III. MATERIAL AND METHODS
III. MATERIAL AND METHODS

Clothes are starched and used by the housewives for different reasons and starching of cotton clothes was done at home since years before. Housewives preferred to follow the method of stiffening clothes at home in the way they have learnt from their elders or the way elders used to do. Though every day brings new finishing material in the market, most of the time housewives are unaware of these products or they opt to follow their own technique of stiffening clothes. Hence it was felt requisite to study the clothes stiffening practices adopted by the housewives and steps followed by them for starching clothes at home.

There are numerous vegetable sources of starch available in nature which are essentially be tapped for procuring starch from them considering the application of starch as stiffening agent on cotton fabric. Mango kernel is one of the non-conventional sources of starch. Mango kernels are available in bulk after extraction of juice and these mango kernels are nuisance for the surrounding. The disposal of mango kernels is also an important concern for the food factories. Starch can be easily extracted from mango kernels with laboratory method. It is white, odorless and has good pasting and film forming property. 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 as the starch has got viscosity as good as tapioca starch. The mango kernel starch can be applied by the boiling method of starching and can be easily removed from the fabric. Mango kernel starch is eco-friendly and does not create any sort of health problems to the person wearing starched clothes. A systematic study of the starch extraction
technique is required for developing environment friendly and economical stiffening agents from agro waste like mango kernels.

When mango kernel starch was to be utilized as effective stiffening agent on cotton fabric it was indispensable to learn whether the starch can be applied on the cotton fabric adopting prevailing clothes stiffening practices of the housewives or by the steps followed by them for starching clothes at home so that the starch will be accepted by the masses for stiffening clothes. The preference of the members who stiffen clothes regularly and who have the proficiency in the field of starching clothes would have better opinion about usefulness of any starch as stiffening agent. Hence it was felt crucial to consider the preferences of such experts for the cotton fabric stiffened with different concentrations of mango kernel starch and with its blends in order to find their acceptance to mango kernel starch as stiffening agent for stiffening cotton fabric.

The physical and textile properties of cotton fabric were tested after the application of mango kernel starch and its blends with the purpose of identifying the performance of the mango kernel starch and of its blends on cotton fabric as stiffening agents. Stiffened fabrics need to undergo repeated washing and starching in their use. The repeated washing and starching of the cotton fabric definitely have an effect on the wearing quality as well as textile properties of the cotton fabric. The consequences of repeated wearing, washing and starching of cotton fabric with mango kernel starch on textile properties of stiffened fabric was considered.

The starch as stiffening agent is essential to store for months to use. The storing of mango kernel starch affects its efficiency as stiffening agent. Storing lowers the utility scores for mango kernel starch.
In this chapter, the material used for conducting survey and also for experiment is enlisted in detail. The methods adopted for conducting study ‘Extraction and utilization of mango kernel starch and its blends as stiffening agents on cotton fabric’ are given in detail. The study has been conducted during the year 2003 – 06.

3.1 Material Used for the Study

The material used for conducting the study ‘Extraction and utilization of mango kernel starch and its blends as stiffening agents on cotton fabric’ consisted of material used for survey and material used for experiment.

3.1.1 Survey

Material used for survey was nothing but a survey schedule. It was formulated for studying ‘Practices adopted by the housewives for stiffening clothes at home’. The survey schedule was consist of three parts

1. General information of the housewives and their families

The general information of the housewives and their families includes information regarding age of the housewives, educational status of the housewives, types of families and monthly income of families of the housewives.

2. Practices adopted by the housewives for stiffening clothes at home

This included the types of fabrics stiffened at home, different stiffening agents used by the housewives at home, types of garments stiffened by the housewives at home, colour of the clothes being stiffened at home, method
adopted for preparing stiffening solution and adhesives used in it, stiffening season, frequency of using stiffened clothes prior to next application, stiffness desired according to type of fabric and the steps followed by the housewives for stiffening clothes at home etc.

3. Reasons stated by the housewives for using stiffened clothes

This part was consisting of different reasons stated by the housewives for using stiffened clothes.

3.1.2 Experiment

The material used for conducting the experiment: 'Extraction and utilization of mango kernel starch and its blends as stiffening agents on cotton fabric' consisted of fabric and starches used, different chemicals, glassware, equipments and other material used for experiment.

3.1.2 (a) Fabric used for experiment

Muslin is loosely woven cotton fabric. It is cool, very light, plain weave cloth and is used for summer wear. Though muslin cloth is comfortable in wear and it can withstand repeated washing but it has very low resiliency. It soils and crushes easily. Wrinkling while wearing is a problem in use of muslin fabric. Being a fine cotton cloth, it is very soft and it clings to the wearer. These drawbacks can be minimized by the way of stiffening.

Starch can be applied on muslin fabric and it penetrates into the fabric well. Muslin fabric takes starch properly and retains it. Starching contributes stiffness, hand and luster to the fabric. Starching makes the surface of muslin fabric smooth and glossy, which is resistant to dirt and dust.
Fabric used for study

Plate 1. Market fabric

Plate 2. Desized fabric
Starches used for study

Plate 3. Different starches used

Plate 4. Weighing of starch

Plate 5. Stored mango kernel starch
Table 1 Fabric used for experiment

<table>
<thead>
<tr>
<th>S. no.</th>
<th>Fabric details</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Name of fabric: <strong>Muslin</strong></td>
</tr>
<tr>
<td>2</td>
<td>Weave of fabric: <strong>Plain</strong></td>
</tr>
<tr>
<td>3</td>
<td>Colour of fabric: <strong>White</strong></td>
</tr>
<tr>
<td>4</td>
<td>Fiber content: <strong>Cotton</strong></td>
</tr>
<tr>
<td>5</td>
<td>Fabric count: 72 End/inch</td>
</tr>
<tr>
<td></td>
<td>72 Picks/inch</td>
</tr>
</tbody>
</table>

3.1.2 (b) Starches used for experiment

Starches are sizing agents that are added during home laundering. When the starch is to be used for stiffening fabric, it should be safe for fabric, colorless, free from odor and easy to apply.

