse injection, and save costs. No pressure, no noise, no moving parts wear, no blockage. The atomizing nozzle is made of titanium material, which has strong height and corrosion resistance (Antonio, 2010).

#### **2.4.2.2 Disadvantages Of Ultrasonic Atomizer**

The Ultrasonic atomizer has narrow spray angle, deep penetration, and high density of aerosol. which mainly consists of large drops. They are mainly used in afterburners and igniters. To increase the spray angle, the atomizers with several nozzles (multi-jet) fed from a single passage are used (Guocheng, 2017). To widen the spray angle in one plane and to reduce the penetration, it is possible to apply slot atomizers. Such devices have a nozzle rectangular in cross-section (instead of the cylindrical one) and produce flat fuel sheet at the exit. Next the most widespread atomizers of the hydraulic spray group are of the centrifugal type. However, one of the first works where the “principle of maximum flow rate” (the basis for the modern methods of centrifugal atomizers calculation) was set (Yasuhito, 2006).

### 3. METHODOLOGY

“A comparative study on Microencapsulated and Ultrasonic Finishes with Selected Natural Sources” is done by effective experimental work, to find out the feasibility of using the fabric. The study was designed and done by giving Microencapsulated and Ultrasonic finishes to the fabrics and thus finished fabric is compared with each other.

#### 3.1 Selection of Fabric

#### 3.2 Preparation of Fabric

##### 3.2.1 Desizing

#### 3.3 Selection of Natural Source

##### 3.3.1 *Curcuma longa*

##### 3.3.2 *Aloe vera*

#### 3.4 Preparation of Extract from Source

#### 3.5 Finishing Method

##### 3.5.1 Microencapsulation Padding Mangle Method

###### 3.5.1.1 Preparation of Microcapsules

###### 3.5.1.2 Finishing Using Padding Mangle

##### 3.5.2 Ultrasonic Atomiser

###### 3.5.2.1 Finishing Using Ultrasonic Atomiser

#### 3.6 Evaluation

##### 3.6.1 Fabric Weight

##### 3.6.2 Fabric thickness

##### 3.6.3 Fabric Stiffness

##### 3.6.4 Tensile Strength

##### 3.6.5 Absorbency

#### 3.7 Statistical Analysis

### **3.1 Selection of Fabric**

Cotton, the king of fibres and also known as white gold has been at the centre of the world textile economy since the last century. Cotton fabric is of natural fibre and it doesn't produce heat. Cotton fabric is one among the highly demanded fabrics in the textile industry because of its several advantages. It is inexpensive, breathable, soft and naturally absorbent (Karol, 2008). Cotton surpasses all other fibres with its most desirable qualities of softness, comfort and durability. One of the greatest abilities of cotton is the ability to impart a wide variety of finishing techniques to the substrate. Cotton is one of the eco-friendly fabrics used in textiles. Considering the qualities, cotton was selected as the fabric material for this study. A total quantity of eight metres pure cotton fabric was purchased from Khadi Gramodyog bhavan, Coimbatore for carrying out this study. Details of the fabric are presented in Appendix - I.

### **3.2 Preparation of Fabric**

The preparation, also known as pre-treatment, consists of a series of various treatment and rinsing steps and these are critical to obtain good results in subsequent textile finishing processes (Sarma, 2020). Most fabric that is dyed, printed or finished must first be prepared, with the exception of denim and certain knit styles. The cotton fabrics were obtained in its grey state, desizing operation was carried out on the fabrics. It was then weighed and wetted out before immersion into the dye liquor.

#### **3.2.1 Desizing**

Desizing is the first wet processing in the textile finishing process used to remove sized materials from the warp yarn of woven fabric. After desizing, the absorption of the fabric increases (Eren, 2009). The desizing process for cotton fabric was carried out by the following recipe:

Recipe for desizing:

Material: liquor ratio - 1: 20

Time duration - 1 hour

Temperature - 50-60°C

Detergent – 2%

Desizing of the fabric was done by boiling the fabric in the water for about one hour. The detergent removes the soil from fabric and also disperse as well as stabilise oil droplet materials from the fabric. The temperature is maintained from 50 to 60°C. [ Plate I] The process was carried out for six metres of woven fabric. The material was removed from the vessel, washed thoroughly in soft water and dried. The weight of fabric before and after desizing was noted. This is necessary to allow easy penetration into the cotton fabrics as compared to the un-desized materials. Fabric after desizing is presented in Appendix - II.

### **3.3 Selection of Natural Source**

Textile finishing is an important process for improving the value of the textile products. Commercial finishing processes involve hazard chemicals and auxiliaries that are not eco friends and skin friendly. With growing awareness on environmental problems, it is very important to shift this process using natural sources. This not only saves the environment but will also provide various health benefits.

#### **3.3.1 *Curcuma longa***

*Curcuma longa* has been used for thousands of years as a remedy in the traditional Indian and folk medicine for the cure of a large variety of illnesses, such as inflammation, infectious diseases, and gastric, hepatic, and blood disorders. Curcumin is a major isolated polyphenol from the rhizome of *Curcuma longa* is also well-known for its anti-carcinogenic, anti-inflammatory, anti-microbial, anti-parasitic, anti-mutagenic and anti-inceptive properties (Kavita et. al., 2021)

#### **3.3.2 *Aloe vera***

Various studies reported that *aloe vera* has useful effects on wounds especially cutaneous wounds healing. The other important compounds in *aloe vera* plants include several sugars such as glucose, mannose, and cellulose (Boudreau 2006). *Aloe vera* contains 75 potentially active components like vitamins, enzymes, minerals, sugars, lignin, saponins, salicylic acids and amino acids and has the ability to penetrate the deepest body tissues seven layers deep. Studies have shown that aloe gel might be effective in treating skin conditions

including: Psoriasis Seborrhea, Minor burns, Skin abrasions, Skin injured by radiation, Herpes sores and Acne.

Hence, considering the above facts the investigator chose *aloe vera* and *Curcuma longa* as the source as they offer various health benefits.

### **3.4 Preparation of Extract from Source**

Raw *Curcuma longa* was obtained right after harvesting from Govanur, Coimbatore. It was cleaned properly to remove any dirt and other pollutants and cut into small pieces. *Aloe vera* was collected from a nearby house and the skin was removed gently. The pulp was completely scooped out and both the sources were grinded together using an electric mixer without adding water. To avoid any lumps, the extract was carefully filtered using a stainless steel strainer. The obtained extracted source was measured and stored at room temperature [Plate-II].

### **3.5 Finishing Method**

Finishing is anything that is done on fibre, yarn or fabric before or after weaving, to change the appearance, feel, serviceability and durability (Singh et al., 2005). Fabric finishing is a series of mechanical and chemical processes that are performed on woven and knitted fabrics to improve the overall quality and essentially make them presentable to market. Further finishes are added to fabrics to make them feel or enhance their properties (Sathianarayanan, 2010).

#### **3.5.1 Microencapsulation Padding Mangle Method**

Micro-encapsulation is a process in which small capsules of many useful properties are made by using tiny particles or droplets surrounded by a coating (Benita, 2005). The material inside the microcapsule is called as the core material whereas the wall is called a shell, coating, or membrane. Usually, microcapsules have diameters between a few micrometres and a few millimetres. Many special and functional properties can be imparted to the fabrics by microencapsulating the core material. Encapsulation has allowed moisturisers, therapeutic oils, and insecticides to be incorporated into fabrics (Jyothi, 2012). Microencapsulation is a unique technique which facilitates a controlled release of these properties as and when required and also enhances its durability. In herbal finishing of textiles, herbal extracts are used as the “core

material” along with the wall material to give a micro-encapsulated finish which is more durable as compared to the other process of finishing.

### **3.5.1.1 Preparation of Microcapsules**

The microcapsules were formed using Sodium Alginate wall and the core is made of *Curcuma longa* and *aloe vera* extract. About 2g of sodium alginate was dissolved in 100 ml distilled water. 30g of calcium chloride was dissolved in 100ml of distilled water. The sodium alginate solution was kept in a magnetic stirrer for 15 minutes to make the emulsion completely dissolved in the distilled water. Calcium Chloride is used to harden the sodium alginate. [Plate III]

The  $\text{CaCl}_2$  solution is poured in a petri dish and the sodium alginate is mixed with the *Curcuma longa* and *aloe vera* extract of 1 ml quantity. [Plate VI] A serench was loaded with the alginate-extract emulsion. Then it was sprayed in the  $\text{CaCl}_2$  solution in the petri dish. The alginate-extract emulsion hardens when it was dripped slowly into the  $\text{CaCl}_2$  solution. The microcapsules were formed in uniform size. The microcapsules were then rinsed with distilled water and the microcapsules were retained through filter paper [Plate V].

