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Explored Agro-waste Starches/Gums as Thickening/ Binding Agents for Textile Printing/Sizing

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Abstract: ***Starches, Gums/Mucilage are highly viscous in nature, so, in the present study agro waste plant sources, namely Jack fruit seeds (JFS); Mango kernel (MK) and Lasoda fruit (LF) were explored to extract starch/mucilage content. Compositional analysis revealed that presence of carbohydrate content in JFS and MK powder, mucilage content of Lasoda fruit contributes good substitute to binding/sizing agents in textiles. SEM analysis revealed particle size of - JFS powder as 5.87-14.4µm lengthwise and 5.87-11.8µm on width direction; MK powder as 18.2-20.1µm length wise and 9.61-15.7µm width wise, which was efficient enough to penetrate into fiber polymer structure. Also viscosity reveals that, selected sources were suitable for printing/sizing, with an appreciable viscosity of 11.9, 7.86 & 3.86 centi-poise for MK, JFS and LF respectively.***

Keywords: Thickening/Binding agents; Jack fruit seed; Mango kernel and Lasoda fruit.

1. Introduction

Starch is naturally occurring polymer, biodegradable, inexpensive and abundantly available polysaccharide molecule. Natural polymer when soluble/dispersible in water solvent produces viscose pastes, widely distributed in the form of tiny granules as the major reserve carbohydrate in stems, roots, grains and fruits of plants (Kavlani Neelam, *et.al*, 2012). Starch powders/Gums readily dissolve in water, whereas, mucilage forms slimy masses.

In recent years, polymers those are derived from plant origin have evoked tremendous interest because of their diverse pharmaceutical applications such as diluents, binder, disintegrant in tablets, thickeners in oral liquids, protective colloids in suspensions, gelling agents in gels, and bases in suppository (Zatz J L and Kushla G P, 1989). They are also used in cosmetics, paints, textiles, and paper making (Jani G K *et.al*, 2009). Sources of polysaccharides and plant seeds are guar gum; sea weed like alginate; plant gum exudates, gum arabic, jhingun gum and gum tragacanth etc,. Sago, wheat/maize flour, arrow root, rice starch and tapioca etc, are sources of starches (Miles, 1981; Shahidullah, 2004-05; Whitler, 1973; Hambay, 1949) are used as textile printing/sizing. These natural sources are preffered against synthetic ones, because of its non-toxic and non-irritant nature.

In printing, Sodium alginate, a natural thickener, as a salt of alginic acid (carbohydrate component of brown sea weeds), possesses to produce soft and brilliant prints especially when reactive dyes are used (Shenai, 1985). Sodium alginates are readily soluble and the extent of interaction with the reactive dyes is negligible. With excessive use of reactive dyes, sodium alginate has now become scarce and expensive. Countries around the North Sea area have brown sea-weed in abundance, whereas it is not readily available in our country (Gularjani, 1979). However for sizing agents from food sources includes high nutritive value, awareness in demand over natural thickening agents, high price and scarcity of them has increased the focus on locally available alternative materials to traditional thickeners (Miah et al., 1993). The main objective of this study is to investigate the substitute starch/gum sources as natural and indigenous thickening/stiffening agents.

2. Materials & Methods

Survey on commonly used thickening/binding agents

A survey was conducted in operational villages and local area of study place, on „type of starch used to treat clothes‟. As well locally available printers were surveyed for „thickening agent‟ used for printing.

Selection and preparation of sources

Jack fruit seed (JFS)

Jackfruit (*Artocarpus heterophyllus* Lam) seeds were collected from local market of Hyderabad. Cleaned seed were peeling off the white aril (seed coats) and later treating with 5% NaOH for 2min brown spermoderm cover can be removed to get fleshy white cotyledons. Seeds sliced into thin chips were subjected to tray drying at 50°-60°C until less than 13% moisture content, which were ground with FFC-23, 70 mesh flour and refrigerated to <4^0C after packing.

Mango kernel (MK)

Commonly available at summer and mature mango fruit‟s kernel was collected from local pickle making market, where kernel was thrown. Kernel was washed thoroughly, ground in motor pestle after tray drying, which was further milled to powder and stored at 4^oC.

