# Efficacy assessment of environmental friendly sizing agent from Mango seed kernel and its application on cotton fabric

Betty Varghese, Jaya Baju Chalakkal, Sindu Francis, Cija K.G, Tincy Mohan, Gayathri K S
Nirmala College of Arts and Science

**ABSTRACT: With the emerging worldwide interest in adopting and studying traditional starching methods and exploiting their potential based on different plant source, nnature has provided abundant plant wealth, which possess medicinal virtues for all living creatures. The essential values of some special fruits and grains have long been published but a large number of them remain unexplored as yet. In this regard, one such fruit is Mango. With this in the mind the present research entitled "Efficacy assessment of environmental friendly sizing agent from Mango seed kernel and its application on cotton fabric" was conducted. To achieve objectives of the study it was carried out in six Stages.**

1. **Ripe Neelum Mangoes were collected from the local market of Thrissur.**
2. **Extraction of Starch from mango seed kernel.**
3. **Characterization of the starch obtained from Mango seed kernel.**
4. **Muslin cloth was selected for the experiments.**
5. **concentration of starch 2%, 5% were prepared and applied on pretreated muslin fabrics.**
6. **These starched samples were visually and mechanically evaluated.**

**Findings of the study revealed that Mango seed kernel starch can be used on cotton muslin fabric. It gives satisfactory results in terms of texture, luster, stiffness and drapability. Five per cent concentration of Mango kernel starch with medium muslin was most preferred while testing. There was increase in physical parameters when sized with mango kernel starch. The stiffness of fabric, fabric weight was increased due to film formation on the surface of the fabric. Fabric colour was not affected.**

**It can be concluded that muslin can be successfully sized with natural starch of mango seed kernel flour.**

## 1. INTRODUCTION

The use of natural fibers in textile production has a rich history spanning thousands of years, evolving from a reliance on natural and regenerated sources to today's diverse range of available fibers. Fiber properties, such as length, size, and surface contour, significantly impact the characteristics of the end product, influencing factors like serviceability, aesthetics, durability, comfort, retention, and care.

Fabric creation involves spinning fibers into yarns, which are then woven into fabric. This process allows for the manipulation of fabric characteristics through blending, fiber manipulation, and other methods. Fabrics can be classified based on fiber origin, manufacturing processes, or end usage. Natural fabrics, sourced from animals, silkworm cocoons, and plants, offer breathability, softness, and durability. Synthetic fabrics, made from inorganic or chemically treated organic materials, exhibit various properties tailored to specific purposes.

Cotton, a leading natural cellulosic fiber, stands out for its comfort, absorbency, color retention, printability, machine washability, and strength. Despite its popularity, cotton has drawbacks such as low crease recovery and poor dimensional stability. Fabric finishes, applied post-production, can enhance appearance, feel, or function. Environmentally friendly processes are now a focus due to global environmental concerns.

Starching, a common fabric finish, addresses issues like damage during transformation and loss of natural fats from fibers. In the case of cotton, starching improves handle, freshness, weight, thickness, and luster. Starched fabrics are easier to clean, resist soil, and aid in stain removal. Starches, sourced from plants, seeds, or roots, contribute to fabric stiffness.

Research exploring the extraction of starch from mango seed kernels, widely used in food and pharmaceutical industries, indicates its potential application in cotton muslin fabrics at concentrations of 2% and 5%. This study exemplifies the continuous quest for sustainable and innovative solutions in the textile industry.

## 2. OBJECTIVE OF THE STUDY

- Extraction of starch from mango seed kernel.
- To utilize mango kernel starch as stiffening agent on cotton fabric.
- To test the durability of mango kernel starch on cotton fabric.

## 3. METHODOLOGY

### 3.1 SAMPLES COLLECTION AND PREPARATION

#### 3.1.1 COLLECTION OF RAW MATERIAL

About 2.50kgs of ripe Neelum mangoes were collected from a local market in Thrissur a district of Kerala State. These mangoes are one of the most popular varieties commonly available in Kerala. It grows well in this state's climatic conditions. These can be preserved for long days without damage and known for its pleasant aroma and taste. The samples were washed and peeled to recover the seeds. The outer casings of the seed were removed manually and the embryos were washed and cleaned and directly subjected to starch extraction.

NEELUM MANGO

### 3.2 STARCH ISOLATION

Starch is the predominant food reserve substance in plants. Its greatly in abundance and readily converted into useful chemicals and products. There are many sources of starch discovered out of which recently, starches from seeds of fruits ,which were usually discarded after eating were also characterized. The starches were found to possess good physicochemical properties.