### **3.5.1.2 Finishing Using Padding Mangle**

A simple padding mangle consisting of two squeezing bowls (rolls). The upper one of iron and covered with rubber and the lower one of brass, arranged over a shallow trough provided with two or more freely rotating guide rollers. The capsules were placed in the fabric then the fabric was passed through the guide rollers and squeezing mangle. The capsules were squeezed and applied to the fabric and it was dried (Ratnapandian., 2013). The finished samples are presented in Appendix III.

### **3.5.2 Ultrasonic Atomiser**

Ultrasonic spraying machine using ultrasonic nozzle technology can produce very small, uniform droplets, with a very tight droplet distribution (Rajan, 2001). The vibrations divide the liquid into individual droplets. The size of the droplet is dependent on the frequency of the electrical energy. This makes the ultrasonic sprayer flow rate controllable range is large, and ultrasonic spraying machines can prepare a very uniform, very thin coating, saving

spraying materials and improve the quality of fabric coating, through a more uniform coating to deal with the performance of the product.

### **3.5.2.1 Finishing Using Ultrasonic Atomiser**

The fabric was laid on an even platform without any folds. The extract was poured inside the atomizer. The machine was set to optimised setting under low speed and the extract was sprayed throughout the fabric. [Plate VII] This was done in the advanced research lab in Avinashilingam Institute of Home Science and Higher Education for Women. The finished samples are presented in Appendix IV.

## **3.6 Evaluation**

Test and evaluation is the process of comparing a system and specifications through the testing. The results are assessed in order to determine design progress, performance and supportability among other things. The original, desized and finished fabrics are evaluated under the following headings.

### **3.6.1 Fabric Weight**

Fabric weight is a way to measure different textiles like cotton, silk, polyester, and canvas. This measurement is determined by the thickness of the threads that make up the material. GSM stands for grams per square metre. GSM cutter is used to measure the fabric weight. It is a means of determining fabric weight. GSM cutter, cutting pad and electric balance are employed for a quick and authentic procedure. A tiny amount of cloth sample is required to measure using the above devices (patwary.,2012). For this the fabric is placed on a rubber pad without wrinkles and then placing the GSM cutter on the top of the fabric and rotating the knob of the GSM cutter. The blades on the cutter help in cutting the fabric to a circular shape (HMS., 2013). Then removing the cutter and the circular specimen is collected of 100cm<sup>2</sup> and the sample is weighted on an electronic balance, two fabric samples were collected and ten readings are taken to find the mean value (Mazhrul,2012). [plate VI] The readings are recorded for the original, desized and finished fabric.

### **3.6.2 Fabric thickness**

Fabric thickness is one of the most important factors determining thermal comfort. It was found that fabric thickness had a direct effect on thermal transmittance, where the thicker

the material, the lower the thermal transmittance, the thermal resistance through individual layers of dry fabric was primarily dependent upon their thickness and was approximately two togs per 1 cm thickness varying from about 0.05 for cotton poplin to about 1 tog for a heavy overcoat. This value would be lower if the wind was present to cause more air penetration and higher natural convective heat loss (Kar. Yu., 2011). The thickness of a cloth determines its handling, creasing thermal resistance, heaviness or stiffness in use and many other characteristics (Dai, 2006). Fabric was held in ten separate locations, ten readings were made, and the average mean value was found and recorded. The fabric thickness is expressed in mm (Textile Advisor., 2020). [plate VII] The readings are recorded for the original, desized and finished fabric.

### **3.6.3 Fabric Stiffness**

The ability to resist the bending of fabric is called fabric stiffness. Stiffness is a special property of a fabric. It is the tendency of the fabric to keep standing without any support. It is a key factor to study handling and drape. Stiffness is an important property of fabric for different end uses. This behaviour can be imparted to fabric by different finishes. We acquire the knowledge about how to find the bending length of the fabric both in warp and weft way. And we also examine the stiffness property of the given sample. [plate VIII] The readings are recorded for the original, desized and finished fabric.

### **3.6.4 Tensile Strength**

When the stretching force (load) is applied to the fabric, it begins to elongate. As the stretching force (load) increases gradually, the elongation also increases. When the amount of stretching force reaches a certain point, the fabric begins to break. Now we can say that the tensile strength of the fabric is the amount of stretching force (load) at which the fabric begins to break when it comes under stretching conditions. It is measured in Newtons, pounds, or kilogram-force. It depends upon the yarn strength, material type or thread count per square inch of the fabric etc. The tensile strength of the fabric is determined separately in the warp and weft direction. Synthetic fabrics have better tensile strength than natural fabrics. The fabric made of fine and long-staple fibres poses higher tensile strength than coarse and short fibres. If the warp and the weft count of two fabrics are same, then the fabric having more threads per square inch will give a higher tensile strength (Textile Advisor., 2021). [Plate IX] The readings are recorded for the original, desized and finished fabric.

### **3.6.5 Absorbency**

Moisture absorbency of a fabric is a very important property of the fabric because it is directly associated with other properties of the fabric. The ability of a fabric to pick up the moisture. When a fabric comes into direct contact of moisture, it starts to absorb moisture. The rate of pick up moisture and amount of absorbed moisture differ for different fabrics. The consumer can compare the moisture absorbency of two different fabrics as follows: Take two fabric swatches of the same size and weight. Take a beaker and fill it with distilled water. Drop the first fabric swatch in the beaker and record the time when the fabric gets completely wet. As the fabric starts to dip into the water, record the time again. Now repeat this process with another fabric swatch. Now make a comparison between the two fabrics. The fabric, which is taking less wetting and dipping time, will show better moisture absorbency. (Textile Advisor., 2019). [plate X] The readings are recorded for the original, desized and finished fabric.

### **3.7 Statistical Analysis**

Statistical analysis is quantitative research, to find the quality the data, and typically, applies some form of statistical analysis. If the data is singular in number, then the univariate statistical analysis is performed. This includes t test for significance, z test, f test, ANOVA one way etc. The arithmetic means or average is the centre value of a discrete set of numbers specifically, the sum of the values is divided by the number of values (Mandel., 2021). One-way ANOVA is carried out in this study. The statistical analysis is presented in the results and discussion.



Plate I

Desized cotton fabric

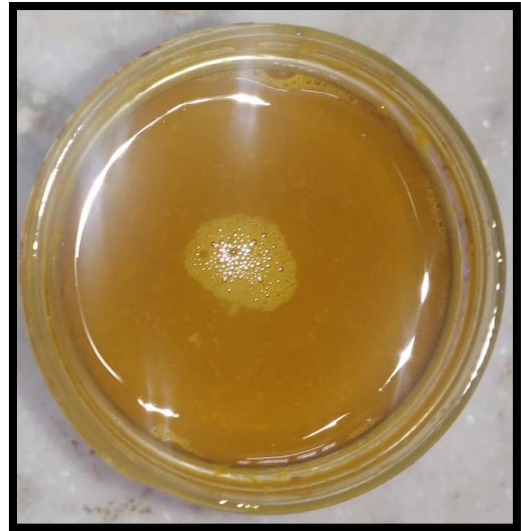


Plate II

Extraction of sources



Plate III

Calcium Chloride solution



Plate VI

Sodium alginate solution

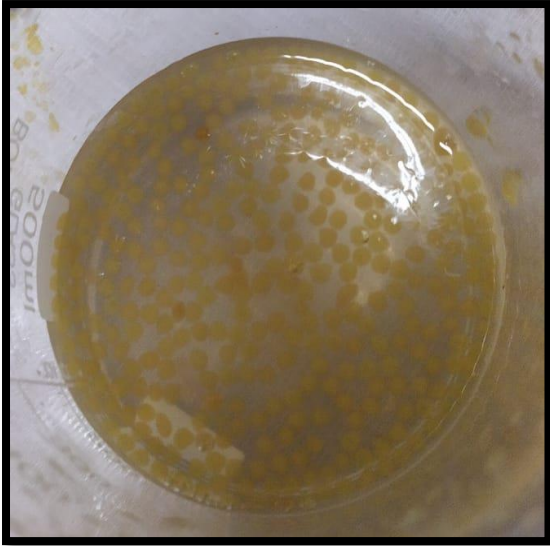


Plate V

microencapsules

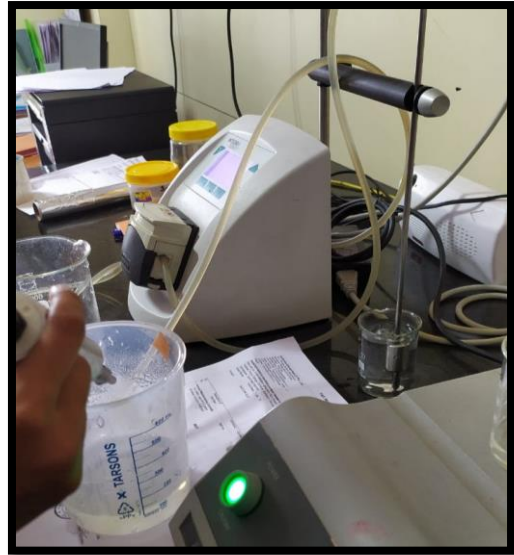


Plate VI

Ultrasonic Atomizer

### **3. RESULTS AND DISCUSSION**

The results pertaining to the study entitled “A comparative study on Microencapsulated padding mangle and Ultrasonic finishes with selected natural sources” is discussed under. The following side headings.