Corn starch is nothing but maize starch and is extracted from Indian maize. The starch gives strong viscose solution leaving the fabric very stiff. It is not used singly for starching clothes as it is difficult to prepare homogeneous paste and also gets dusted off after drying. It makes fabric harsh but if used in conjunction with other starches good stiffening is imparted by corn starch. Tapioca is got from the root of cassava plant. The roots are dried, sliced and crushed to a pulp with water. The mash is washed with several changes of water and then evaporated to dryness to get the starch. Starches used in blends with mango kernel starch were procured from Food Technology department of college of Agricultural Technology, MAU, Parbhani.
Table 2: Starches used for experiment

<table>
<thead>
<tr>
<th>S. no.</th>
<th>Starches used</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Mango kernel starch</td>
</tr>
<tr>
<td>2</td>
<td>Tapioca starch</td>
</tr>
<tr>
<td>3</td>
<td>Corn starch</td>
</tr>
</tbody>
</table>

3.1.2 (c) Chemicals used for the experiment

There were very few and common chemicals used for conducting the experiment in the laboratory. The chemicals were not rare and are required in very little amount. The chemicals were particularly used in the extraction of mango kernel starch, for desizing of the market fabric and in washing of stiffened garment during wear study.

Table 3: Chemicals used for experiment

<table>
<thead>
<tr>
<th>S. no.</th>
<th>Chemical used</th>
<th>Purpose</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Sodium Meta-bi-sulphide</td>
<td>Extraction of mango kernel starch</td>
</tr>
<tr>
<td>2</td>
<td>Sodium Hydroxide</td>
<td>Extraction of mango kernel starch</td>
</tr>
<tr>
<td>3</td>
<td>Hydrochloric acid</td>
<td>Extraction of mango kernel starch</td>
</tr>
<tr>
<td>4</td>
<td>Iodine</td>
<td>Identification of starch presence</td>
</tr>
<tr>
<td>5</td>
<td>Neutral soap</td>
<td>Washing and desizing</td>
</tr>
<tr>
<td>6</td>
<td>Distilled water</td>
<td>Extraction of mango kernel starch</td>
</tr>
<tr>
<td>7</td>
<td>Acetone</td>
<td>Extraction of mango kernel starch</td>
</tr>
</tbody>
</table>

3.1.2 (d) Glassware used for experiment

The glassware were particularly used in conducting the experiment in laboratory for extraction of mango kernel starch and for testing of samples.
Table 4  Glassware used for experiment

<table>
<thead>
<tr>
<th>S. no.</th>
<th>Equipments used</th>
<th>Purpose</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Distillation unit</td>
<td>Distillation of water</td>
</tr>
<tr>
<td>2</td>
<td>China dish</td>
<td>Preparation of starch paste</td>
</tr>
<tr>
<td>3</td>
<td>Beakers</td>
<td>Extraction of Mango kernel starch</td>
</tr>
<tr>
<td>4</td>
<td>Glass rods</td>
<td>Stirring of starch solution</td>
</tr>
<tr>
<td>5</td>
<td>Glass jars</td>
<td>Soaking of Mango Kernels</td>
</tr>
<tr>
<td>6</td>
<td>Pipette</td>
<td>Determining viscosity</td>
</tr>
<tr>
<td>7</td>
<td>Density bottle</td>
<td>Determining viscosity</td>
</tr>
<tr>
<td>8</td>
<td>Thermometer</td>
<td>Determining viscosity</td>
</tr>
</tbody>
</table>

3.1.2 (e) Equipments used for the experiment

For carrying out the textile testing of the sample different equipments were used which are listed below.

Table 5  Equipments used for experiment

<table>
<thead>
<tr>
<th>S. no.</th>
<th>Equipments used</th>
<th>Purpose</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Electronic Balance</td>
<td>Weighing of starch and chemicals</td>
</tr>
<tr>
<td>4</td>
<td>Stiffness tester</td>
<td>Stiffness testing</td>
</tr>
<tr>
<td>5</td>
<td>Abrasion Resistance tester</td>
<td>Abrasion Resistance testing</td>
</tr>
<tr>
<td>6</td>
<td>Tensile Strength tester</td>
<td>Fabric strength testing</td>
</tr>
<tr>
<td>7</td>
<td>Fabric Thickness Tester</td>
<td>Fabric Thickness Testing</td>
</tr>
<tr>
<td>8</td>
<td>Sewing machine</td>
<td>Sample stitching</td>
</tr>
<tr>
<td>9</td>
<td>Water bath</td>
<td>Preparation of starch solution</td>
</tr>
<tr>
<td>10</td>
<td>Grinder</td>
<td>Grinding of soaked mango stones</td>
</tr>
</tbody>
</table>
3.1.2 (f) Other material used for experiment

Besides glassware and chemicals different other materials were required for the extraction and application of mango kernel starch as well as for conducting tests in the experiment.

**Table 6** Other material used for experiment

<table>
<thead>
<tr>
<th>S. no.</th>
<th>Material used</th>
<th>Purpose</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Steel vessels</td>
<td>Starch preparation</td>
</tr>
<tr>
<td>2</td>
<td>Buckets and tubs</td>
<td>Washing of fabric</td>
</tr>
<tr>
<td>3</td>
<td>Hangers</td>
<td>Drying of Scarves</td>
</tr>
<tr>
<td>4</td>
<td>Polythene Bags</td>
<td>Storage of Mango kernel starch</td>
</tr>
<tr>
<td>5</td>
<td>Clothes Line</td>
<td>Drying of Fabric</td>
</tr>
<tr>
<td>6</td>
<td>Wooden spoons</td>
<td>Stirring of starch solution</td>
</tr>
<tr>
<td>7</td>
<td>Clothes Pegs</td>
<td>Holding of Fabric while drying</td>
</tr>
<tr>
<td>8</td>
<td>Pair of tongs</td>
<td>Holding of vessels</td>
</tr>
<tr>
<td>9</td>
<td>Stop clock</td>
<td>Determining viscosity</td>
</tr>
<tr>
<td>10</td>
<td>Scissors</td>
<td>Sample cutting</td>
</tr>
<tr>
<td>11</td>
<td>Pencil</td>
<td>Marking of samples</td>
</tr>
<tr>
<td>12</td>
<td>Inch steel scale</td>
<td>Measuring fabric for sampling</td>
</tr>
<tr>
<td>13</td>
<td>Fine muslin cloth</td>
<td>Straining of</td>
</tr>
<tr>
<td>14</td>
<td>Cooking gas</td>
<td>Preparation of starch solution</td>
</tr>
<tr>
<td>15</td>
<td>Steel spoons</td>
<td>Preparation of starch paste</td>
</tr>
<tr>
<td>16</td>
<td>Sifter</td>
<td>Sifting of freshly prepared mango kernel starch</td>
</tr>
<tr>
<td>17</td>
<td>Strainer</td>
<td>Straining of starch solutions</td>
</tr>
</tbody>
</table>
Methods Adopted for Study