Lasoda fruit (LF) (*Cordia myxa Roxb*)

Fruits have medicinal value and considered as anthilmintic, diuretic, demulcent and expectorant. Fruits were collected from in and around the premises of the university and operational villages. A very commonly found fruit yielding about 100 to 125kgs per season grows allover except high hills, which remained unexplored. The fruit is rich in sugar and has mucilaginous pulp which constitutes about 70 percent of the fruit and also economical, hence an attempted been made to extract gum to be used as thickening agent. Fruits were washed in distilled water and trails were made for standardizing gum extraction recipe by squeezing after soaking in water (I), wet grinding (II) and Blanching (III). In all the methods 1kg of fruit was used with one liter of water, where I:II:III yields 700:500:600ml of extract. Blanching method was selected over other two methods, as they posses difficultly in squeezing and seed separation due to thick uneven substrate. Extract was refrigerated at 4^0C.

Compositional analysis

Composition of mango kernel and jack fruit seed were analyzed in terms of ash, protein, fibre, fat and carbohydrate at Quality control lab, ANGRAU.

Scanning electron microscopy

Scanning electron micrographs were taken in Ruska lab, SREE VENKATSWARA VETANEARY UNIVERSITY. Test samples were suspended in ethanol to obtain a 1% suspension. One drop of it was applied to an aluminum stub using double-sided adhesive tape and prepared test sample was coated with gold–palladium (60:40). An accelerating potential of 9kV and 1500 magnificence with scale of 10µm was used during micrograph.

3. Results and Discussion

Identified thickening/binding agents for Textile printing/sizing through survey

Sizing agents

From the survey at rural and urban areas, it was noticed that, Rice, arrow root, sago and Maida are used as stiffening agents by majority of respondent"s families. 67 % of rural respondents said that they apply drained out rice starch only for shirt and saris. Apart from blended shirt, kurta, saris, salwar-kameez, uniforms, etc cottons were applied starch by the urban people. As per stiffness and cost effectiveness sago, maida followed by arrow root starch was used by rural people. In urban sago is used by the majority of the respondents followed by Maida and arrow root.

Printing agents

Textile printing is a complex process as the printing pastes consists of colorants, special chemicals and thickeners, which can influence the consequent behavior of printing paste and their penetration into the fabric. So, it is very important to understand the behavior of the thickening agents (Bandyopadhyay & Bhattacharya, 1998).

Commonly used thickening agents are Gum acacia, Bhagavathi gum, Guargum, Tamarind seed gum and Synthetic Binder, which printers procure from „Textile auxiliary firms" of local market. Block, screen and kalamkari/madhubani printers were selected from local market of the study area. Among them 12% uses rapid and kadi printing dyes, where 90 % uses pigment colors and 7% uses natural dyes for printing. 90% of printers use bhagavathi gum as thickening agent along with water as medium for block printing, where 50% of the kalamkari printers uses gum acacia and remaining use rice starch. SLN, a synthetic binder along with kerosene as medium was also used in block, screen, pigment and flock/kadi printing. 90% of the respondents were following medium viscosity for thickening agents for all above mentioned printing methods.

Composition of the sources

Results obtained on compositional analysis for the starch powders are given in Table 1.

Table 1: Compositional analysis of selected sources (g/100g)

Plant Source	*Ash*	*Fiber*	*Fat*	*Protein*	*CHO*
JFS powder	4.06	9.88	2.09	10.59	73.38
MK powder	2.60	8.90	7.98	6.20	74.32
LF Extract	-	2.0	2.0	4.0	92

From the Table 1, it is observed that both MK and JFS powders are rich in Carbohydrates, in turn which suggests high starch content. **The Lasoda fruit has mucilaginous pulp which constitutes about 70 percent of the fruit is rich in sugar and less acidic.**