4.1 Tensile strength of Original, Desized, Microencapsulated padding mangle and Ultrasonic Finished Fabric-Warp

4.2 Tensile strength of Original, Desized, Microencapsulated padding mangle and Ultrasonic Finished Fabric-Weft

4.3 Stiffness of Original, Desized, Microencapsulated padding mangle and Ultrasonic Finished Fabric-Warp

4.4 Stiffness of Original, Desized, Microencapsulated padding mangle and Ultrasonic Finished Fabric-Weft

4.5 Thickness of Original, Desized, Microencapsulated padding mangle and Ultrasonic Finished Fabric

4.6 Weight of Original, Desized, Microencapsulated padding mangle and Ultrasonic Finished Fabric

4.7 wrinkling ability of Original, Desized, Microencapsulated padding mangle and Ultrasonic Finished Fabric.

4.8 Spray rate of Original, Desized, Microencapsulated padding mangle and Ultrasonic Finished Fabric.

4.9 Sinking of Original, Desized, Microencapsulated padding mangle and Ultrasonic Finished Fabric.

#### 4.1 Tensile strength of original, desized, microencapsulated padding mangle and ultrasonic finished Fabric-warp

The tensile strength of the Original, Desized, Microencapsulation padding mangle and Ultrasonic Finished Fabric has been manifested in Table I. The ANOVA in Table Ia.

Table I

Fabric Strength - Warp

S.no	Sample	Original (mean)	Desized (mean)	Finished fabric(mean)	Loss or gain over original			%Loss of gain over original			F value
					O vs D	D vs F	O vs F	O vs D	D vs F	O vs F	
1	A	10.32	10.26	10.58	0.06	-0.32	10.64	0.58	3.10	0.58	3470.458
2	B	10.32	10.26	11.62	0.06	-1.36	-1.3	0.58	13.17	.058	

**A - The sample of Microencapsulation padding mangle finish, B - The sample of ultrasonic finish**

**O – Original fabric; D – Desized fabric; F – Finished fabric**

Table I shows the result of the fabric strength in warp direction for original, desized and finished fabric with Microencapsulation padding mangle and Ultrasonic method. From the Table I it is clear that fabric strength has reduced by 0.58 percent after desizing and increased by 0.58 percent after finishing the sample by Microencapsulation padding mangle method. Likewise, the fabric strength has reduced by 3 percent after desizing and increased by 0.58 percent after finishing the sample by Ultrasonic method.

On comparison between sample A and sample B between original versus finished, desized versus finished and desized versus finished fabric for microencapsulation padding mangle and ultrasonic finish is significant at 1% level. Similarly, between two finishing techniques also there is significant at one percent level.

Hence, it could be concluded that on comparison with microencapsulation padding mangle method and ultrasonic method the fabric strength in the warp direction for ultrasonic method was found to have more strength when compared to microencapsulation padding mangle.

**Table 1(a)**

**ANOVA between the Original, Desized, and Finished Fabric**

<b>SAMPLE</b>	<b>PARAMETERS</b>	<b>GROUPS</b>	<b>SUM OF SQUARE</b>	<b>DF</b>	<b>SQUARE MEAN</b>	<b>F</b>	<b>SIG</b>
<b>A</b>	O VS D	Between Groups	.029	1	.029	89.014	<.001
		Within Groups	.006	18	0		
		Total	.035	19			
	D VS F	Between Groups	.441	1	.441	271.414	<.001
		Within Groups	.029	18	.002		
		Total	.470	19			
	O VS F	Between Groups	.251	1	.251	154.124	<.001
		Within Groups	.029	18	.002		
		Total	.280	19			
<b>B</b>	O VS D	Between Groups	.025	1	.025	101.953	<.001
		Within Groups	.004	18	.000		
		Total	.030	19			
	D VS F	Between Groups	9.536	1	9.536	18966.242	<.001
		Within Groups	.009	18	.001		
		Total	9.545	19			
	O VS F	Between Groups	8.437	1	8.437	37497.800	<.001
		Within Groups	.004	18	.000		
		Total	8.441	19			
<b>A AND B</b>	MEAN	Between Groups	5.703	1	5.703	3470.458	<.001
		Within Groups	.030	18	.002		
		Total	5.733	19			

## 4.2 Tensile strength of original, desized, microencapsulated padding mangle and ultrasonic finished Fabric-weft

The tensile strength of the Original, Desized, Microencapsulation padding mangle and Ultrasonic Finished Fabric has been manifested in Table II. The ANOVA in Table IIa.

Table II

Fabric Strength – weft

S.no	Sample	Original (mean)	Desized (mean)	Finished fabric(mean)	Loss or gain over original			%Loss of gain over original			F value
					O vs D	D vs F	O vs F	O vs D	D vs F	O vs F	
1	A	13.67	18.16	20.07	-4.49	-1.91	-6.4	32.84	13.97	46.81	24450.1 98
2	B	13.67	18.16	13.8	-4.49	4.36	-0.13	32.84	13.89	0.95	

**A - The sample of Microencapsulation padding mangle finish, B - The sample of ultrasonic finish**

**O – Original fabric; D – Desized fabric; F – Finished fabric**

Table II shows the result of the fabric strength in weft direction for original, desized and finished fabric with microencapsulation padding mangle and ultrasonic method. From the Table II it is clear that fabric strength has increased by 32 percent after desizing and increased by 46 percent after finishing the sample by microencapsulation padding mangle method. But in case of ultrasonic method the strength has decreased by 0.95 percent.

On comparison between sample A and sample B between original versus finished, desized versus finished and desized versus finished fabric for microencapsulation padding mangle and ultrasonic finish is significant at 1% level. Similarly, between two finishing techniques also there is significant at one percent level.

Hence, it could be concluded that on comparison with microencapsulation padding mangle method and ultrasonic method the strength of the fabric in the weft direction for ultrasonic method was found to have more strength when compared to microencapsulation padding mangle method.

**Table II(a)****ANOVA between the Original, Desized, and Finished Fabric**

<b>SAMPLE</b>	<b>PARAMETERS</b>	<b>GROUPS</b>	<b>SUM OF SQUARE</b>	<b>DF</b>	<b>SQUARE MEAN</b>	<b>F</b>	<b>SIG</b>
<b>A</b>	<b>O VS D</b>	Between Groups	74.305	1	0.029	347400.584	<.001
		Within Groups	.004	18	.000		
		Total	74.309	19			
	<b>D VS F</b>	Between Groups	121.722	1	386.408	1700574.88	<.001
		Within Groups	.003	18	.000		
		Total	386.412	19			
	<b>O VS F</b>	Between Groups	386.408	1	386.408	1700574.88	<.001
		Within Groups	.004	18	.000		
		Total	366.412	19			
<b>B</b>	<b>O VS D</b>	Between Groups	74.421	1	74.421	248069.400	<.001
		Within Groups	.005	18	.000		
		Total	74.426	19			
	<b>D VS F</b>	Between Groups	10.325	1	10.325	882.432	<.001
		Within Groups	.211	18	.012		
		Total	10.535	19			
	<b>O VS F</b>	Between Groups	29.330	1	29.330	2493.141	<.001
		Within Groups	.212	18	.012		
		Total	29.542	19			
<b>A AND B</b>	<b>MEAN</b>	Between Groups	199.459	1	199.459	24450.198	<.001
		Within Groups	.147	18	.008		
		Total	119.606	19			

### 4.3 Stiffness of Original, Desized, Microencapsulated padding mangle and Ultrasonic Finished Fabric-Warp

The stiffness of the Original, Desized, Microencapsulation padding mangle and Ultrasonic Finished Fabric has been manifested in Table III. The ANOVA in Table IIIa.

Table III

Fabric Stiffness - Warp

S.no	Sample	Original (mean)	Desized (mean)	Finished fabric(mean)	Loss or gain over original			%Loss of gain over original			F value
					O vs D	D vs F	O vs F	O vs D	D vs F	O vs F	
1	A	1.92	1.68	1.8	0.24	-0.12	0.12	12.50	6.25	6.25	.109
2	B	1.92	1.68	1.71	-0.06	-0.03	-0.09	12.50	1.85	5.56	

**A - The sample of Microencapsulation padding mangle finish, B - The sample of ultrasonic finish**

**O – Original fabric; D – Desized fabric; F – Finished fabric**

Table III shows the result of the fabric stiffness in warp direction for original, desized and finished fabric with microencapsulation padding mangle and ultrasonic method. From the Table III it is clear that fabric stiffness in the warp direction has reduced by 12 percent after desizing and increased by 6 percent after finishing the sample by microencapsulation padding mangle method. Likewise, the fabric stiffness in the warp direction has decreased by 3 percent after desizing and increased by 5 percent after finishing the sample by ultrasonic method.