**Survey**
- Formulation of survey schedule
- Selection of sample
- Collection of data
- Tabulation of data
- Statistical Analysis
- Presentation and Interpretation of data

**Experiment**
- Extraction of mango Kernel Starch
- Application of mango kernel starch and its blends
- Organoleptic evaluation of stiffened samples
- Testing Textile Properties of stiffened samples
- Wear study mango kernel starched garment
- Storage study of mango kernel starch

Developing economical and eco-friendly stiffening agent for cotton fabric
3.2. Methods Used for the Study

The methods used for conducting the study "Extraction and utilization of mango kernel starch and its blends as stiffening agents on cotton fabric" were consisted of two parts as follows:

1. Method used for survey
2. Method used for experiment

3.2.1 Survey

The methods used for conducting the study on "Practices adopted by the housewives for stiffening clothes at home" were consist of studying socio-economic status of the families of the housewives, existing practices adopted by the housewives for stiffening clothes at home and the reasons stated by the housewives for stiffening clothes at home. It was consist of different steps.

3.2.1 (a) Location of survey

3.2.1 (b) Formulation of survey schedule

3.2.1 (c) Selection of sample

3.2.1 (d) Collection of data

3.2.1 (e) Tabulation of data

3.2.1 (f) Statistical Analysis

3.2.1 Survey

The survey conducted for studying the practices adopted by the housewives for stiffening clothes at home was systematically carried out from the first step of screening of families and the housewives to be interviewed till
the last step of interpretation of the information collected from these housewives about clothes stiffening practices. The survey method consisted of different steps.

3.2.1 (a) Location of survey

The location for the survey was selected keeping in view the type of families whose family members wear stiffened clothes and the housewives of the families do stiffen their family clothes at home. The survey was conducted among housewives of Parbhani town particularly from the area of Bhagyalakshmi nagar, Shivaji nagar, Ramkrishna nagar and Snehsharda nagar.

3.2.1 (b) Formulation of survey schedule

The survey schedule was formulated to study the practices adopted by the housewives for stiffening clothes at home. The schedule consists of different aspects of clothes starching practices including general information of the housewives and their families.

Under the general information the points covered were name of the respondent, age of the respondent, educational of the respondent, type of family of the respondent and monthly income of family of the respondent.

Besides general information survey schedule was mainly focused on practices adopted by the housewives for stiffening clothes at home. This part of survey schedule includes following aspects of clothes stiffening practices.

1. Types of fabrics stiffened at home- Different types of fabrics like cotton, silk, synthetics and woollen were enlisted.
2. Different Stiffening agents used. For different fabrics Stiffening agents were quoted in schedule i.e. sago, Maida, rice, Arrowroot, aerosol stiffeners, commercial stiffening agents.

3. Type of garments stiffened at home. - Different types of garments enlisted were sari, blouse, cap, Punjabi suit, Chunniies/ Duppatta, Kurti-Pajama, shirt, handkerchiefs, tablecloth, bed-cover and sofa-cover etc of different types of fabrics.

4. Method adopted for preparing stiffening solution- Information regarding methods adopted for preparation of stiffening solution either by boiling method, cold method or instant method for stiffening cotton, silk or synthetic clothes was sought.

5. Additives used in stiffening solution- Information regarding addition of bleaching agents, blueing agents, tea extract or any other for cotton, silk or synthetic clothes was collected.

6. Colour of garment stiffened at home was focused by including shades of colours like dark, light, white or any special of cotton, silk or synthetic clothes.

7. Stiffening is done in season- Particular season if preferred for stiffening cotton, silk or synthetic clothes was studied.

8. Use of stiffened clothes prior to next stiffening- Different options about the frequency of using cotton, silk or synthetic stiffened clothes prior to next stiffening like 1-2 times, 3-4 times, 5-6 times or 7 and more than 7 times were enlisted

9. Stiffness desired according to type of fabric- For stiffening cotton, silk or synthetic clothes stiffness like light, medium, heavy or no choice were the options given
10. Steps followed for stiffening clothes at home. Information regarding stiffening procedure for cotton, silk or synthetic clothes was collected considering the different steps like sorting as per colour, use, stiffness, any other, treatment prior to stiffening like washing, bleaching, bluing, wetting, preparation of starch paste/gum solution either in cold water or in hot water, preparation of starch solution in cold water or hot water, soaking of clothes in starch solution, spraying of starch solution, wringing of stiffened clothes and drying of stiffened clothes in sunlight or in shade in folded or open forms.

Reasons stated by the housewives for using stiffened cotton, silk or synthetic clothes were included in the last portion of survey schedule. The reasons listed in survey schedule were stiffened cotton, silk or synthetic clothes imparts stiffness, improves appearance, removes wrinkles, provides smooth surface, maintains shape, holds less dirt & dust, gives up-to-date look, love to wear stiffened clothes, easy to clean, provides shiny surface, adds weight to clothes, imparts attractiveness to clothes and provides imitation to high quality clothes. (The survey schedule of the practices adopted by the housewives for stiffening clothes at home is given in appendix I.)

