Journal Homepage: - www.journalijar.com
INTERNATIONAL JOURNAL OF ADVANCED RESEARCH (IJAR)
ISSN NO. 2320-5407
Article DOI: 10.21474/IJAR01/9636
DOI URL: http://dx.doi.org/10.21474/IJAR01/9636

RESEARCH ARTICLE

ARECA HUSK FIBRES AS AGRO-WASTE TO VALUE ADDED PRODUCTS IN TEXTILE SECTOR – A PRACTICABILITY STUDY.

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Manuscript Info

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Manuscript History
Received: 02 July 2019
Final Accepted: 04 August 2019
Published: September 2019

Key words:-
Cellulase activity on natural fibre, Bio-softening Areca fibres, Enzymatic treatment of natural fibres, Bio-polishing in Textile sector.

Abstract

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India continues to be dominating the world in the production and productivity of areca nut and simultaneously with its husk fibres as an unmanaged agro-waste comprehensively. At present, the majority of waste is disposed of by burning which resulted in a loss of the potential source of organic matter and valuable plant nutrients. The areca husk in the plantation causes bad odour and other decay- related problems and poses environmental pollution. This husk can be used as raw material due to its low cost, less weight, low density and biodegradability for the production of value-added products through bio-softening which aims to achieve a polishing effect and avoids the use of caustic chemicals thereby minimizing pollution. The areca nut husk fibres are predominantly composed of cellulose and varying proportions of hemicellulose, lignin, pectin, and proto-pectin. The current study aimed at using cellulase enzyme to act on areca fibres to get fine fibres. These fine fibres obtained through enzymatic treatment can be commercially used in textile industries to produce value-added products blended with an appropriate percentage of cotton.

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Introduction:-

Natural fibres are the alternative resource for synthetic fibres. As new natural fibres are in to the limelight, many researchers are contributing new facts about less utilized fibres which may be a fillip for its improvisation. Arecanut husk is one such agro-waste product and it constitutes to 60-80% of the arecanut fruit by volume. If the husk is not disposed, it starts bio degrading and during this process produces a very bad odour if left unmanaged and poses environmental pollution. The arecanut husk fibres are predominantly composed of cellulose (35-64.8%) and varying proportions of hemicellulose, lignin (13-26%), pectin (7%) and protopectin. Once the softer husk fibre is separated it becomes easy for processing and production of value added products like furnishing fabrics, in textiles by blending with cotton and polyester, thick boards, fluffy cushions and thermal insulators. This husk can be used as raw material for biosoftening through enzyme treatment which brings about softening, thinning and bleaching of the fiber and also avoids the use of caustic chemicals thereby minimizing pollution. The main purpose of using cellulose

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enzyme in the current study was to get fine and softened areca fibres from low cost, less weight, low density and a biodegradable agro-waste.

Objectives:-

1. Extraction of fibers from areca husk using cellulose enzyme.
2. Bio-softening with selected enzyme brings about softening, thinning and bleaching of fibers which avoids the use of caustic chemicals minimizing pollution.
3. Cost effective and Eco-friendly processing for separating of areca fibers.
4. Commercial use of Bio-softened areca nut fibers for the use in furnishings, in textile industries and some value added products.

a) Areca nut plant (Areca catechu) b) Areca nut c) Dried areca husk d) Areca husk fibers.

Materials And Methods:-

Retting:
The areca husk is loosened by soaking in deionized water in every alternate day with fresh deionized water for about 5 days. Using normal tap water may cause growth of microbes which spoil the husk and influences decaying. The separated fibers are spread on polythene sheet for sun drying for about 3 days.

Alkali Treatment:
The loosened and sundried areca fibers after retting is subjected for alkali treatment using a solution of 3% NaOH at room temperature for about 48 hrs. The fibers are then washed with deionized water until to reach neutral pH and spread over polythene sheet for drying in room temperature for about 72 hours.