On comparison between sample A and sample B between original versus finished, Desized versus finished and desized versus finished fabric for microencapsulation padding mangle and ultrasonic finish is significant at 1 % level. But on comparison, between two finishing techniques there is no significant difference.

Hence, it could be concluded that on comparison with microencapsulation padding mangle method and ultrasonic method the stiffness of the fabric in the warp direction for microencapsulation padding mangle was found to have more s when compared to ultrasonic method.

**Table III(a)**

**ANOVA between the Original, Desized, and Finished Fabric**

<b>SAMPLE</b>	<b>PARAMETERS</b>	<b>GROUPS</b>	<b>SUM OF SQUARE</b>	<b>DF</b>	<b>SQUARE MEAN</b>	<b>F</b>	<b>SIG</b>
<b>A</b>	O VS D	Between Groups	.328	1	.328	1544.042	<.001
		Within Groups	.004	18	.000		
		Total	.331	19			
	D VS F	Between Groups	.034	1	.034	4.206	<.001
		Within Groups	.147	18	.008		
		Total	.182	19			
	O VS F	Between Groups	.175	1	.175	21.321	<.001
		Within Groups	.148	18	.008		
		Total	.322	19			
<b>B</b>	O VS D	Between Groups	.328	1	.328	1544.042	<.001
		Within Groups	.004	18	.000		
		Total	.331	19			
	D VS F	Between Groups	.010	1	.010	45.853	<.001
		Within Groups	.004	18	.000		
		Total	.013	19			
	O VS F	Between Groups	.244	1	.244	45.853	<.001
		Within Groups	.004	18	.000		
		Total	.248	19			
<b>A AND B</b>	MEAN	Between Groups	.001	1	.001	.109	.745
		Within Groups	.162	18	.009		
		Total	.163	19			

#### 4.4 Stiffness of original, desized, microencapsulated padding mangle and ultrasonic finished Fabric-weft

The tensile strength of the Original, Desized, Microencapsulation padding mangle and Ultrasonic Finished Fabric has been manifested in Table VI. The ANOVA in Table VIa.

Table VI

Fabric Stiffness – weft

S.no	Sample	Original (mean)	Desized (mean)	Finished fabric(mean)	Loss or gain over original			%Loss of gain over original			F value
					O vs D	D vs F	O vs F	O vs D	D vs F	O vs F	
1	A	1.74	1.66	2.36	0.08	-0.7	-0.62	4.60	40.23	35.63	1.569
2	B	1.74	1.66	2.35	0.08	-0.69	-0.61	4.60	39.66	35.06	

**A - The sample of Microencapsulation padding mangle finish, B - The sample of ultrasonic finish**

**O – Original fabric; D – Desized fabric; F – Finished fabric**

Table VI shows the result of the fabric stiffness in weft direction for original, desized and finished fabric with microencapsulation padding mangle and ultrasonic method. From the Table VI it is clear that fabric stiffness has in the weft direction reduced by 4 percent after desizing and increased by 35 percent after finishing the sample by microencapsulation padding mangle method. Likewise, the fabric stiffness has decreased by 4 percent after desizing and increased by 35 percent after finishing the sample by ultrasonic method.

On comparison between sample A and sample B between original versus finished, desired versus finished and desired versus finished fabric for microencapsulation padding mangle and ultrasonic finish is significant at 1% level. Similarly, between two finishing techniques also there is significant at one percent level.

Hence, it could be concluded that on comparison with microencapsulation padding mangle method and ultrasonic method the stiffness of the fabric in the weft direction for padding mangle was found to have more stiffness when compared to ultrasonic method.

**Table VI(a)**

**ANOVA between the Original, Desized, and Finished Fabric**

<b>SAMPLE</b>	<b>PARAMETERS</b>	<b>GROUPS</b>	<b>SUM OF SQUARE</b>	<b>DF</b>	<b>SQUARE MEAN</b>	<b>F</b>	<b>SIG</b>
<b>A</b>	<b>O VS D</b>	Between Groups	.016	1	.016	121.332	<.001
		Within Groups	.002	18	.00		
		Total	.019	19			
	<b>D VS F</b>	Between Groups	2.394	1	2.394	16835.063	<.001
		Within Groups	.003	18	.00		
		Total	.2397	19			
	<b>O VS F</b>	Between Groups	1.934	1	1.934	3012.073	<.001
		Within Groups	.012	18	.001		
		Total	1.946	19			
<b>B</b>	<b>O VS D</b>	Between Groups	.016	1	.016	3012.073	<.001
		Within Groups	.002	18	.000		
		Total	.019	19			
	<b>D VS F</b>	Between Groups	2.429	1	2.429	16752.034	<.001
		Within Groups	.003	18	.000		
		Total	2.432	19			
	<b>O VS F</b>	Between Groups	1.934	1	2.429	16752.034	<.001
		Within Groups	.012	18	.000		
		Total	1.946	19			
<b>A AND B</b>	<b>MEAN</b>	Between Groups	.000	1	.000	1.569	.226
		Within Groups	.003	18	.000		
		Total	.003	19			

#### 4.5 Thinkness of Original, Desized, Microencapsulated padding mangle and Ultrasonic Finished Fabric

The thinkness of the Original, Desized, Microencapsulation and Ultrasonic Finished Fabric has been manifested in Table V. The ANOVA in Table Va.

Table V

Fabric Thinkness

S.no	Sample	Original (mean)	Desized (mean)	Finished fabric(mean)	Loss or gain over original			%Loss of gain over original			F value
					O vs D	D vs F	O vs F	O vs D	D vs F	O vs F	
1	A	24.74	25.43	45.2	-0.69	-19.77	-20.46	2.79	79.91	82.70	219928 .303
2	B	24.74	25.43	29.24	-0.69	-3.81	-4.5	2.79	15.40	18.19	

**A - The sample of Microencapsulation padding mangle finish, B - The sample of ultrasonic finish**

**O – Original fabric; D – Desized fabric; F – Finished Fabric**

Table V shows the result of the fabric thickness for original, desized and finished fabric with microencapsulation padding mangle and Ultrasonic method. From the Table V it is clear that fabric thickness has increased by 2 percent after desizing and by 82 percent after finishing for sample finished by Microencapsulation method. Likewise, the fabric thickness has increased by 2 percent after desizing and increased by 18 percent after finishing the sample by Ultrasonic method.

On comparison between sample A and sample B between original versus finished, desized versus finished and desized versus finished fabric for microencapsulation padding mangle and ultrasonic finish is significant at 1% level. Similarly, between two finishing techniques also there is significant at one percent level.

Hence, it could be concluded that the fabric thickness of the microencapsulation padding mangle method was found to have more thickness when compared to ultrasonic method. This may be due to the more deposition of the finishing sources in the capsules.

**Table V(a)****ANOVA between the Original, Desized, and Finished Fabric**

<b>SAMPLE</b>	<b>PARAMETERS</b>	<b>GROUPS</b>	<b>SUM OF SQUARE</b>	<b>DF</b>	<b>SQUARE MEAN</b>	<b>F</b>	<b>SIG</b>
<b>A</b>	<b>O VS D</b>	Between Groups	2.080	1	2.080	13715.160	<.001
		Within Groups	.003	18	.000		
		Total	2.083	19			
	<b>D VS F</b>	Between Groups	1961.982	1	1961.982	213143.118	<.001
		Within Groups	.166	18	.009		
		Total	1962.148	19			
	<b>O VS F</b>	Between Groups	2091.831	1	2019.831	228144.392	<.001
		Within Groups	.165	18	.009		
		Total	2091.831	19			
<b>B</b>	<b>O VS D</b>	Between Groups	2.080	1	2.080	13715.110	<.001
		Within Groups	.003	18	.000		
		Total	2.083	19			
	<b>D VS F</b>	Between Groups	72.276	1	72.276	464631.557	<.001
		Within Groups	.003	18	.004		
		Total	72.279	19			
	<b>O VS F</b>	Between Groups	98.924	1	98.924	947140.085	<.001
		Within Groups	.002	18	.002		
		Total	98.925	19			
<b>A AND B</b>	<b>MEAN</b>	Between Groups	1280.965	1	1280.960	219928.303	<.001
		Within Groups	.105	18	.006		
		Total	1281.065	19			

#### 4.6 Weight of Original, Desized, Microencapsulated padding mangle and Ultrasonic Finished Fabric

The weight of the Original, Desized, Microencapsulation padding mangle and Ultrasonic Finished Fabric has been manifested in Table VI. The ANOVA in Table VIa.

