I. INTRODUCTION
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Food, clothing and shelter are the basic necessities of mankind. Clothing is as important as food for human survival. Clothing provides protection, modesty and self-adorment. It occupies very important place in determining the status of an individual in the society. Clothing can be used to communicate, motivate, to attract, to separate, to show discipline and also rebellion. (Kefgen, Touchie-Specht, 1976).

For thousands of years natural fibers served the clothing needs of man. Cotton has long been the world's major textile fiber. It has been most universally used single textile fiber. The origin of cotton is unknown but most authorities do agree that cotton was produced in India in 3000 B.C. India was the center of cotton industry and cloth which was then woven was in rather crude and primitive manner but it was known for its exceptional fineness and quality. Cotton is still the most used fiber worldwide. It is excellent for multitude of end uses.

Cotton is undisputed 'number one fiber' used for clothing purpose. It is soft fiber and can be worn with comfort. The reasons are its softness, air permeability and pliability. Cotton can be worn all the way around the clock. As the fiber strength increases when wet, it is washable, durable and holds up well after many launderings. It is more tolerant of combined effect of hot water; detergent, alkali, bleaches and agitation involved the process of washing.

Cotton is up against man made fibers contributing over 60% of fiber consumption today. Today we are living in the world of eco-friendly textiles.
Luckily we are cotton oriented in our textile industry and being natural fiber cotton is considered to be eco-friendly. Cotton is enjoying a big ecological bonus as it is natural fiber and will therefore compete very strongly on the track. In consumption of cotton India takes second place after China in the world. With the world population of just over 6 billion, fiber consumption per head is around 9.5 kg. Cotton is still key fiber for most of the textile end uses.

Cotton is a versatile fiber and can be used to make lightweight for summer and heavy weight for winter. Thus cotton fabric range from light and sheer such as Voile to heavy and thick like Flannel and strong like Denim. (Gini, Stephens and Frings 1978). Cotton has got very good absorbency and also wicking property. It absorbs moisture and has ability to transfer it away from body. It allows cooler temperature outside to reach the body, which makes it feel cool against skin in hot humid weather. Because of this cotton is traditionally been a summer fabric and it is one of the best-suited fabrics for the Indian climate.

Cotton fabric has multi-pherual utilities as an important textile fiber. A single cotton fabric can be used for house wears, summer dress, sport dress, bathing suit and is therefore appropriate for wearing apparel, home furnishing, industrial uses and military supplies. (Isable Wingate, 1984)

However cotton suffers from the drawbacks of low crease recovery and poor dimensional stability. As the resiliency and elastic recovery of cotton is low and also elongation, fabric wrinkle easily and also do not recover from creasing. Cotton makes a very limp fabric. It has property of holding the surfaces it comes in contact with and of clinging to the surfaces. These drawbacks of cotton can be corrected with finishing.
All the processes that come in final stage of fabric construction are regarded as Finishes. Environment friendly chemical processes for textiles are being searched for today on the account of global importance attached to environmental protection combined with stringent regulations for industrial effluents.

The textile material, during the transformation of fiber to fabric undergo damages or in some cases natural fat may get removed from the fibers resulting in harsh and undesirable handle. The restoration of satisfactory handle is achieved through addition of suitable substances like in case of cotton fabric starch; oil or waxes are applied to the fabric. The finishing of cotton fabric consists of mainly coating of fabric surface with starch paste and calendaring that corresponds to the home practice of starching and ironing.

Cotton can be given stiffness, smoothness and strength by immersion in the solution of starch and the processes is commonly known as starching. A small amount of starch in the consumer’s good especially cotton fabric helps to retain freshness while they are on the dealer’s shelves. (Corbman, 1983) Starch fills in the openings in the constructed cloth creating an appearance of greater compactness. Vegetable starches are applied on textiles for adding weight to the fabric. Besides building weight of the fabric, starching imparts thickness and also improves luster of the fabric.

Starches added during home laundering helps to restore body to the limp fabrics. It also helps to keep fabric cleaner as dust and dirt tend to slide of the smooth finish produced by starching or dust and dirt tend to cling to the starch particles and thus easy for removal. Soil may become attached to the starching material rather than fiber, making the dirt or soil easier to come out. It also facilitates stain removal as stain remains on the surface and do not
penetrate in the fabric. Starching is done to the clothes in the process of washing. It is added in the rinse cycle of laundering in the last stage before drying. An aerosol spray also does starching to the clothes at the time of ironing. Whiteness alone is not enough to make white cotton look better. Apart from whitening and ironing of clothes, starching them properly makes the texture look better and crisp. 'Individual differ in their tastes because some like quite stiff clothes, while others prefer crisp while many go in for mild starched clothes.' (Savitri Pandit, 1981)

Starches called sizes, when applied to yarns gives them strength and protection to withstand hard-wear of weaving operation. Modified starches or Dextrin are also used for finishing dyed or printed fabrics. They impart weight and firmness to fabric without causing undue stiffness or dulling of shades.

