

**A SUMMARY OF FINAL REPORT OF MAJOR RESEARCH PROJECT**

**On**

**“Application of *acacia* and rice husk lignin in the synthesis of biopolymers,  
biofilms and resins.**

**UGC Reference No. : F.No. 41-543/2012 (SR), Date: 17/07/2012**

**Submitted by**

**Dr. Harit Jha**

**Principal Investigator**

**Department of Biotechnology**

**Guru Ghasidas Vishwavidyalaya, Bilaspur, Chhattisgarh**

**UNIVERSITY GRANTS COMMISSION**  
**BAHADUR SHAH ZAFAR MARG, NEW DELHI – 110002**  
**Final Report of the work Done on the Major Research project**

1	Project report no:	Final Report
2	UGC Reference No	.F. 41-543/12 SR, Date: 17/07/2012
3	Period of report	17/07/2012 to 30/12/2016
4	Title of research project	<i>“Application of acacia and rice husk lignin in the synthesis of biopolymers, biofilms and resins</i>
5	Name of the Principal Investigator	Dr Harit Jha
a	Department	Department of Biotechnology
b	University/College where work has progressed	Guru Ghasidas Vishwavidyalaya
6	Effective date of starting of the project	17/07/2012
7	Grant approved and expenditure incurred during the period of the report:	
a.	Total amount approved Rs	Rs. 11,26,800.00 (Eleven lakh twenty six thousand eight hundre only)
b.	Total amount released	Rs 10,40,468.00 (Ten lakhs forty thousand four hundred sixty eight)
c	Total expenditure	Rs. 10, 42, 237.00 (Ten lakhs forty two thousand two hundred thirty seven)
d	Report of the work done: (Please attach a separate sheet)	Attached
i.	Brief objective of the project :	
		Extraction and purification of lignin from agricultural biomass and forest waste. Applications of lignin in Biopolymer and biofilm formation. Characterization of biopolymer and biofilm. Application of lignin derived biopolymer and biofilm.
ii.	Work done so far and results achieved and publications, resulting from the work	
		1. Lignin extraction method was successfully optimized for <i>Acacia</i> and rice husk, using different methods like alkali, hot water and oragonosolv extraction. 2. Purified extracted lignin was subjected to synthesize biopolymer with different biopolymers such as gelatin/alginate/chitosan/poly vinyl alcohol/starch/agar.

	3. Standardized the polymerizing agent involving glycerol/PEG 200/PEG 800/Epichlohydine.	
	4. Chemical, mechanical (tensile strength/bursting index/tearing resistance) and structure characterization of film: including moisture content, water solubility, swelling properties, transparency, FTIR, DSC, TGA, XRD, AFM; 5. Drug delivery application of Lignin-Alginates (LA) and Lignin-Gelatin (LG) film. 6. LG and LA film: Characterization completed. 7. Resin preparation: Condition optimized. Synthesized successfully with different catalyst using NaOH/KOH. Thermal and structural characterization: By FTIR; DSC/TGA, XRD	
	<b>List of Publications and Reprints enclosed</b>	
iii.	<b>Has the progress been according to original plan of work and towards achieving the Objective? if not, state reasons:</b>	The progress was as per plan initially, however, delay in release of second installment of funds adversely affected the work of project
iv	<b>Please indicate the difficulties, if any, experienced in implementing the project</b>	Delay in release of second installment of funds adversely affected the work of project and led to interruption in the research work as well as in timely utilization of the funds
v	<b>If project has not been completed, please indicate the approximate time by which it is likely to be completed: N.A.</b>	Not applicable
vi	<b>If the project has been completed, please enclose a summary of the findings of the study. Two bound copies of the summary of the findings of the study and work done may also be sent to the Commission</b>	Completed
vii	<b>vii. Any other information which would help in evaluation of work done on the project: Attached Enclosure I</b>	Eight research papers published nine conference presentation and one PhD produced from the project. The Instruments purchased from the project are housed at laboratory for access and use of all