3.2.1 (b) Selection of sample

As the survey was based on studying the procedure followed by the housewives for stiffening clothes at home, a purposive sample of five hundred housewives who wear stiffened clothes and also stiffen their family clothes at home and who were responsive in giving the answers to the questions asked, for collecting the information about their clothes stiffing practices formed the universe of the study. Purposive stratified randomization was followed for selection of the subjects. Thus the two major criteria considered while
selecting the sample were (1) housewives and her family members, wear stiffened clothes (2) housewives stiffen their family clothes at home.

3.2.1 (c) Collection of data

The method of data collection was personal interview method. The information was collected from the housewives who stiffened their family clothes at home with the help of structured survey schedule adopting personal interview method. The researcher had conducted door to door visits to the housewives for collecting the data.

3.2.1 (d) Tabulation of data

The data collected on the practices followed by the housewives for stiffening clothes at home was then tabulated under different headings i.e. types of fabrics stiffened at home, different stiffening agents used, types of garments stiffened at home, method adopted for preparing stiffening solution and additives used in stiffening solution, stiffening season, frequency of using stiffened clothes, stiffness desired according to type of fabric, steps followed for stiffening clothes at home and reasons stated by the housewives for using stiffened clothes in order to study the prevalent clothes stiffening practices adopted by the housewives at home.

3.2.1 (e) Statistical Analysis

The tabulated data was statistically analyzed applying Line Chi-Square test in order to find out the significance of analyzed data statistically.
Collection of information through survey

Plate 6.

Plate 7.

Plate 8.
3.2.2 Experiment

The methods used for conducting the study ‘Extraction and utilization of mango kernel starch and its blends as stiffening agents on cotton fabric’ consisted of method adopted in the laboratory for studying the properties of mango kernel starch and of its blends on cotton fabric as stiffening agents. The experiment consisted of following steps.

3.2.2 (a) Selection of fabric

3.2.2 (b) Desizing of fabric

3.2.2 (c) Extraction of mango kernel starch

3.2.2 (d) Organoleptic evaluation of mango kernel and other starches

3.2.2 (e) Different concentrations of mango kernel starch

3.2.2 (f) Preparation of different mango kernel starch blends

3.2.2 (g) Application of mango kernel starch and of its starch blends

3.2.2 (h) Organoleptic evaluation of mango kernel starched samples

3.2.2 (i) Organoleptic evaluation of samples starched with mango kernel starch blends

3.2.2 (j) Wear study of mango kernel starched garment

3.2.2 (k) Storage study of mango kernel starch

3.2.2 (l) Textile testing of mango kernel starched samples
3.2.2 (a) Selection of fabric

Cotton has good absorption power. It has pleasant, crisp handle. Cotton gives good durability and can withstand hard wear and repeated washing. It is comfortable in wear; the fact cotton absorbs moisture readily. In the research studies conducted on wear-ability of different types of cotton fabrics like Muslin, Voile, Poplin, Flannel and Jeans, it was observed that muslin is loosely constructed, fine, thin and soft fabric and has got good wearing quality. Muslin, is the cotton fabric which is used widely for wearing commodities particularly sari, Punjabi suits, Duppatta, Kurta-Pajama, shirt and many others. Though muslin cloth is comfortable in wear, used extensively and can withstand repeated washing, it has very low resiliency, it soils and crushes easily. Wrinkling while wearing is a problem in use of muslin fabric. Being a fine cotton cloth, it is very soft it clings to the wearer. The details of cotton fabric used for experiment were as follows:

Name of fabric : Muslin  
Fiber content : Cotton  
Weave of fabric: Plain  
Colour of fabric: White  
Fabric count : 72 ends / inch  
  72 picks/ inch  
Cost of the fabric: Rs 36/- per mt

3.2.2 (b) De-sizing of fabric

For conducting the experimental trials of different concentrations of mango kernel starch and its blends with other starches as stiffening agents on cotton fabric, it was required to have muslin fabric free from starch or from any other stiffening agent. Hence a laboratory procedure prescribed as IS : 1967-1961 was conducted. (Procedure for desizing of fabric is shown in form of a flow chart 1)
CHART-1 DESIZING OF MARKET FABRIC

Boiling of fabric in distilled water for 45 min (MLR- 1:100)

Decantation of supernatant liquid

Re-boiling of fabric in distilled water for 30 min (MLR- 1:25)

Decantation of supernatant liquid

Addition of few drops of iodine

If appearance of blue colour

Repeat of above procedure

No observation of blue colour on fabric
3.2.2 (c) Extraction of mango kernel starch

Potentially a mango seed has large quantity of starch. A simple laboratory scale method of isolation of amaranth starch has been developed by Perez et. al. (1993). The new simpler method involves steeping in dilute alkali, neutralization and ambient air drying without using expensive or highly hazardous chemicals. Dr. D. M. Shere in his Ph.D. research adopted simple method of extracting starch from mango kernels, which was followed for extraction of starch.

Mango kernels were steeped in tap water for twenty-four hours with change of water for every six hours. The supernatant liquid containing tannin was discarded. The steeped mango kernels were then washed with water and then ground in grinder with addition of 1% Potassium Meta-bisulphate. The paste was mixed with water with MLR 1:20. The milky suspension of ground mango kernels was then passed through double fold muslin cloth. The residue was again ground and process was repeated until no starch passes through muslin cloth. The milky water was then allowed to settle. The supernatant was siphoned off after six hours of sedimentation. The sediment was washed with water. The crude starch was then treated with 0.1 N Sodium Hydroxide solutions. The suspension was agitated from time to time and allowed to settle. The supernatant was siphoned off again and the residue was washed with distilled water. The washed residue was then treated with 0.1 N Hydrochloric acids to get white starch. The decolorized starch was washed with distilled water again and again. Finally the starch was made free from moisture by treating it with Acetone and by drying under the shade in open air. The free flowing starch was white and powdery. (Procedure for mango kernel starch extraction is shown in form of a flow chart 2)
FLOW CHART-2 EXTRACTION OF MANGO KERNEL STARCH