Table VI

Fabric Weight

S.no	Sample	Original (mean)	Desized (mean)	Finished fabric(mean)	Loss or gain over original			%Loss of gain over original			F value
					O vs D	D vs F	O vs F	O vs D	D vs F	O vs F	
1	A	3.86	4.07	5.21	-0.21	-1.14	-1.35	5.44	29.53	34.97	5.664
2	B	3.86	4.07	4.49	-0.21	-0.42	-0.63	5.44	10.88	16.32	

**A - The sample of Microencapsulation padding mangle finish, B - The sample of ultrasonic finish**

**O – Original fabric; D – Desized fabric; F – Finished fabric**

Table VI shows the result of the fabric thickness for original, desized and finished fabric with Microencapsulation padding mangle and Ultrasonic method. From the Table VI it is clear that fabric weight has increased by 5 percent after desizing and by 34 percent after finishing the sample by Microencapsulation padding mangle method. Likewise, the fabric weight has increased by 5 percent after desizing and increased by 16 percent after finishing the sample by Ultrasonic method.

On comparison between sample A and sample B between original versus finished, desized versus finished and desized versus finished fabric for microencapsulation padding mangle and ultrasonic finish is significant at 1% level. Similarly, between two finishing techniques also there is significant at one percent level.

Hence, it could be concluded that microencapsulation padding mangle method was found to have more weight when compare to ultrasonic methods. This proves that microencapsulation padding mangle method to deposit more amount of material source of the fabric.

**Table VI(a)**

**ANOVA between the Original, Desized, and Finished Fabric**

<b>SAMPLE</b>	<b>PARAMETERS</b>	<b>GROUPS</b>	<b>SUM OF SQUARE</b>	<b>DF</b>	<b>SQUARE MEAN</b>	<b>F</b>	<b>SIG</b>
<b>A</b>	O VS D	Between Groups	.210	1	.210	1543.776	<.001
		Within Groups	.002	18	.000		
		Total	.213	19			
	D VS F	Between Groups	6.590	1	6.590	76032.923	<.001
		Within Groups	.022	18	.000		
		Total	6.591	19			
	O VS F	Between Groups	9.153	1	9.153	58613.605	<.001
		Within Groups	.003	18	.000		
		Total	9.156	19			
<b>B</b>	O VS D	Between Groups	.210	1	.210	1543.776	<.001
		Within Groups	.002	18	.000		
		Total	.213	19			
	D VS F	Between Groups	.861	1	.861	9394.091	<.001
		Within Groups	.002	18	.000		
		Total	.863	19			
	O VS F	Between Groups	1.922	1	1.922	11929.655	<.001
		Within Groups	.003	18	.000		
		Total	1.925	19			
<b>A AND B</b>	MEAN	Between Groups	6.6212	1	66.212	5.664	<.001
		Within Groups	210.404	18	11.689		
		Total	276.616	19			

#### 4.7 Wick Ability of Original, Desized, Microencapsulated padding mangle and Ultrasonic Finished Fabric

The wick ability of the Original, Desized, Microencapsulation padding mangle and Ultrasonic Finished Fabric has been manifested in Table VII. The ANOVA in Table VIIa.

Table VII

Wick ability

S.no	Sample	Original (mean)	Desized (mean)	Finished fabric(mean)	Loss or gain over original			%Loss of gain over original			F value
					O vs D	D vs F	O vs F	O vs D	D vs F	O vs F	
1	A	0.38	2.85	2.92	-2.47	-0.07	-2.54	650.0	18.42	668.42	37.768
2	B	0.38	2.85	3.25	-2.47	-0.4	-2.87	650.0	105.26	755.26	

**A - The sample of Microencapsulation padding mangle finish, B - The sample of ultrasonic finish**

**O – Original fabric; D – Desized fabric; F – Finished fabric**

Table VII shows the result of the fabric wick ability for original, desized and finished fabric with microencapsulation padding mangle and ultrasonic method. From the Table VII it is clear that fabric wick ability has increased by 65 percent after desizing and increased by 66 percent after finishing the sample by microencapsulation padding mangle method. Likewise, fabric wick ability has increased by 65 percent after desizing and by 75 percent after finishing the sample by Ultrasonic method.

On comparison between sample A and sample B between original versus finished, Desized versus finished and desized versus finished fabric for microencapsulation padding mangle and ultrasonic finish is significant at 1% level. Similarly, between two finishing techniques also there is significant at one percent level.

Hence, it could be concluded that on comparison with Microencapsulation padding mangle method and ultrasonic method, the ultrasonic method has better wicking ability when compared to microencapsulation padding mangle.

**Table VII(a)**

**ANOVA between the Original, Desized, and Finished Fabric**

<b>SAMPLE</b>	<b>PARAMETERS</b>	<b>GROUPS</b>	<b>SUM OF SQUARE</b>	<b>DF</b>	<b>SQUARE MEAN</b>	<b>F</b>	<b>SIG</b>
<b>A</b>	<b>O VS D</b>	Between Groups	30.603	1	30.603	204022.533	<.001
		Within Groups	.003	18	.000		
		Total	30.606	19			
	<b>D VS F</b>	Between Groups	.784	1	.784	6136.278	<.001
		Within Groups	.002	18	.001		
		Total	.786	19			
	<b>O VS F</b>	Between Groups	41.357	1	41.357	256697.876	<.001
		Within Groups	.003	18	.001		
		Total	41.360	19			
<b>B</b>	<b>O VS D</b>	Between Groups	30.603	1	30.603	204022.533	<.001
		Within Groups	.003	18	.000		
		Total	30.606	19			
	<b>D VS F</b>	Between Groups	.020	1	.020	117.118	<.001
		Within Groups	.003	18	.000		
		Total	.023	19			
	<b>O VS F</b>	Between Groups	32.334	1	32.334	159456.551	<.001
		Within Groups	.004	18	.000		
		Total	32.338	19			
<b>A AND B</b>	<b>MEAN</b>	Between Groups	.365	1	.365	37.768	<.001
		Within Groups	.175	18	.010		
		Total	.538	19			

#### 4.8 Spray rate of Original, Desized, Microencapsulated padding mangle and Ultrasonic Finished Fabric

The Spray rate of the Original, Desized, Microencapsulation padding mangle and Ultrasonic Finished Fabric has been manifested in Table VIII. The ANOVA in Table VIIIa.

Table VIII

Spray rate

S.no	Sample	Original (mean)	Desized (mean)	Finished fabric(mean)	Loss or gain over original			%Loss of gain over original			F value
					O vs D	D vs F	O vs F	O vs D	D vs F	O vs F	
1	A	8.25	1.29	1.10	6.96	0.19	7.15	84.36	2.30	86.67	50
2	B	8.25	1.29	2.90	6.96	-1.61	5.35	84.36	19.52	64.85	

**A - The sample of Microencapsulation padding mangle finish, B - The sample of ultrasonic finish**

**O – Original fabric; D – Desized fabric; F – Finished fabric**

Table VI shows the result of the fabric spray rate for original, desized and finished fabric with microencapsulation padding mangle and ultrasonic method. From the Table VI it is clear that fabric spray rate has reduced by 84 percent after desizing and by 86 percent after finishing the sample by Microencapsulation padding mangle method. Likewise, fabric spray rate has reduced by 84 percent after desizing and reduced by 64 percent after finishing the sample by Ultrasonic method.

On comparison between sample A and sample B between original versus finished, Desized versus finished and desized versus finished fabric for microencapsulation padding mangle and ultrasonic finish is significant at 1% level. Similarly, between two finishing techniques also there is significant at one percent.

Hence, it could be concluded that on comparison with Microencapsulation padding mangle method and ultrasonic method absorbency of ultrasonic method finishes has better absorbency value.

**Table VIII(a)**

**ANOVA between the Original, Desized, and Finished Fabric**

<b>SAMPLE</b>	<b>PARAMETERS</b>	<b>GROUPS</b>	<b>SUM OF SQUARE</b>	<b>DF</b>	<b>SQUARE MEAN</b>	<b>F</b>	<b>SIG</b>
<b>A</b>	O VS D	Between Groups	242.138	1	242.138	2355941.238	<.001
		Within Groups	.002	18	.000		
		Total	242.140	19			
	D VS F	Between Groups	.182	1	.182	1334.768	<.001
		Within Groups	.002	18	.000		
		Total	.184	19			
	O VS F	Between Groups	255.613	1	255.613	1825803.571	<.001
		Within Groups	.003	18	.000		
		Total	255.615	19			
<b>B</b>	O VS D	Between Groups	242.138	1	242.138	2355941.238	<.001
		Within Groups	.002	18	.000		
		Total	242.140	19			
	D VS F	Between Groups	4.278	1	4.278	1.760	<.001
		Within Groups	43.754	18	2.431		
		Total	48.032	19			
	O VS F	Between Groups	142.471	1	142.471	682043.074	<.001
		Within Groups	.004	18	.000		
		Total	142.471	19			
<b>A AND B</b>	MEAN	Between Groups	16.417	1	16.417	67775.450	<.001
		Within Groups	.004	18	.000		
		Total	16.421	19			

#### 4.9 Sinking of Original, Desized, Microencapsulated padding mangle and Ultrasonic Finished Fabric

The Sinking of the Original, Desized, Microencapsulation padding mangle and Ultrasonic Finished Fabric has been manifested in Table IX. The ANOVA in Table IXa.