The removed embryos of the sample weighed to be 0.210gms which were cut into small pieces and then grinded in the domestically used mixer. The ground slurry were then moved to a vessel to be mixed with 21/2 liter of water. This mixer is then kept aside for 24hr. at normal room temperature for sedimentation. After the noted time the above liquid is poured out leaving the settled starch layer of the residue which is then left for drying under direct sunlight and finally scraped off after drying. This starch is then taken for further analysis.

⌗ To note -

Out of 0.210gms of mango seed kernels an approximate rate of achieved starch flour was 0.25gms.


REMOVED EMBRYOS


WASHING THE EMBRYOS


MIXER GRINDER


GROUND SLURRY


mixing with water
for sedimentation

3.3 FABRIC SELECTION AND TREATMENTS

3.3.1 FABRIC

Cotton fabric with plain weave was used. The fabric was desized, scoured as pretreatment for giving starch finish. 1mtr of muslin fabric was used for the purpose.

3.3.2 CHEMICAL

The chemicals used were Hydrochloric Acid, Sodium Carbonate, Caustic Soda (sodium hydroxide), Sodium Silicate. All were of analytical grade and purchased from Chemind House, M.G. Road, Thrissur.

- PROXIMATE ANALYSIS OF SAMPLE
- Total starch content determination :
- Optical micrographs of Neelum Mango flour starch.:

3.3.3 METHOD OF TREATMENT

Desizing

It is necessary to remove the size from the fabric before it is taken for subsequent processing. The desizing operation can be physical, chemical or biological depending on the fiber type and sizing agent applied. Here the fabric is desized as to check the use and care of the fabric by applying mango kernel starch.

Recipe

Liquor Ratio - 1:20
Hydrochloric Acid - 2%
Sodium Carbonate - 2%
Temperature - Room Temperature
Duration - 3 hrs

Method

For this study 1mtr of cotton fabric( Muslin) was treated for 10 minutes with a bath containing boiling water because grey fabric are almost repellent and will not easily take up the desizing solution. The wet fabric samples were then treated with 2% hydrochloric acid solution at room temperature for 2 hours and taken from the beaker squeezed and kept for 30 minutes.

Starch present in the cloth is hydrolysed and is removed by washing. The fabric is washed with hot water after desizing since cold water reduces solubility of thestarches. Then the fabric is neutralized by heating with mild solution of 2% sodium carbonate and rinsed with cold water thoroughly.

3.2.2 Scouring

The desized grey cotton is not suitable for any kind of finishing process as it contains natural impurities such as fat, wax, colouring matter, pectins, dirt, broken seeds and leaves, small bits of starch etc. In order to making the cloth more absorbent and obtain level dyeing penetration of the dye stuff and shades with good fastness properties, these impurities have to be removed.

Recipe

Liquor Ratio - 1:20
Caustic Soda - 3%
Soap - 1%
Sodium Silicate -3%
Wetting Agent - 1%
Temperature - 100˚C
Duration - 3 hours

METHOD

The present study the fabric 8 samples after scouring add the samples with hot alkali solution in an open kier. Under pressure or in an open kier without pressure. The boiling out operation varies from place to place depending upon the nature of materials, equipment's, quality of water etc.

The desized samples are boiled for 2 – 3 hours in the liquor containing 3% caustic soda, 3% sodium silicate and 1% detergent and with soft water, care should be taken to see that the cloth remain immersed in the liquor throughout the boiling period. Then the material is taken and washed thoroughly with cold water.

3.3 APPLICATION OF 5% STARCH FINISH TO THE PRETREATED FABRIC

Recipe

Fabric - 1mtr
Starch - 5%
Liqiud ratio - 1:20

Method

Mango kernel starch was applied on pretreated muslin fabric at 5%. The starch is prepared by mixing the starch flour in cold water and then heated to boil for 3-4 min as it gets concentrated. Then the starch solution is kept for cooling in open air for few minutes. This cool concentrated starch solution is then added to the liquor(plain water). A 1mtr of muslin fabric is then soaked in the starch solution for a duration of 5mins. On removing the fabric from the starch solution, it is then squeezed and dried in open form in direct sunlight.

3.3.1 Application of starch gallery

## 4. OBJECTIVE EVALUATION OF SIZED FABRIC

The textile properties of the stiffened fabric i.e tensile strength, tear strength ,fabric stiffness and shrinkage test were tested on the basis of International standard test methods.