Table 2: Percentage Yield of Starch

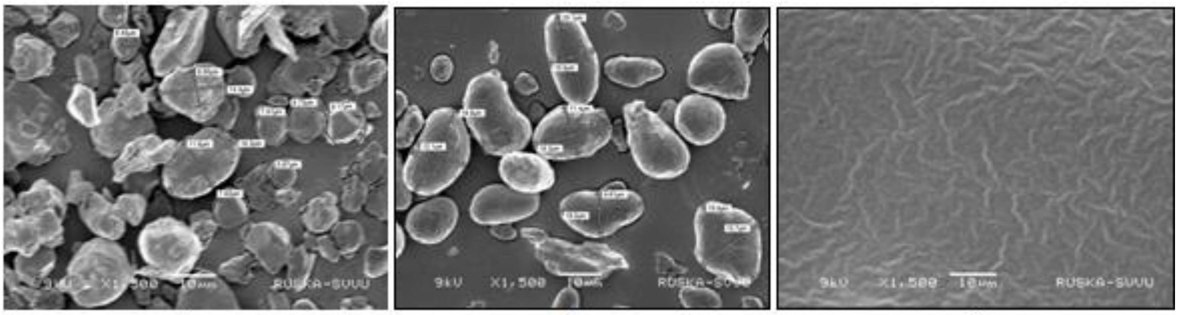
MangoVarieties	Amount of raw material used (g)	Solid to solvent ratio	Amount of starch /mucilage obtained (g)	Percentage yield of starch /mucilage (%)
Sindhoori	10	1:14	5.906	59.06
Totapuri	10	1:14	4.745	47.45
Bagenpalli	10	1:14	4.842	48.42
Jack fruit seed	10	1:14	4.572	45.72
Lasoda	10	1:14	3.882	38.82

SEM analysis

Table 3 and Figure 1 show granules of JFS and MK powders. From the figures, it was noticed that both JFS and MK Powders were well dispersed with a size of 5.87-14.4µm and 9.02-20.1 µm respectively, where as LF extract has no granule size as the dispersion in even although, but after stored for longer period all the mucilage content accumulates at bottom of the vessel/bowl which needs to be stirred well while in use. Most of the molecules are smaller in size, which in turn suggests more absorbency of the source by the textile material during printing/sizing. Compared to JFS powder granules, MK powder granules are larger in size. The higher amylose content of mango kernel starch may be due to the presence of more large-size granules. Strength and absorbency is more if the molecules size and shape is small, vise versa. As, JFS powder molecules size is smaller than MK powder, so, we can conclude that starch prepared form JFS powder absorbs readily than MK starch**.** Both powders have collapsed oval, round and elliptical shaped granules, where JFS powder granules also possess hexagonal shape. The shape and size of starch granules has been reported to vary with plant species and maturity (Manners D J, 1974).

Table 3: SEM analysis of selected sources

Parameters	MK Powder	JFS Powder	LF Extract
Shape	Irregular Elliptical	Round Elliptical	No specified size and shape
Size	9.61 – 20.1 µm	5.87-18µm	
Magnificence	1500X	1500X	1500X
Dispersion	Better	Better	Mucilage form Dispersed completely



A. B. C.

Figure 1: SEM analysis of A. JFS powder, B. MK powder and C. Lasoda extract

Viscosity

To know the thickness, fluids flow consistence viscosity was determined. Among all Mango kernel powder has more viscosity than jack fruit seed starch, which determines less usage of the source for printing/sizing. LF extract is in light brownish color, it is suitable as sizing agent, but its mucilage content can assist it in printing as thickening agent. As, the JFS and MK powders were wheatish in color, they were suitable as sizing agents. As well, they can also be applied as thickening agent in printing.

Table 3: Viscosity of explored sources

Source	*Viscosity(Cps)*
JFS powder	786
MK powder	1150
LF Mucilage	386

4. Conclusion

From the present study, it can be concluded that the explored agro waste plant sources are much suitable and can be a substitute for commercially available thickening/binding agents in textile sizing and printing. Results showed that, LF extract is in light brownish color so, it is suitable as sizing agent, but its mucilage content can assist it in printing as thickening agent. As, the JFS and MK powders were wheatish in color, they were suitable as sizing agent. As well, they can also be applied as thickening agent in printing. Strength and absorbency is more for smaller size molecules, vise versa. As, JFS powder molecules size is smaller than MK powder, so, we can conclude that starch prepared form JFS powder absorbs readily than MK starch

5. Implicates of the study

Exploring and Identification of other agro wastes; Comparison of identified sources can be done with commonly usable sources; Further study can be carried out on application as stiffening/thickening agent and testing of fabrics; etc

6. Acknowledgement

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