Enzymatic Treatment:
The fibers treated with alkali, washed and dried at room temperature were considered for cellulase enzyme treatment. A suspension of cellulose enzyme powder in distilled water (about 3 g in 100 ml concentration) was prepared and the areca fibers are soaked providing optimal parameters of pH 6.7 and temperature about 55^{o} C required for the cellulase enzyme to on cellulose of the areca fibers for about 60 minutes. Then the areca fibers were washed with deionized water and sundried for 2 days. The procedure was repeated 3 times to ensure cellulose of areca fibers was removed to the maximum extent.

Determination of Cellulose concentration and Cellulase activity on Areca fibers:
The sample of areca fibers both enzymatically treated and untreated were made a fine powder and a suspension was prepared using deionized water taking 1g, 2g & 3g separately to carry out comparative analysis for the concentration of cellulose in the fibers using standard calibration curve of maltose by Dinitro salicylic acid (DNS) method using colorimeter at 520nm followed by cellulase activity determination.

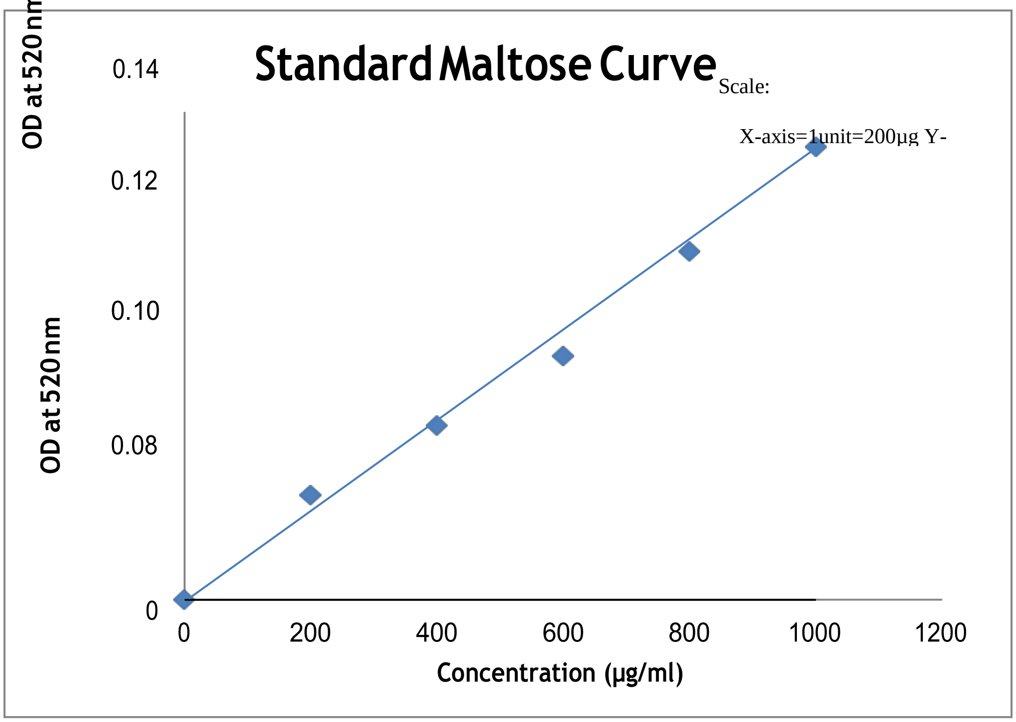
Results And Discussions:-

Preparation of Standard Maltose (1 mg/ml) Curve.