Tensile Strength: Tensile strength of the starched fabric with different concentrations of selected starch (Mango Kernel seed starch) was measured by tensile strength testing machine cut strip test method as described in ISI (IS: 1969- 1968) was used to measure the breaking strength of the starched sample the warp way and weft way test specimen of 8X12 inch were cut from the fabric the warp and weft direction for which the breaking load was required. The sample are prepared and clamped on the top and bottom jaw of the fabric strength tester care should be taken while fixing the sample to ensure that fabric is acting tangential to the width of the sample. The equipment is operated till the fabric gets ruptured. At the time of rupturing the load applied for the sample to treat and the rate of elongation is noted.

Fabric Stiffness: To determine the stiffness of the fabric i.e. resistance of fabric to bending, until ever test as described in ISI (IS: 6490-1971) was used. The instrument used was 'cloth stiffness tester'.The fabric sample is cut with the help of the template. The stiffness tester was placed on a horizontal platform. The mirror indicator should be at eye level and check the two lines. One of the specimens was placed on the platform with the scale on the top of its lengthwise and '0' of the scale coincides with loading edge of the specimen. While holding the scale in the horizontal plane stated pushing the specimen and the scale together slowly and steadily. An increased part of the specimen was over hanged towards the inclined plane and start bonding under its own- weight. When the tip pf the specimen reaches the inclined plane. The reading is taken from the scale to the nearest mm.4 readings from each specimen with each side up first at one end and then at the other end. Determine the weight per unit area of the fabric and express in $MGM^E/Cm^2$. Calculating the bending length and flexural rigidity of the fabric.

Bending length (c) = L/2

Warp bending length =

Weft bending length =

Flexural rigidity (G) = $W(L/2)^3$

Warp flexural rigidity (G/W) =

Weft flexural rigidity (G/F) =

Overall flexural (G/O) = $\sqrt{Gw \times Gf}$

Tearing strength: To determine the tear strength of the starched fabric. The average force required to continue tomgue type tear in a fabric is determined by measuring the work done through a fixed distance. The test is carried out in a standard atmosphere after conditioning the sample check the level; 0 point and the jaw of the tear tester and make any adjustment of machines so that the specimen tears between 20-60% scale value.

IMPLICATION OF THE STUDY:

1. This study will be useful in initiating cottage and small scale industries of natural sizing material which will prove very beneficial for income generation in rural and tribal areas.
2. Result of this research work will be beneficial in fighting back the environmental pollution to a certain level.
3. The study shall contribute to the present knowledge on naturally available sizing agent
4. The study will give direction towards exploring new and wider possibilities in the use of natural sizing agent.
5. The work shall be used as a guideline towards exploring more plant source for extraction as sizing agent.
6. The study will suggest Mango seed kernel as a suitable sizing agents source for cotton thus providing totally eco-friendly cost effective sizing.

## RESULTS AND DISCUSSION

Empirical and verifiable interpretation of data collected during the course of investigation plays a pivotal role in determining the success of any study. Results obtained during the course of investigation were subjected to suitable fabric property tests, tabulated and systematically presented through classified and supportive material enabling investigator to interpret the comprehensive outcomes. The findings of the present investigation have been discussed under the following sections:

1. Characterization of the starch obtained from Mango seed kernel.
2. Optimization of different concentrations of mango kernel seed starch through visual evaluation.
3. Effect of sizing material on quality parameters of cotton fabric.

1. Characterization of the starch obtained from Mango seeds kernel:
The morphology (size and shape) of starch powder from Mango seed kernel was captured by means of scanning electron microscope (SEM). All micrographs were taken at different magnification and an accelerating voltage (kv). Mango kernel starch particles shows the presence of starch granules which are in oval shapes.

2. Optimization of the different concentration of Cassia fistula seed starch through visual evaluation:
Fabric sample starched using different concentrations of Mango seed kernel starch (2% and 5% ) were visually evaluated for various attributes through visual evaluation and it was seen that the 5% concentration of starch application was found to be smooth in texture.

3. Effect of sizing material on quality parameters of cotton fabric:
The quality parameters of cotton fabric were tested through International standard testing methods.

Table 1: Strength of the fabric applied with mango kernel starch as sizing agent.

| Sl. no | Mango Kernel starch % | Tensile strength(Kg.f) | | Tear Strength (g.f) | |
|---|---|---|---|---|---|
| | | Warp way | Weft way | Warp way | Weft way |
| 1. | 2% | | | | |
| 2. | 5% | | | | |

Table 2: Stiffness of fabric applied with Mango kernel starch.

| Sl.no | Mango kernel starch% | Bending length (cm) | |
|---|---|---|---|
| | | Warp way | Weft way |
| 1 | 2% | | |
| 2 | 5% | | |

## REFERENCES

[1] Cotton: Science & technology, by S.Gordon and Y-L.Hsieh, Woodhead publishing limited, Cambridge England, 2007
[2] Chattopadhyay, D.P. and Inamdar, M. S. 2013. Improvement in properties of cotton fabric through synthesized nano-chitosan applications. Indian journal of fiber and textile research. 38: 14-21.
[3] Handbook of tensile properties of textiles & technical fibres by A.R.Bunsell, published 2009,by woodhead publishing Limited.