Suitable starches are stored by the nature in the stem of certain plants but more often in grains or seeds and in roots and tubers, which are used for the purpose of stiffening. The term starch is given to these products. Today starches may be either vegetable or resinous compounds used to make fabric stiffer.

Starch is a tasteless, odorless, white farinaceous material of vegetables. It is polysaccharides consisting of 75-80 percent amylo-pectin and 20-25 percent amylase. Starch is used in large quantities in various industrial applications. It is used to provide body and consistency to solutions, in transferring colours, as adhesive for paper and paper products and also in food industry. Starch is insoluble in cold and in hot water but when aqueous solution is heated, the granules swell that is water enters the starch granules. The starch granules get hydrated and finally burst forming a viscose paste. This is reached when the aqueous opaque starch suspension forms a clear
translucent gel. The gelatinization temperature differs for different starches. In this condition the starch gel gets attached to fabric surface, enters into the fiber making the fabric stiffer on drying. The effect of starch is temporary and once the fabric is washed most of the stiffness is removed.

The commonly used starches in textile industry were corn, wheat, rice, tapioca and potato. Starch occurs as such in plants and needs only extraction. Besides these at household level there is much use of sago and arrowroot starch for stiffening clothes.

The starches that are used for stiffening textiles are edible and are consumed as foodstuff on large scale. There is recurrent shortage of edible starch particularly shortage of grains leads to shortage of starch which is required in bulk to the textile industry. More than seventy percent of the starch produced in India is used in textile industry. During recent years it has been increasingly becoming difficult to make use of cereals for manufacture of starch due to shortage of food grains. In developing country like India, where there is scarcity of food, the availability of grains for starch manufacturing is limited. During the period of shortage of starch therefore, the textile industry experienced difficulties in processing of yarn and fabric. It is therefore necessary to work on alternatives to food grain starch for textile processing.

India is blessed with wide variety of flora and fauna and much of the starch sources of India are yet largely untapped. (Mehta P. C. 1981). Starches can be procured from unconventional sources particularly from different agro waste. Disposal of this agro waste is big problem and can successfully be utilized as a best source of starch, which will replace the use of food grain starches in textile industry.
The mango (Mangifera indica) is commonly known as the ‘King of Fruits’. It is one of the commercial fruit crop as it is important fruit crop of India and it is grown in almost all parts of India. Out of total world mango production India contributes 54.22 percent (FAO, 2000). India produces 11000 tones of mango annually (Ramteke et al. 1999 and Singh and Kaur, 2000). It is estimated that from the annual crop of mango nearly two/three million tones of mango kernel go waste as they are thrown away. Disposal of mango kernels after extraction of juice is considered to be a problem for food industry. Disposal of these kernels in the vicinity of the industry is a trouble from environmental point of view.

The mango kernels are rich in starch content which can be used as substitute for cereal starches in the preparation of stiffening agents. Mango kernel contains 69–79 percent carbohydrates. Out of which starch alone accounts 92 percent, which could be extracted by a simple laboratory method. Annually approximately 0.13 million tones of starch can be isolated from mango kernels (Mehta P. C., 1981). It is observed that mango starch like tapioca starch has high viscosity and the starch gel gets attached to fabric surface, enters into the fiber thus makes the fabric stiffer on drying.

Although there are problems in collection of mango kernel from widely distributed mango crop in India and the protection of them from microbial infestation in highly humid conditions, they are not insurmountable. Potentially mango kernels are the rich source of large quantity of starch, which can be utilized successfully as stiffening agent in textile industry.

Keeping in view the application of starch as stiffening agent on cotton fabric and limitation of availability of food grain starch for the textile industry, it is felt necessary to try out substitute to these starches. It is required to extract
starch from mango kernels and its utilization as stiffening agent on cotton fabric.

Mango kernel starch is eco-friendly and does not create any sort of health hazard to the wearer. Eco-standards relating to any production and processing are generally around in the European countries. There are regulations and directives that are meant for ensuring that only those products which are safe and which meet the health, environmental and consumer production requirements should be produced and will enter into the consumer market.