Soaked mango kernels for 24 hours hour with change of water for every six hours

Grinding of mango kernels to fine paste with addition of water (Addition of 1% Potassium Meta-bisulphite, MLR-1:20)

Filtered the slurry through fine muslin cloth

Regrinding of the residue with addition of water

Filtered through fine double fold muslin cloth

Diluted the slurry (MLR- 1:30)

Settlement of the sediment at bottom

Removal of supernatant

Washed crude starch with 0.1 N Sodium Hydroxide

Washed starch with distilled water

Starch treated with 0.1 N Hydro-Chloric Acid

Washed the starch with Acetone

Dried the starch in shade in open air
Extraction of Mango kernel starch

Plate 9. Mango kernels

Plate 10. Mango kernels soaked in water
Plate 11. Slurry of ground mango kernels
Plate 12. Sedimentation of mango kernel starch
Plate 13. Mango kernel starch
3.2.2 (d) Organo-leptic evaluation of different starches

According to J.A. Radley, 'Although starches from various plants may have similar analytical data, the form and colour of individual granules varies and also gelatinisation temperature'.

A panel of judges of fifteen members was constituted in order to carry out organo-leptic evaluation of extracted mango kernel starch and also of other starches i.e. tapioca starch and corn starch. The panel for various criteria such as colour, texture, odor and free flowing behavior evaluated the starches by visual inspection, smell and feel. The subjective evaluation was done using ranking system. The scores obtained by these starches for different parameters were statistically analyzed by Analysis of Variance. (The evaluation schedule for different starches is given in appendix - II)

3.2.2 (e) Different concentrations of mango kernel starch

There is variation in the degree of stiffness desired by the users for their clothes. A few would like to have clothes with light stiffness while some desire to have medium stiffness and others want to wear clothes with high degree of stiffness. In the application of starch to the clothes, thickness of fabric and stiffness desired is taken into consideration. Hence the starch is applied to the fabric in various concentrations according to the thickness of fabric and degree of stiffness required.

In the pilot study conducted in the year 2003 on the application of mango kernel starch on muslin fabric, mango kernel starch was applied on muslin fabric in varying concentrations from 1% to 10%. The team of evaluators judged the starched samples for stiffness, texture, whiteness and overall appearance. In the study it was noted that the preferences for the
stiffened muslin fabric started from the fabric stiffened with 3% concentration of mango kernel starch and were lasted for the fabric stiffened with 6% concentration of mango kernel starch. The members of the panel neither approved the samples stiffened with 1% and 2% concentrations of mango kernel starch nor the samples stiffened with 7%, 8%, 9% and 10% concentrations of mango kernel starch.

Hence the mango kernel starch was applied on desized muslin fabric in four various concentrations from 3% to 6% concentrations. These concentrations were labeled as follows:

<table>
<thead>
<tr>
<th>S. no.</th>
<th>Concentration (Percent)</th>
<th>Label</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>3</td>
<td>M1</td>
</tr>
<tr>
<td>2.</td>
<td>4</td>
<td>M2</td>
</tr>
<tr>
<td>3.</td>
<td>5</td>
<td>M3</td>
</tr>
<tr>
<td>4.</td>
<td>6</td>
<td>M4</td>
</tr>
</tbody>
</table>

3.2.2 (f) Preparation of different mango kernel starch blends

There are various types of starches available. Although chemically they are the same different types of starches produce different effects in the mixing. The starches obtained from different natural sources vary considerably in their sizing properties. In general, physical structure of starch granule varies considerably according to the type of starch. Vibha Parihar (2003)

Corn starch gives quite stable solution and is often used in conjunction with other starches. Its use gives crisp effect, which is slightly harsher than other starches. Tapioca is rarely used alone since it gives thin and soft effect.
The finish is tough and flexible as compared with corn starch. As the acceptability scores of mango kernel starch were low particularly for colour and texture, it was required to compensate this low acceptability of mango kernel starch with the addition of starches of high acceptability scores particularly for colour and texture. Hence different starch blends were prepared using mango kernel starch, tapioca starch and corn starch.

Proportion of tapioca starch and corn starch was kept constant at 1 percent in all the mango kernel starch blends and the proportion of mango kernel starch in these blends was increased from 1 percent to 4 percent. (mango kernel starch : tapioca starch : corn Starch). There was increase of 0.5% of mango kernel starch in each starch blend i.e. in MB1 mango kernel starch blend the proportion of mango kernel starch: tapioca starch: corn starch was 1:1:1 while in MB2 blend it was 1.5:1:1 and in the MB3 it was 2:1:1 likewise a total of seven blends of mango kernel starch were prepared for applying on the cotton fabric.

Table 8 Labeling of the different mango kernel starch blends

<table>
<thead>
<tr>
<th>S .no.</th>
<th>Proportion of starches in blends (Mango kernel: Tapioca: Corn)</th>
<th>Label</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>1:1:1</td>
<td>MB1</td>
</tr>
<tr>
<td>2</td>
<td>1.5:1:1</td>
<td>MB2</td>
</tr>
<tr>
<td>3</td>
<td>2:1:1</td>
<td>MB3</td>
</tr>
<tr>
<td>4</td>
<td>2.5:1:1</td>
<td>MB4</td>
</tr>
<tr>
<td>5</td>
<td>3:1:1</td>
<td>MB5</td>
</tr>
<tr>
<td>6</td>
<td>3.5:1:1</td>
<td>MB6</td>
</tr>
<tr>
<td>7</td>
<td>4:1:1</td>
<td>MB7</td>
</tr>
</tbody>
</table>
3.2.2 (g) Application of starch and starch blends

Mix the starch with cold water to form smooth paste. Add it to boiling water quickly stirring all the time until the appearance of the liquid changes to transparent gray. The starching process is simple. The articles are dipped up and down in the starch solution till they are thoroughly saturated after which they are wrung out and put to dry. (Susheela Danthyagi, 1959)

Mrs. S. N. Kale carried out a pilot study on the use of mango kernel starch as stiffening agent on cotton fabric in the year 2003. It was observed that mango kernel starch is not suitable for cold starching method. The starching when was done by the cold method, the mango kernel starch granules did not enter into the fiber neither got attached to the fabric. The mango kernel starch granules lied on the surface of the fabric and got detached from the fabric without imparting any stiffness to the fabric.