[4] **A**nne Kelly.,2016,Textile Nature -Textile techniques and inspiration from the natural world.)

[5] Chemical Technology in the pretreatment processes of textile by SR. Karmakar,1999,volume 12

[6] Textile processing with enzymes Cavaco-Paulo & G.M Gubitz, Woodhead publisher 2003

[7] Qin, Z.J. (2006). Development and application of green sizing agent. Progress in Textile Science & Technology, 4:5-6.

[8] Yang, Z.Q. (2008). Green environment protection textile size. Textile Decoration Science & Technology, 1:5-6.

[9] Qu, C.X. (2005). Application analyses on environment protection sizing agent. Cotton Textile Technology, 33(5):257-260.

[10] Zhang, C., Yu, S.M., & Gao, X.L. (2007). Research progress of green textile size at home and abroad. Progress in Textile Science & Technology, 6:15-16.

[11] Schwartz.,E.R., 1939, Technical evaluation of finishing treatments., Am.Dyestuff Reporter, 28,238.

[12] Peirce, F.T 1930,' The handle of cloth as measurable quantity., J.Text.Inst/.21,T377.

[13] Madigan, E. (2003). New Uses for Starch. HealthGuidance for Better Health. Retrieved on 20/1/2011 from: http://www.healthguidance.org/pages/Terms-of-Service.

[14] Uba, A.,Izuagie,T.,Hassan, L. G., Achor, M and Sahabi, D.M. (2011a) Charaterization of starch isolation from Mangifera indica seeds. Nigerian Journal of Basic and Applied Science, 19(2) :224-230

[15] Kaur, L. J., Sing, and Q. Liu (2007). "Starch a Potential Biomedical Applications" Nanometer, Nanosyst.,Biomed., Appl., p.83

[16] Chrastil, J (1987) Improved Colorimetric Determination of Amylose in Starches of Flours. Carbohydrate Research,159:154-158

[17] Nadiha, M.Z.N., Fazilah,., Bhat , R and Karim, K. A. (2010); comparative Suspectibililties of Sago, Potato and corn Starches to Alkali Treatment. Food Chemistry,(121): 1053-1059

[18] Devi, A. K. 2012. Efficiency of sizing materials on cottons M.H.Sc thesis submitted to Human Development and Family Studies University of Agricultural Sciences, Dharwad College of Rural Home Science, Dharwad-Karnataka.

[19] Qin, Z. J. 2006. Development and application of green sizing agent. Progress in Textile Science & Technology. 4: 5-6.

[20] Yang, Z. Q. 2008. Green environment protection textile size. Textile Decoration Science & Technology. 1: 5-6.

[21] Kittiphoom, S. 2012. Utilization of mango seed. International Food Research Journal.19: 211.

[22] Kurlageri, S. D. 2009. A study on Impact of special finishes on mechanical and Textiles and Apparel Designing University functional properties of organic cotton fabric M.Sc. thesis submitted to of Agricultural Sciences, Dharwad (Karnataka).

[23] Lewicka, K., Siemion, P. and Kurcok, P. 2015. Chemical Modifications of Starch: Microwave Effect. International Journal of Polymer Scienc.2015: 1-11.

[24] Singh, J., & Singh, N. Studies on the morphological and rheological properties of granular cold water soluble corn and potato starches. Food Hydrocolloids, 17, 63–72(2003).

[25] Kittiphoom.S, Utilization of Mango seed, International Food Research Journal 19(4): 1325-1335 (2012)

[26] L.G Hassam, A.B. Muhammad, A.B. Muhamma, R.U. Aliyu, Z.M. Idris, T. Izuagie, K.J. Umar and N.A.Sani, Extraction and characterisation of starches from four varieties of Mangifera indica seeds, IOSR Journal of Applied Chemistry, Vol. 3, Issue 6, pp 16-23,2013

[27] Priya D. patil, M.V. Gokhale and N.S.Chavan, Mango starch: its use and future prospects, Innovare Journal of Food Science, Vol 2, Issue 1, (2014).

[28] The textile material during the transformation of fiber to fabric undergo damages or in some cases natural fat may get removed from the fiber resulting in harsh and undesirable handle. The restoration of satisfactory handle is achieved through addition of suitable substances like in case of cotton fabric and the process 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 dealers shelves (corbman 1983)