Mango kernel starch is low cost non-conventional starch. Starch is white odorless and has good pasting and film forming property. The study is undertaken with the aim of developing environment friendly and economical stiffening agent from agro waste.

The study was undertaken with the following objectives:

➢ To study the practices adopted by the housewives for stiffening clothes at home.

➢ To extract the starch from mango kernels.

➢ To utilize mango kernel starch and its blends with other starches as stiffening agent on cotton fabric.

➢ To test the properties of cotton fabric stiffened with mango kernel starch and with its blends.

➢ To conduct wear studies of the stiffened clothes.

➢ To conduct storage study of mango kernel starch.
SCOPE AND LIMITATIONS

Scope

- It was not commonly known that the starch can be extracted from mango kernels which can be used as stiffening agent for textiles.
- Mango kernels are rich in starch content and starch can be extracted successfully from them for different uses.
- Mango kernel starch is white, odorless and has good pasting and film forming property.
- Mango kernel starch has high viscosity and it penetrates into the fabric rapidly.
- Mango kernel starch has good compatibility to fabric and the starch gel gets attached to fabric surface, enters into the fiber thus makes the fabric stiffer on drying.
- Starch can be easily extracted from mango kernels with simple laboratory method.
- Cost of production of mango kernel starch is very low without using sophisticated machineries and high cost chemicals.
- The method of mango kernel starch application is very simple.
- The mango kernel starch can be applied by the boiling method of starching.
- Mango kernel starch can be easily removed from the fabric.
- Mango kernel starch is safe and does not create any sort of health hazard to the wearer.
- Mango kernel starch is environment friendly and it is biodegradable.
Eco-standards relating to production and utilization of starches can be suitably adopted with use of mango kernel starch.

Mango kernel starch can meet consumer production requirements and can enter into the consumer market as effective stiffening agent.

Due to limitation of availability of food grain starches for the textile industry, mango kernel starch can be substitute to these starches and can be used as substitute for cereal starches in the preparation of stiffening agents.

Disposal of mango kernel after extraction of juice in the food industry is big problem and can successfully be solved by utilizing mango kernels as a best source of starch. Hence mango kernel starch is an agro waste starch.

Limitations

There are problems in collection of mango kernels from widely distributed mango crop area.

Protection of mango kernels from microbial infestation in highly humid conditions is a difficult task.

Mango kernels are not insurmountable.

Mango kernel starch is not suitable for cold method of starching.

Mango kernel starch acquires pinkish tint after the storage for long period.
PLAN OF WORK

The work planned under the title 'Extraction and utilization of mango kernel starch and its blends as stiffening agents on cotton fabric' was chalked out in order to learn clothes starching methods followed by the housewives, procedure for procuring starch from agro waste like mango kernels which could be easily applied on cotton fabric adopting usual household method of starching, the preferences of the experts to the mango kernel starch as stiffening agent so as to study the possibility of using it as stiffening agent, effect of application of mango kernel starch on textile properties and wearing qualities of the cotton fabric and the keeping quality of mango kernel starch on storage. Hence the line of action and approximate time allotted for each task mentioned below.

A. Survey

<table>
<thead>
<tr>
<th>Action</th>
<th>Duration</th>
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<tbody>
<tr>
<td>✓ Formulation of survey schedule and Data collection</td>
<td>Nine months</td>
</tr>
<tr>
<td>✓ Tabulation and statistical analysis of data</td>
<td>Three months</td>
</tr>
<tr>
<td>✓ Interpretation and presentation of data</td>
<td>Three months</td>
</tr>
<tr>
<td>✓ Collection and reviewing of the literature</td>
<td>Three months</td>
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Experiment

<table>
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<th>Action</th>
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<tr>
<td>✓ Extraction and application of mango kernel starch</td>
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<tr>
<td>✓ Evaluation of mango kernel starched samples</td>
<td>Four months</td>
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<tr>
<td>✓ Statistical Analysis</td>
<td>Four months</td>
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<tr>
<td>Task</td>
<td>Duration</td>
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<tr>
<td>----------------------------------------------------------------------</td>
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<tr>
<td>Wear study of mango kernel starched garment</td>
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<tr>
<td>Storage study of mango kernel starch</td>
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<td>Textile testing of mango kernel starched samples</td>
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</tr>
<tr>
<td>Compilation, interpretation, presentation of the results</td>
<td>Nine months</td>
</tr>
<tr>
<td>Refining presentation of the results</td>
<td>Three months</td>
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