When the mango kernel starch was added in water the starch granules did not mix and were suspended in water but with the heating of the suspension, mango kernel starch granules burst out resulting in colourless, gelatinous and translucent solution. The solution thus formed had high viscosity. In this condition when cotton fabric was dipped in the starch solution, it entered into the fabric and became intricate part of that fabric, leaving the fabric very stiff on drying. Hence the boiling method of application of starch to the fabric was found to be appropriate for applying mango kernel starch and its blends as stiffening agent on cotton fabric. (Procedure for starching of fabric is shown in form of a flow chart)
FLOW CHART-3: APPLICATION OF MANGO KERNEL STARCH AND ITS BLENDS ON FABRIC

Preparation of starch / starch blend paste in cold water (MLR- 1:5)

Addition of starch / starch blend paste in boiling water at boiling temperature, (MLR - 1:15)

Continued boiling of solution for ten min.

Cooling of starch solution at room temperature for three hours

Filtered starch solution through muslin cloth

Soaked desized fabric in starch solution for five min. (MLR- 1:15)

Removed the fabric from starch solution

Slight wringing of starched fabric

Dried the starched fabric in open form in direct sun
3.2.2 (h) Organoleptic evaluation of mango kernel starched samples

Organoleptic evaluation involves evaluation of the substance with help of sensory organs. It is done to judge the acceptability of the substance for different parameters for eg. colour, odor, texture and taste. It is required to evaluate the qualities of starched fabrics from the consumer point of view in order to study the preferences of the users for stiffened fabrics.

A panel of judges of fifteen members was constituted with five members who make use of starch as stiffening agent on commercial level i.e. laundry-men, five members from the field of Clothing and Textiles or rather subject experts and remaining five were housewives who make use of starches at home for starching their family clothes. The organoleptic evaluation of samples stiffened with different concentrations of mango kernel starch was done by these panel members. The evaluation was carried out to study their preferences for muslin fabric applied with different concentrations of mango kernel starch on the basis of various parameters. The each starched fabric was judged and ranked by each panel member for stiffness, texture, whiteness and overall appearance by visual inspection and feel. This subjective evaluation was done using ranking system. The ranks allotted were 1- for poor, 2-fair, 3-good and 4-for best. The scores thus obtained by these samples for different parameters were statistically analyzed by Analysis of Variance and the results were interpreted keeping in view the statistical results obtained. The statistically significant differences in the samples starched with different concentrations of mango kernel starch for each parameter were studied. (The evaluation schedule for the samples starched with different concentrations of mango kernel starch is given in appendix -III).
Organoleptic evaluation of mango kernel starched samples

Plate 14. Subject expert

Plate 15. Laundry-man

Plate 16. House wife
3.2.2 (i) Organo-leptic evaluation of samples starched with mango kernel starch blends

A panel of judges of fifteen members which included five laundry-men, five members from the field of Clothing and Textiles and remaining five were housewives who make use of starches at home for starching their family clothes was made for evaluation. The evaluation was carried out to study their preferences for muslin fabric applied with mango kernel starch blends on the basis of various parameters. The each starched fabric was judged and ranked by each panel member for stiffness, texture, whiteness and overall appearance by visual inspection and feel. This subjective evaluation was done using ranking system. The ranks allotted were 1- for poor, 2-fair, 3-good and 4- for best. The scores thus obtained by these samples for different parameters were statistically analyzed by Analysis of Variance and the results were interpreted keeping in view the statistical results obtained. (The evaluation schedule for the samples starched with mango kernel starch blends is given in appendix –IV).

3.2.2 (j) Wear study of mango kernel starched garment

A temporary stiffness can be obtained by drying starch into the fabric. The starch is removed in the process of washing after each use and the fabric needs to be starched again in order to restore its stiffness and shape. The repeated washing and starching of the cotton fabric definitely affect the wearing quality as well as textile properties of the cotton fabric.

In the discussion with Dr. Krishnabai, Head Dept. of Clothing and Textiles, Avinashilingam Institute for Home Science and Higher Education for Women, Coimbatore, it was stressed that the garment to be selected for wear
study must be in the use by majority, should be of muslin fabric and should be washed and stiffened at home frequently. In order to study wearing quality of the fabric stiffened with mango kernel starch, three sets of scarf (Duppatta) were used. These three sets of the muslin fabric, each consists of two scarves (Duppatta) of 2.25 mt. in length were made. Each scarf from all the three sets was used for eight hours every day. After each use the scarf was hand washed with simple household method of washing and then starched with 4% concentration of mango kernel starch. The washing was done in tap water using soap and applying light hand friction. The starching of the scarf was done by boiling method and after starching the scarf was dried in direct sunlight in open form.

Table 9 Labeling of the samples for different periods of wear study

<table>
<thead>
<tr>
<th>S.No.</th>
<th>Label</th>
<th>Period of wear study</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>W1</td>
<td>Ten days</td>
</tr>
<tr>
<td>2</td>
<td>W2</td>
<td>Twenty days</td>
</tr>
<tr>
<td>3</td>
<td>W3</td>
<td>Thirty days</td>
</tr>
</tbody>
</table>

The total period of conducting wear study of the scarves stiffened with mango kernel starch was of two months. Every scarf from the first set was used, washed and starched for five times i.e. first set was used for ten days with five washes to each scarf. Every scarf from second set was used, washed and starched for ten times. The second set was used for twenty days with ten washes to each scarf. The total period of use for the third set of scarf was thirty days with fifteen washes to each scarf. Every scarf from third set of scarf was used, washed and starched for fifteen times. Thus the total period of wear study was of two months.
FLOW CHART-4 WASHING OF GARMENT FOR WEAR STUDY

Garment soaked in tap water for half an hour

Removed softened stiffening agent with light friction

Garment rinsed in water with dousing

Repeated II and III step till the stiffening agent is removed

Steeped garment in soap solution for fifteen min

Applied light friction

Garment rinsed in tap water for 3-4 times

Dried garment in sun on clothes line
Wear study of mango kernel starched scarf

Plate 17. Washing of scarf

Plate 18. Mango kernel starched scarf
3.2.2 (k) Storage study of mango kernel starch

It is studied that the scores for acceptability are decreased significantly with prolonged period of storage. The quality of starch may get affected during the storage. As the mango kernel starch needs to be stored for long period if it is to be used as stiffening agent. Hence it was felt necessary to conduct the storage study of mango kernel starch to learn its acceptability. The viscosity as well as the moisture content of the mango kernel starch also gets affected due to the storing.