Table IX

#### Sinking

S.no	Sample	Original (mean)	Desized (mean)	Finished fabric(mean)	Loss or gain over original			%Loss of gain over original			F value
					O vs D	D vs F	O vs F	O vs D	D vs F	O vs F	
1	A	115.6	35.68	116.52	79.92	-80.84	-0.92	69.93	69.93	0.79	240058786 .868
2	B	115.6	35.68	33.73	79.92	1.95	81.87	96.93	1.68	70.83	

**A - The sample of Microencapsulation padding mangle finish, B - The sample of ultrasonic finish**

**O – Original fabric; D – Desized fabric; F – Finished fabric**

Table XI shows the result of the fabric sink rate for original, desized and finished fabric with Microencapsulation padding mangle and Ultrasonic method. From the Table IX it is clear that fabric spray rate has reduced by 69 percent after desizing and increased by .79 percent after finishing for the sample finishing by Microencapsulation padding mangle method. Likewise, the fabric sink rate has reduced by 96 percent after desizing and reduced by 70 percent after finishing the sample by Ultrasonic method.

On comparison between sample A and sample B between original versus finished, Desized versus finished and desized versus finished fabric for microencapsulation padding mangle and ultrasonic finish is significant. Similarly at 1% level, between two finishing techniques also there is significant at one percent level.

Hence, it could be concluded that ultrasonic method was found to be better absorbency when compared to microencapsulation padding mangle method.

**Table IX(a)**

**ANOVA between the Original, Desized, and Finished Fabric**

SAMPLE	PARAMETERS	GROUPS	SUM OF SQUARE	DF	SQUARE MEAN	F	SIG
<b>A</b>	O VS D	Between Groups	31908.865	1	31908.865	5416442.565	<.001
		Within Groups	.106	18	.006		
		Total	31908.971	19			
	D VS F	Between Groups	30958.572	1	30958.572	163955051.867	<.001
		Within Groups	.003	17	.000		
		Total	30958.575	18			
	O VS F	Between Groups	61866.126	1	61866.126	48938.160	<.001
		Within Groups	22.755	18	1.264		
		Total	61888.126	19			
<b>B</b>	O VS D	Between Groups	31908.865	1	31908.865	5416442.565	<.001
		Within Groups	.106	18	.006		
		Total	31908.971	19			
	D VS F	Between Groups	17.981	1	17.981	94054.806	<.001
		Within Groups	.003	17	.000		
		Total	17.984	18			
	O VS F	Between Groups	31719.031	1	31519.031	5211287.735	<.001
		Within Groups	.103	17	.006		
		Total	31719.134	18			
<b>A AND B</b>	MEAN	Between Groups	34275.060	1	34275.060	240058786.868	<.001
		Within Groups	.003	18	.000		
		Total	34275.063	19			

## 5.SUMMARY AND CONCLUSION

Finishing is done on fibre, yarn or fabric before or after weaving, to change the appearance, feel, serviceability and durability. Textile finishes are significant because they improve the fabric's look while also making it more practical and acceptable for its intended application. It can also be treated during the fibre or yarn manufacturing stages of textile production. Textile processing is one of the most polluting manufacturing businesses, and it is a major source of pollution today. Textile processing requires large amount of energy, water and chemicals for the processing of textiles. These processes generate water, air and soil pollution. it is necessary that the finishes are ecofriendly, biodegradable & non-toxic. Chemical substances such as waxes, chrome complexes, silicones and fluorochemicals are used in textile finishing process. Out of all types of chemical finishing processes, water-repellant is one of the most commonly used but it might be danger so natural sources are replaced for it.

Turmeric is one of the major crops cultivated around the world. India is one among the major turmeric producer. The production of turmeric is constantly threatened by diseases caused by biotic and abiotic factors. Aloe vera is a succulent plant species of the genus Aloe. The name derives from Latin as aloe and vera. Aloe gel not only increased collagen content of the wound but also changed collagen composition and increased the degree of collagen cross linking. An increased synthesis of hyaluronic acid and dermatan sulfate in the granulation tissue of a healing wound. Cotton is a soft, fluffy staple fiber grows in a boll, or a protective case, around the seeds of the cotton plants. All plants consist of cellulose, but to varying extents. Cotton fibers can hold water 24–27 times their own weight. They are strong, dye absorbent and can stand up against abrasion wear and high temperature.

Considering all these points and views, the investigator has planned to carry out a project entitled “A comparative study on microencapsulated and ultrasonic finishes with natural sources” with the following objectives,

- to select suitable natural sources for finishing,
- to select fabric for finishing,
- to incorporate the natural extract into the fabric using microencapsulation and ultrasonic methods and
- to analyse and compare the microencapsulated and ultrasonic finishes with fabric.

## Experimental Procedure

- Selection of fabric

Cotton fabric is a natural fiber. A soft, ecofriendly, breathable and comfortable weave-cotton fabric has a soft hand-feel and a sturdy, drape, along with a versatility that makes it suitable for an extended variety of uses.

- Pre-treatment of Fabric

Desizing process was carried out as a pre-treatment step to remove the soil from fabric and also disperse as well as stabilize oil droplets from materials.

- Selection of Source

*Curcuma longa* commercially called as turmeric and *Aloe vera* were selected for the research as curcuma is well known for its anti-carcinogenic, anti-inflammatory anti-microbial and anti-inceptive property, similarly, aloe vera contains medicinal property like Minor burns, Skin abrasions, Skin injured by radiation, Herpes sores and Acne.

- Preparation of Extraction from sources

fresh turmeric and aloe vera leaves were extracted using grinding technique and it was put together and mixed well.

- Finishing

The finishing process is done using the method of padding mangle and ultrasonic atomizer and dried. The wall of the microcapsules is made of Sodium Alginate, and the core is made of *Curcuma longa* and aloe vera extract. When the alginate-extraction emulsion was slowly dripped into the  $\text{CaCl}_2$  solution, it hardened. The microcapsules were uniform in size. The microcapsules were then rinsed with distilled water, and the microcapsules containing *Curcuma longa* and aloe vera were retained using filter paper. Finishing using padding mangle. The capsules were placed in the fabric then the fabric was passed through the guide rollers and squeezing mangle. The capsules were squeezed and applied to the fabric and it was dried. For the ultrasonic finish, the fabric

was laid on an even platform without any folds. The extract was poured inside the atomizer. The machine was set to optimised setting under low speed and the extract was sprayed throughout the fabric.

### **Evaluation**

The physical properties of the fabric were tested using thickness test, tensile strength, weight test and stiffness test. Wicking and Spray Test was analysed for absorbency.

### **Findings of the Study**

Microencapsulated and ultrasonic finishing samples cotton fabric were evaluated under physical properties. The laboratory test was analysed statistically.

- The fabric strength in the warp direction for ultrasonic method was found to have more strength when compared to microencapsulation padding mangle. the fabric strength has reduced by 0.58 percent after desizing and increased by 0.58 percent after finishing the sample by Microencapsulation padding mangle method. Likewise, the fabric strength has reduced by 3 percent after desizing and increased by 0.58 percent after finishing the sample by Ultrasonic method. From the ANOVA results it is proved that is significant between the groups.
- The fabric strength of the fabric in the weft direction for ultrasonic method was found to have more strength when compared to microencapsulation padding mangle method. The fabric strength has increased by 32 percent after desizing and increased by 46 percent after finishing the sample by microencapsulation padding mangle method. But in case of ultrasonic method the strength has decreased by 0.95 percent. From the ANOVA results it is proved that is significant between the groups.
- The stiffness of the fabric in the warp direction for microencapsulation padding mangle was found to have more stiffness when compared to ultrasonic method. The fabric stiffness in the warp direction has reduced by 12 percent after desizing and increased by 6 percent after finishing the sample by microencapsulation padding mangle method. Likewise, the fabric stiffness in the warp direction has decreased by 3 percent after desizing and increased by 5 percent after finishing the sample by ultrasonic method. From the ANOVA results it is proved that is significant between the groups.