Sl no.	Std Maltose	Distilled water	Conc of Maltose	DNS (ml)		Rochelle's Salt (ml)	Optical Density

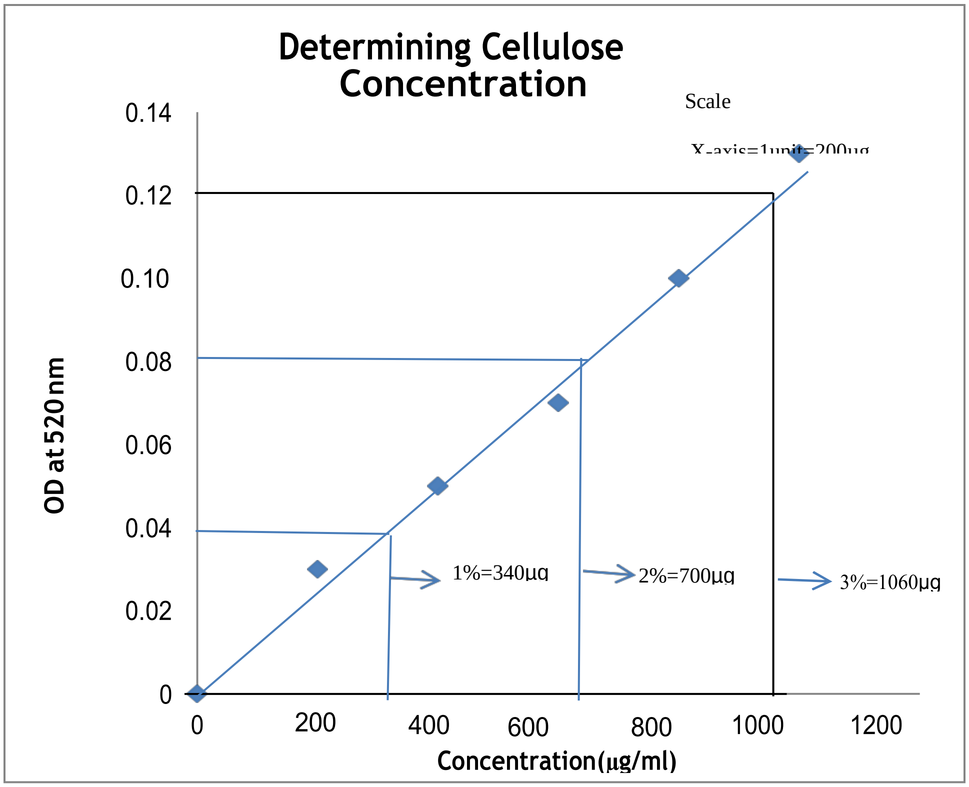
	solution (ml)	(ml)	(µg)				at 520nm
1	0.0	5	000	1.0	Heat for 20 min in water bath at 55°C and cool	1.0	0.00
2	0.2	4.8	200	1.0		1.0	0.00
3	0.4	4.6	400	1.0		1.0	0.01
4	0.6	4.4	600	1.0		1.0	0.07
5	0.8	4.2	800	1.0		1.0	0.10
6	1.0	4.0	1000	1.0		1.0	0.13

Obtained Standard Maltose Curve



Determination of cellulose concentration in areca fibers powder.