For the study the mango kernel starch was stored for different periods at room temperature. The total duration of the storage was of twenty four months. After extraction of starch, it was stored in four polythene bags. The polythene bags were opened one after another with interval of six months. The moisture content and viscosity of the starch was tested after every opening of the bag and also the scores for acceptability of the stored mango kernel starch were noted.

Table 10 Labeling of the mango kernel starch samples stored for different periods

<table>
<thead>
<tr>
<th>S. No.</th>
<th>Label</th>
<th>Store period</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>S1</td>
<td>Six months</td>
</tr>
<tr>
<td>2</td>
<td>S2</td>
<td>Twelve months</td>
</tr>
<tr>
<td>3</td>
<td>S3</td>
<td>Eighteen months</td>
</tr>
<tr>
<td>4</td>
<td>S4</td>
<td>Twenty four months</td>
</tr>
</tbody>
</table>

3.2.2 (k)-1 Organo-leptic evaluation of mango kernel starch stored for different periods
The mango kernel starch stored for different periods was evaluated by the panel of fifteen members for various criteria. The each starch sample was judged and ranked by each panel member for by visual inspection, smell and feel. This subjective evaluation was done using ranking system. The ranks allotted were 1- for poor, 2-fair, 3-good and 4-for best. The scores thus obtained by these samples for different parameters were statistically analyzed by Analysis of Variance and the results were interpreted keeping in view the statistical results obtained. The statistically significant differences in the samples of stored mango kernel starch for each parameter were studied. (The evaluation schedule for the stored mango kernel starch samples is given in appendix –V).

3.2.2 (k)-2 Determination of moisture content of starch samples stored for different periods

Moisture content of mango kernel starch samples stored for different periods was determined by oven drying method of Association of Official Chemist, 1984

Three samples from each mango kernel starch stored for different periods were accurately weighed in an amount of 5.0g each in weighing bottle previously heated to 90°c to 100°c and cooled in desecrator. The bottles loosely covered with lids, which contain starch samples, were then transferred to oven for three hours at 105°c. After three hours bottles were removed from oven, allowed to cool in desecrator and weighed accurately. Then again the bottles were returned to oven for one hour and weighed. This procedure was repeated until constant weight was observed. Moisture content of mango kernel starch samples was calculated by the formula
Moisture content of sample (\%) = \frac{W2 - W3}{W2 - W1} \times 100

Where,

W1 - Initial weight of the bottle with lid
W2 - Initial weight of the bottle with lid and starch sample before drying
W3 - Final weight of the bottle with starch sample after drying

3.2.2 (i)-3 Determination of relative viscosity of starch stored for different periods

The most important of all tests used to characterize the starch is that of paste viscosity. It is recognized that to obtain the measure of viscosity, it must be determined at low concentration. The commonest method used for determination of starch viscosity is the measurement of time required for a definite volume to flow and this is taken as relative viscosity without changing it into absolute viscosity unit. In other cases the volume, which flows in definite time, is measured, this is called fluidity of the paste. It will be seen that these qualities are inverse of each other so that a starch of low viscosity has high fluidity. (Radley J.A., 1976).

The method adopted for determining the viscosity of mango kernel starch stored for different periods was a pipette method. This method was used to determine the time of flow of definite volume of water at room temperature and the time of definite volume of paste to flow and known as Scott Viscosity.

Three samples from mango kernel starch stored for different periods were accurately weighed on electronic balance in an amount of 2.0 g each.
The starch samples were then transferred to the beakers of 500 ml. One hundred milliliter distilled water was added at room temperature in each beaker. The mixtures were then stirred and beakers were then placed in a rapidly boiling water bath of large size. The temperature of water bath was maintained at boiling point during the cooking. The paste was cooked for fifteen minute with stirring. The starch paste was allowed to cool for three hours at room temperature.

The skin formed on the surface of the starch paste was removed. The paste was then drawn into the ten ml pipette up-to the mark and the mouth of the pipette was then closed with thumb. The stopwatch was started exactly at the same time when the thumb was removed. The time taken by the ten ml mango kernel starch paste to flow was measured with the stop watch and noted for all the stored mango kernel starch paste samples. Thus the time for the flow of ten ml mango kernel starch paste was measured.

Before measuring the flow time of the mango kernel starch paste, the time required for the ten ml distilled water to flow through the pipette was noted. The relative viscosity of mango kernel starch samples was calculated by the formula

\[
\text{Relative Viscosity} = \frac{T_1 D_1}{T_2 D_2}
\]

Where,

- **T1** - Time for the flow of mango kernel starch paste
- **T2** - Time for the flow of distilled water
- **D1** - Density of mango kernel starch paste
- **D2** - Density of distilled water
Viscosity determination of mango kernel starch

Plate 19. Addition starch in water

Plate 20. Drawing of water in pipette
3.2.2 (I) Textile testing of mango kernel starched samples

Testing of physical and textile properties of cotton fabric stiffened with mango kernel starch was done in the Textile Testing laboratory of Textile Technology Dept., Shri Guru Gobind Singhji college of Engineering, Nanded. The Textile Testing laboratory has got all the testing equipments for testing textile fiber, yarn and fabric and the testing of the samples was done under the guidance of Dr. Pramanik and Dr. Chakraborty.