- The stiffness of the fabric in the weft direction for padding mangle was found to have more stiffness when compared to ultrasonic method. fabric stiffness has in the weft direction reduced by 4 percent after desizing and increased by 35 percent after finishing the sample by microencapsulation padding mangle method. Likewise, the fabric stiffness has decreased by 4 percent after desizing and increased by 35 percent after finishing the sample by ultrasonic method. From the ANOVA results it is proved that is significant between the groups.
- The fabric thickness of the microencapsulation padding mangle method was found to have more thickness when compared to ultrasonic method. This may be due to the more deposition of the finishing sources in the capsules. The fabric thickness has increased by 2 percent after desizing and by 82 percent after finishing for sample finished by Microencapsulation method. Likewise, the fabric thickness has increased by 2 percent after desizing and increased by 18 percent after finishing the sample by Ultrasonic method. From the ANOVA results it is proved that is significant between the groups.
- Microencapsulation padding mangle method to deposit more amount of material source of the fabric. The fabric weight has increased by 5 percent after desizing and by 34 percent after finishing the sample by Microencapsulation padding mangle method. Likewise, the fabric weight has increased by 5 percent after desizing and increased by 16 percent after finishing the sample by Ultrasonic method. From the ANOVA results it is proved that is significant between the groups.
- The ultrasonic method has better wicking ability when compared to microencapsulation padding mangle. fabric wick ability has increased by 65 percent after desizing and increased by 66 percent after finishing the sample by microencapsulation padding mangle method. Likewise. fabric wick ability has increased by 65 percent after desizing and by 75 percent after finishing the sample by Ultrasonic method. From the ANOVA results it is proved that is significant between the groups.
- Microencapsulation padding mangle method and ultrasonic method absorbency of ultrasonic method finishes has better absorbency value. fabric spray rate has reduced by 84 percent after desizing and by 86 percent after finishing the sample by Microencapsulation padding mangle method. Likewise. fabric spray rate has reduced by 84 percent after desizing

by 64 percent after finishing the sample by Ultrasonic method. From the ANOVA results it is proved that is significant between the groups.

- ultrasonic method was found to be better absorbency when compared to microencapsulation padding mangle method. The fabric spray rate has reduced by 69 percent after desizing and increased by .79 percent after finishing for the sample finishing by Microencapsulation padding mangle method. Likewise, the fabric sink rate has reduced by 96 percent after desizing and by 70 percent after finishing the sample by Ultrasonic method. From the ANOVA results it is proved that is significant between the groups.

## **CONCLUSION**

Finishing is one of the most important processes in the textile world. Today every consumer looks out for some innovation in textile especially with something new like fragrance finish, better absorbance, water repellent finish and so on. In this connection there are different techniques to finish a textile fabric like did and dry, using padding mangle, using ultrasonic atomizer, coating method, compression technique and so on. In the recent days nano finish, microencapsulated technique, plasma finish is gaining importance. Therefore this research has forced upon two major finishing techniques namely preparation of microencapsulation and application through padding mangle and using the ultrasonic atomizer. The sources selected are also natural with medicinal properties namely *Curcuma longa* and *Aloe barbadensis miller*. Combinations of aqueous extracts were used to finish plain woven 100 percent cotton fabric. The results has proved that microencapsulation padding mangle technique has more strength, thickness whereas the ultrasonic atomizer finishing technique showed better absorbency. Further it is clear that both the techniques have good mechanical properties, evolving both the methods to be excellent in their own aspects. Hence it could be concluded that based upon the final product the finishing technique can be selected, like when we need to prepare a face wipe ultrasonic atomizer finishing technique can be used. Whereas when some wound healing materials are to be developed microencapsulated technique can be used.

## **Limitation of the Research**

- Due to lack of time product developments were not accomplished.

### Scope for Future Research

- Other techniques in finishing can be compared

## BIBLIOGRAPHY

- Chopra A, D Golwala, AR Chopra - Journal of Southwest Jiaotong ..., 2022. SCOR - SUPPLY CHAIN OPERATIONS REFERENCE- MODELIN TEXTILE INDUSTRY, P. 67.
- Agrawal. M - IJNRD-International Journal of Novel Research and ..., 2022. MICROENCAPSULATION OF CITRONELLA OIL FOR FRAGRANT COTTON FABRICS, PP. 37-40.
- Agrios, G. N. 2005. Introduction to plant pathology. Elsevier Academic Press Publication. PP. 68-69.
- Alappat, L. and Awad, A. B. 2010. Curcumin and obesity: evidence and mechanisms. Nutr, PP. 729-738.
- Alyssa M. Parian MD, ... Amy C. Brown PhD, in Integrative Medicine (Fourth Edition), 2018. Inflammatory Bowel Disease, P. 42.
- Antonio, L., Juan, A. G., Jose, L. N., Esteban C., and Felix B., 2010. Influence of Viscosity on Droplet Size Distribution and Generation Rate in Ultrasonic Atomization, Atomization and Sprays, Vol. 20, (11), PP. 923–934.
- Bairagi, N.;Gulrajani, M. L.Dyeing of N-modified viscose rayon fibres with reactive dyes, Indian Journal of Fibre Textile Research, 2005, vol.30, P. 196.
- Barreras, F., Amaveda, H., Lozano, A., 2002. Transient High Frequency Ultrasonic Water Atomization, Experiments in Fluids, Vol. 33, PP. 405-413.
- Beckert, Sven, 2014. Empire of Cotton: A Global History. New York: Knopf, PP. 1-15.
- Begum SG, CM Chetty, R Kota, K Susmitha... - World Journal of ..., 2018. A Review on Microencapsulation, PP. 1-15.
- Benita, S. (2005). Microencapsulation: methods and industrial applications. Crc Press, PP. 1-20.
- Bhutkar S, K Shanmuganathan - Micro-and Nano-containers for Smart ..., 2022. Polymer Based Microcapsules for Encapsulation, PP. 23-43.
- Boudreau, M. D., & Beland, F. A. (2006). An evaluation of the biological and toxicological properties of Aloe barbadensis (miller), Aloe vera. Journal of Environmental Science and Health Part C, PP. 103-154.
- Brennan, J (15 October 2008). "Turmeric". *The National*. 1637.

- CABI, 2019. "Aloe vera (true aloe)". Retrieved 15 October 2019.
- Cas Dei, M., & Ghidoni, R. (2019). Dietary curcumin: correlation between bioavailability and health potential. *Nutrients*, P. 11.
- Chandran B, Goel A (2012). A randomized, pilot study to assess the efficacy and safety of curcumin in patients with active rheumatoid arthritis. *Phytother*, PP. 1719–1725.
- Chandrasekaran, K., & Senthilkumar, M. (2018). Effect of Herbal Extract Treatment on the Moisture Management Properties of Cotton Knitted Fabrics. *Journal of Natural Fibers*, PP.1-16.
- *Chattopadhyay I, Kaushik B, Uday B, Ranajit KB (2004). "Turmeric and curcumin: Biological actions and medicinal applications" (PDF), PP. 44–53.*
- Cheetharambil, A., Pillai, G. S. Balachandran, I. 2013. Comparative studies on in vitro microrhizome induction in three varieties of *Curcuma longa* (Turmeric) – The role of two stress hormones. *International Journal of scientific research and management*, PP. 230-237.
- Chen, C., Belanger, R. R., Benhamou, N. and Paulitz, T. C. 2000. Defense enzymes induced in cucumber roots by treatment with plant growth-promoting rhizobacteria (PGPR) and *Pythium aphanidermatum*. *Physiol Mol Plant Pathol*, PP. 13-23.
- Cheng, S. Y., Yuen, C. W. M., Kan, C. W., & Cheuk, K. K. L. (2008). Development of cosmetic textiles using microencapsulation technology. *Research journal of textile and apparel*, PP. 41-51.
- Chequer, F. M. D., de Oliveira, G. A. R., Ferraz, E. R. A., Cardoso, J. C., Zanoni, M. V. B., & de Oliveira, D. P. (2013). Textile dyes: dyeing process and environmental impact. In *Eco-friendly textile dyeing and finishing*, PP. 36-49.
- Cintra, M. M. D. F., Pinheiro, J. B. and Sibov, S. T. 2005. Genetic divergence among *Curcuma longa* L. accessions. *Crop breed appl biotechnol*, P. 410.
- DAVID, GREENHALGH (2005), *Cotton finishing*, PP. 02-12
- Debjit Bhowmik, C., Kumar, K. S., Chandira, M. and Jayakar, B. 2009. Turmeric: A herbal and traditional medicine. *Arch*, PP. 86-108.
- Duke, J. A. 2007. The garden pharmacy: turmeric, the queen of COX-2-inhibitors. *Altern Complement Ther*, PP. 229-234.
- Eren, H. A., Anis, P., & Davulcu, A. (2009). Enzymatic one-bath desizing—bleaching—dyeing process for cotton fabrics. *Textile research journal*, PP. 1091-1098.