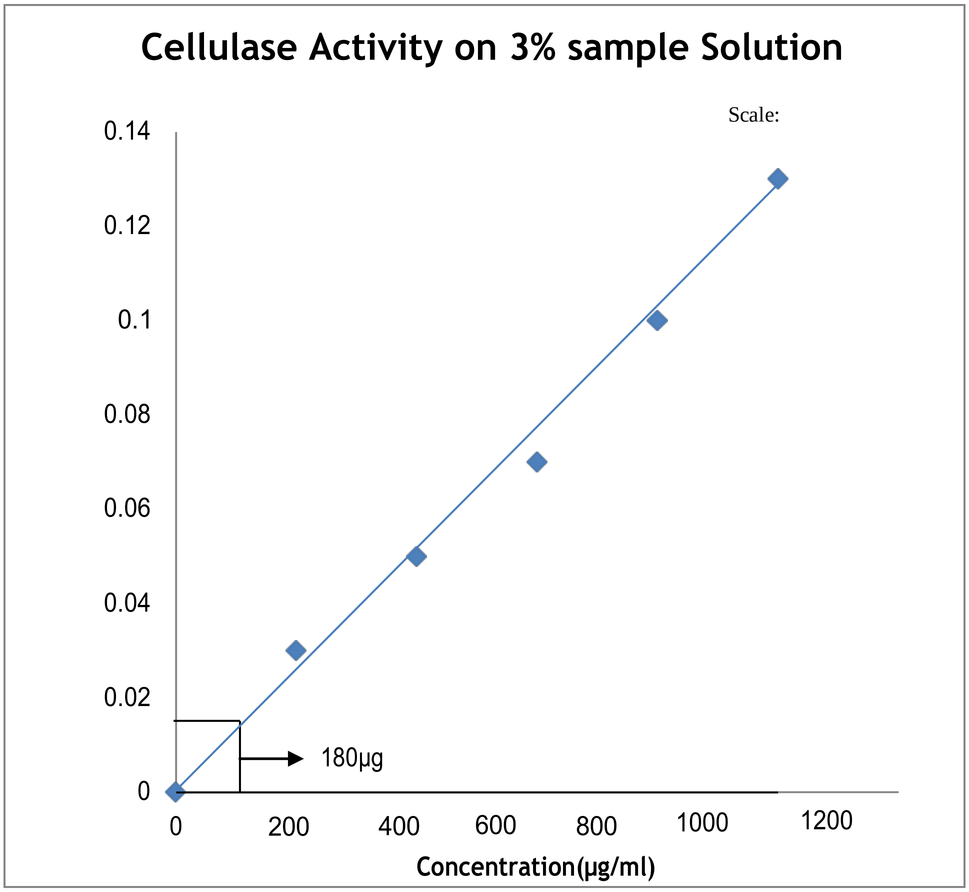
Sl no	Test tubes	Incubate at	DNS (ml)	Heat	Rochelle's salt (ml)	Dw (ml)	OD at 520nm
1	Control	RT for 10 minutes with occasional shaking	1.0	Heat in water bath for 10 min at 55°C	1.0	5.0	0.0
	Test solution I) TS-1- 1%		1.0		1.0	5.0	0.04
2	II) TS-2- 2%		1.0		1.0	5.0	0.08
	III) TS-3- 3%		1.0		1.0	5.0	0.12



The concentration of cellulose found in areca fiber powder for 1%, 2% and 3% of sample solution, the 3% sample solution shown maximum concentration of cellulose of about 1 milligram.

Determination of cellulase activity on 3% sample solution of areca fibers powder.

Sl No	Test tubes		DNS (ml)		Rochell's salt (ml)	D. water (ml)	OD at 520nm
1	Control without cellulase	Incubate at room temp for 10min with occasional shaking	1.0	Heat in water bath for 10min at 55^{o}C and cooled	1.0	5.0	0.0
2	Test solution (1.0 ml 3% sample solution and 1.0 ml cellulase of 3 mg/ml conc.)		1.0		1.0	5.0	0.01



Cellulase Activity = [Enzyme concentration found / Mol.wt of cellulose*incubation time]*DF Where; Molecular weight of cellulose = 162.14 gm/mol, Incubation time = 10min, Dilution factor = 10

Cellulase activity = [180/162.14*20]*10

A. = 0.55ku

Discussions:-

The alkali treated areca fibers when treated with cellulase enzyme, the obtained fibers without cellulose was reduced up to 50% of total mass and become much softened fibres after sundried for 8 hours for 2 days. The whole procedure of determining the cellulase enzyme activity before and after enzymatic treatment of areca fibers was evident with the study results that around 1 mg of cellulose was removed per 3% of areca fiber powder used

Conclusion:-

Overall studies with enzymatic treatment of areca husk fibers which was the main objective of our project given us the positive results that established more polished and biosoftened fibers. This can be considered to manufacture a value added products by blending with appropriate percent of cotton (up to 40%) in textile industries. Although the study on physical characteristics of a thread to use in industrial scale pose challenges to be addressed which paves the way for added scope of research in that line. As an agrowaste, arecanut husk can be recycled by the methods discussed and substantiated with results could give us an eco- friendly, biodegradable and cost effective value added product.

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