Method of sample selection

Muslin fabric treated with mango kernel starch and its blends with other starches were tested for different physical and textile properties. The samples taken for conducting the tests for different textile properties were selected in a way that they were representative of whole fabric. The warp-wise and weft wise test specimens of the required size were cut from different portions of the treated cotton fabric. The length wise direction of the sample was parallel to the warp or weft wise direction for which the test was to be conducted. The samples cut in each direction were selected in such a scattered manner that no two warp-way samples contain the same set of warp yarns and no two weft-way samples contain the same set of weft yarns.

3.2.2 (I)-1 Determination of weight per square meter of treated samples (IS:1964-1970)

The apparatus used for calculating weight per square meter of treated samples were a flat smooth table, graduated steel scale and an electronic weighing balance. The test was carried out in standard atmosphere. The ten swatches of dimensions 250 mm x full width of the fabric to be tested were
cut. The swatches were then weighed each on electronic weighing balance. Weight of each swatch was noted and mean of ten readings was calculated. Weight per square meter of treated samples was calculated using following formula and it was expressed in terms of grams per square meter

\[
\text{Weight per gram square meter} = \frac{W \times 4 \times 10}{B} \quad (\text{g/m}^2)
\]

where

\[
W - \text{Weight of the sample in kg}
\]

\[
B - \text{Width of the treated fabric in cm}
\]

3.2.2 (I)-2 Determination of thickness of treated samples (IS: 7702-1975)

The thickness of the treated samples was measured as the distances between the reference plate on which the sample rested and the parallel circular pressure foot that exerted specific pressure on the area under test. The test was carried out in the standard atmosphere.

The instrument used for testing thickness of fabric had Interchangeable Pressure foot, a reference plate with plane upper surface of diameter at least 50 mm greater than the pressure foot, mean for moving the pressure foot to the upper surface of reference plate and a Gauge for measuring the vertical distance between the surfaces of pressure foot and reference plate.

Reference plate and pressure foot were cleaned and the free movement of pressure foot shaft was checked. The thickness gauge was set to zero. The thickness of samples was tested for the area 150 mm away from the selvedge. The area was free from the creases. The pressure foot was raised with the help of pressure foot lever and the sample was placed on reference plate, between pressure foot and reference plate. The pressure foot was
lowered gently on the sample at ten different places containing different warps and wefts. The average mean of the ten readings was calculated. The thickness of the samples is expressed in terms of millimeter.

3.2.2 (I)-3 Determination of stiffness of treated samples (IS: 6490-1971)

Stiffness means resistance of fabric to bending. Bending length is one of the factors that determine the manner in which fabric drapes. It is related to the quality of stiffness and the cloth having high bending length drape stiffly.

The stiffness of treated samples was tested by cantilever test. It prescribes a method for determination of stiffness of the woven samples. The principle used is to measure a particular length of the sample of specific dimensions which when used as a cantilever, bends to a constant angle under its own weight.

The sample was drawn from different places of the treated fabric and cut rectangular warp way and weft way of 25x200 mm size with a help of template. The lengthwise direction of sample was parallel to the warp or weft direction. Care was taken in cutting the sample that no two warp way sample had same set of warp yarns or no two weft way sample had same set of weft yarns. The selvedges, end portions and creased places of the treated fabric were not included in testing samples.

The testing machine was placed on the rigid table and its platform was adjusted horizontal with the help of spirit level. The treated and cut sample was placed with the scale on top of it, lengthwise and the zero of scale coinciding with the leading edge of the sample. Holding the scale in the horizontal plane the sample and scale were pushed slowly and steadily. An increasing part of the sample started overhanging and bending under its own
Testing mango kernel starched samples

Plate 21. Testing of stiffness

Plate 22. Testing of abrasion resistance
weight. The pushing of sample was stopped when its tip reached the level of inclined plane. The length of overhanging portion was noted from the scale to the nearest millimeter. Four readings were taken from each sample with each side up, first at one end and then at other. A total of ten samples were tested for each warp way and weft way. Average of the four readings for each sample was calculated and average of the values for the warp way and weft way test samples separately. The bending length of the sample was determined with following formula

\[
C = \frac{L}{2}
\]

Where

- \(C\) - Bending length
- \(L\) - Mean length of overhanging portion on centimeter

3.2.2 (I)- 4 Determination of tensile strength of treated samples

(IS: 6490- 1971)

The strength of the fabric is tested for numerous and varied reasons for e.g. effect of changes in structural details, effect of physical and chemical treatment particularly like washing, starching and laundering or help in designing fabric for specific use.

The treated fabrics were tested for strength by strip test. The cut samples were 2 in. in width prepared by initially cutting the fabric to a width of about 2.5 in. and removing thread from both ends until the width had been reduced to 2 inch. The test length was about 8 inch between the jaws and enough extra length was allowed for gripping the both edges in the jaws. The samples were mounted centrally, securely gripped along the full width to
prevent slippage and the jaws were aligned and parallel so that the load was applied uniformly across the full width of samples.

The tensile properties of the treated fabric in term of breaking load and breaking elongation were measured at kg / cm at the weight of 200 kg from 2 x 8 inch sample size. Breaking load was denoted in Kilogram and breaking elongation in Centimeter.

3.2.2 (l)-5 Determination of resistance to abrasion by the treated samples

Abrasion is an aspect of wear and it is the rubbing away of the component fibers and the yarns of the fabric. The determination of resistance to abrasion by the treated samples was done using Martindale Abrasion Tester.

The test samples were cut from the treated fabrics with the help of a template. The samples were then weighed on electronic weighing balance ($W_1$). The samples were then mounted on the machine with the help of screws and nuts. The reading of the revolution counter was adjusted to zero. The samples were applied with the weight of 400 g and the number of revolution was set for 500 revolutions. The end point of the test was after completion of 500 abrasion cycles, the appearance of broken threads, holes, the rapture of the sample. The samples were removed from the machine and weighed again to ($W_2$) note the loss of weight of the samples. Abrasion resistance was expressed in terms of percentage weight loss in mg and was calculated using following formulae.

$$\text{Percent loss of weight} = \frac{W_1 - W_2}{W_1} \times 100$$