- Guocheng Wang, yelan Xiao, Wenfei Huang, Chi, Pong Tsui, ChakYin Tang,
- Hadi, A., Pourmasoumi, M., Ghaedi, E., & Sahebkar, A. (2019). The effect of Curcumin/Turmeric on blood pressure modulation: A systematic review and meta-analysis. *Pharmacological research*, PP. 150.
- *Harper Douglas. 2021 "Aloe". Online Etymology Dictionary.*, Retrieved 1 July 2021.
- *Hauser, P. J; Schindler, W. D, . Elsevier (2004-08-10). Chemical Finishing of Textiles, PP. 1, 2.*
- Hewlings, S. J., & Kalman, D. S. (2017). Curcumin: A review of its effects on human health. *Foods (Basel, Switzerland)*, pp. 42-44.
- Holme, I. (2003). Challenge and change in wool dyeing and finishing. *Review of Progress in Coloration and Related Topics*, PP. 85-92.
- *Jana, Leong-Škornickova; Šida, Otakar; Wijesundara, Sirtl; Marhold, Karol (May 2008). "On the identity of turmeric: the typification of Curcuma longa L. (Zingiberaceae)". Botanical Journal of the Linnean Society, PP. 37–46.*
- Janani V, NMS Mangai - 2022 International Conference on ..., 2022. Analysis and Classification of Rhizome rot Disease for Turmeric Plant using Artificial Intelligence, PP. 13-26.
- Jangra SR, DC Bhatt - *World Journal of Pharmaceutical Sciences*, 2017. Recent trends in microencapsulation: A review, PP.11-42.
- Joshi, M., Ali, S. W., Purwar, R., & Rajendran, S. (2009). Ecofriendly antimicrobial finishing of textiles using bioactive agents based on natural products, P. 74.
- Jyothi. S. S., Seethadevi, A., Prabha, K. S., Muthuprasanna, P., & Pavitra, P. (2012). Microencapsulation: a review. *Int. J. Pharm. Biol. Sci*, 3, PP. 509-531.
- Kavita Gulati, Pankaj Verma, Nishant Rai, Arunabha Ray, (2021). Chapter 7 - Role of nutraceuticals in respiratory and allied diseases, *Nutraceuticals (Second Edition)*, Academic Press, PP. 101-115,
- Keiji, Y., Hiroyuki, H., Zheng, X., Yoshiyuki, A., and Shinobu K., 2011. Ultrasonic Atomization Amount for Different Frequencies, *Japanese Journal of Applied Physics*, Vol. 50, PP. 07HE23-1 - 07HE23-5.
- *Kew Science, Kew Gardens, Royal Botanic Gardens, Kew, England. "Curcuma longa L." Plants of the World Online*, Retrieved 26 March 2018.
- Kew, "Aloe vera". Royal Botanic Gardens. 2016. Retrieved 10 August 2016.

- Lazona, A., Amaveda, H., Barreras, F., Jorda, X., and Lazano, M., 2003. High-Frequency Ultrasonic Atomization with Pulsed Excitation, *Journal of Fluid Engineering*, Vol. 125, PP. 941-945.
- Lei Zhng Ultrasonic atomization based fabrication of bio-inspired micro-nano-binary particles for superhydrophobic composite coatings with lotus/petal effect *Composites Part B: Engineering*, Volume 121, 2017, PP. 92-98
- Mishra, S. P. (2000). *A text book of fibre science and technology*. New Age International, P. 16.
- Mishra, S., Majumdar, A., & Butola, B. S. (2014). Modeling of yarn strength utilization in cotton woven fabrics using multiple linear regression. *Journal of Engineered Fibers and Fabrics*, P. 9.
- *Nair, K.P. Prabhakaran (2013). The Agronomy and Economy of Turmeric and Ginger: The Invaluable Medicinal Spice Crops. Newnes. PP. 7–10.*
- *Nelson, KM; Dahlin, JL; Bisson, J; et al. (2017). "The Essential Medicinal Chemistry of Curcumin: Miniperspective". Journal of Medicinal Chemistry, P. 1620.*
- Novaković, Milada; Popović, Dušan M.; Mladenović, Nenad; Poparić, Goran B.; Stanković, Snežana B. (September 2020). "Development of comfortable and eco-friendly cellulose-based textiles with improved sustainability". *Journal of Cleaner Production*, P. **267**.
- Pandit, Rajan, R., & A. B. (2001). Correlations to predict droplet size in ultrasonic atomisation. *Ultrasonics*, PP. 235-255.
- Perkins, Cyndi. "Is Aloe a tropical plant?". *SFgate.com*. Retrieved 13 February 2016.
- *Peter, K. V. (2008). Underutilized and Underexploited Horticultural Crops, Volume 2. New India Publishing, P. 341.*
- pickles, J., Smith, A., Bucěk, M., Roukova, P., & Begg, R. (2006). Upgrading, changing competitive pressures, and diverse practices in the East and Central European apparel industry. *Environment and Planning A*, PP. 2305-2324.
- Poli Fusar, L., Voza, L., Gabbiadini, A., Vanella, A., Concas, I., Tinacci, S., ... & Aguglia, E. (2020). Curcumin for depression: a meta-analysis. *Critical reviews in food science and nutrition*, PP. 60(15).
- Rajan, R., & Pandit, A. B. (2001). Correlations to predict droplet size in ultrasonic atomisation. *Ultrasonics*, PP. 235-255.

- Rani S, A Goel - Pharma Innov. J, 2021. Microencapsulation Technology in Textiles: A Review Study, P.16.
- Roy Choudhury, Asim Kumar (2017). Principles of textile finishing. Elsevier Science, P. 55
- Sahdeo Prasad, Sanjay K. Srivastava, in Cancer (Second Edition), 2021 Oxidative stress and cancer: Antioxidative role of Ayurvedic plants, P. 34.
- Sara J, Kadolph, (2007). Textiles (10 ed.). Pearson/Prentice-Hall, PP. 1- 25.
- Sathianarayanan, M. P., Bhat, N. V., Kokate, S. S., & Walunj, V. E. (2010). Antibacterial finish for cotton fabric from herbal products, PP. 14-19.
- Sathish P - Journal of the Indian Chemical Society, 2022. Application of selected natural sources on mulberry silk fabric, P. 8.
- Tarun G, RSR Murthy - Journal of Pharmacy Research, 2011. Patented microencapsulation techniques and its application. PP. 22-49.
- Tortora, Phyllis G.; Johnson, Ingrid (2013-09-17). The Fairchild Books Dictionary of Textiles. A&C Black, P. 564.
- Wahbeh G, Suskind DL, Burpee T, Cohen M, Christie D, Weber W (2013). Tolerability of curcumin in pediatric inflammatory bowel disease: a forced-dose titration study. J Pediatr Gastroenterol Nutr, PP.277–279.
- Yosuhito, K., Yoshiyuki, B., Soyoko, Y., Kazuyoshi, D., Massaki, N., Keiji, Y., and Akiyoshi, O., 2004. The Effect of Operational Condition on the Contribution of Evaporation in Ultrasonic Atomization, Journal of Chemical Engineering of Japan, Vol. 37, (10), PP. 1286-1289.

## **WEBSITES**

<https://www.medicalnewstoday.com/articles/318405#takeaway>

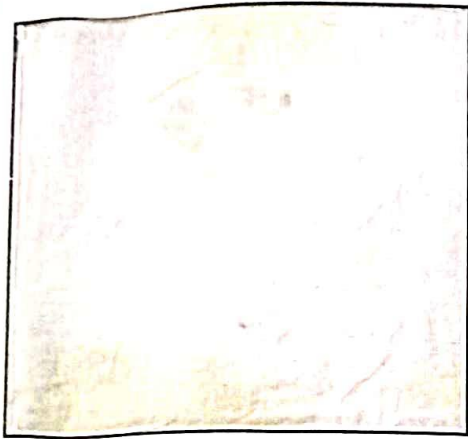
[www.textileschool.com/164/cotton-fibers-and-its-properties/](http://www.textileschool.com/164/cotton-fibers-and-its-properties/)

Techniques for Finishing of Textiles | Methods of Textile Finishing (textilelearner.net)

(PDF) Cotton: An Introduction (researchgate.net)

<https://www.fibre2fashion.com/industry-article/7221/development-of-cosmetic-textiles-using-microencapsulation-technology>

**APPENDICES**



**PURE COTTON FABRIC  
APPENDIX – I**



**DESIZED COTTON FABRIC  
APPENDIX - II**



**FINISHED FABRIC USING  
PADDING MANGLE  
APPENDIX – III**



**FINISHED FABRIC USING  
ULTRASONIC ATOMIZER  
APPENDIX - IV**