Signature of the Principal Investigator

Dr Harit Jha

**Dr. Harit Jha**  
Principal Investigator  
UGC-MRP Project  
No. 41/543-2012



Signature of Registrar  
**Registrar (Acting)**  
Gurukul Ghasidas Vishwavidyalaya  
(A Central University)  
Bilaspur (C.G.) 495 009 India

### List of publications and presentation from the project

1. Aadil KR, Barapatre A, Sahu S, **Jha H\***, Tiwary BN (2014) Free radical scavenging activity and reducing power of *Acacia nilotica* wood lignin, *International Journal of Biological Macromolecules* (Elsevier) 67, 220–227 ISSN: 0141-8130 peer reviewed IF: 3.128
2. Kumari Shweta and **Jha H** (2015) Rice husk extracted lignin–TEOS biocomposites: Effects of acetylation and silane surface treatments for application in nickel removal. *Biotechnology Reports* 06/2015; 15. DOI: 10.1016/j.btre.2015.05.003. ISSN 2215-017X
3. Barapatre A, Aadil, KR and **Jha H** (2016) Synergistic antibacterial and antibiofilm activity of silver nanoparticles biosynthesized by lignin-degrading fungus. *Bioresources and Bioprocessing* 3 (8), DOI 10.1186/s40643-016-0083-y
4. Aadil KR, Barapatre A, Meena AS, **Jha H** (2016) Hydrogen peroxide sensing and cytotoxicity activity of *Acacia* lignin stabilized silver nanoparticles. **International Journal of Biological Macromolecules** 82, 39-47 ISSN: 0141-8130 peer reviewed IF: 3.128
5. KR Aadil, Jha R, **Jha H** (2016) Synthesis, characterization and metal adsorption capacity of *Acacia* lignin based resin. *Asian Journal of Biological and Life Sciences* 5(1) 40 -45
6. KR Aadil, Barapatre A, Jha H \*(2016) Synthesis and characterization of *Acacia* lignin-gelatin film for its possible application in food packaging. *Bioresources and Bioprocessing* DOI 10.1186/s40643-016-0103-y
7. Aadil KR and Jha, H\* (2016) Influence of different plasticizers on the physicochemical properties of lignin-alginate based films. *Iranian Polymer Journal* DOI 10.1007/s13726-016-0449-1
8. Aadil KR and Jha, H\*(2016) Improvement of physico-chemical and functional properties of alginate film by *Acacia* lignin *Food Packaging and Shelf Life* 10(2016)25–33

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## PAPERS PRESENTED

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1. Entitled: 'Hydrogen peroxide sensing and cytotoxicity of *Acacia* lignin stabilized silver nanoparticles' presented in International Conference on Biomaterials, Biodiagnostics, Tissue Engineering, Drug Delivery and Regenerative Medicine (BiTERM-2016) Organized by Centre for Biomedical Engineering, Indian Institutes of Technology-Delhi, New Delhi, from April 15-17, 2016. **Poster Presentation.**
2. 'Catalytic Activity of *Acacia* Lignin stabilized silver Nanoparticles', presented in 17<sup>th</sup> National Conference on Surfactants, Emulsions and Biocolloids (NATCOSEB-XVII,) organized by School of Studies in Chemistry, Pt. Ravishankar Shukla University, Raipur, Chhattisgarh, under the aegis of Indian Society for Surface Science and Technology (ISSST) Kolkata. November 4-6, 2015. **Poster Presentation. [Best Poster Award]**
3. Entitled: '*In-vitro* cytotoxicity and antimicrobial activity of novel lignin-zinc oxide nanoparticles,' presented in 'National Conference on Empowering Mankind with Microbial Technologies (AMI-EMMT 2014), Organized by Association of Microbiologists of India (AMI) and Tamil Nadu Agriculture University (TNAU), Coimbatore from November 12-14, 2014. **Poster Presentation.**
4. Entitled 'synthesis and characterization of cellulose nanocrystals from *acacia* wood for its putative applications in biomedical,' presented in International Conference on Polymeric Biomaterials, Bioengineering & Biodiagnostics (Biomaterial-2014 Organized by Department of Textile Engineering, Indian Institutes of Technology-Delhi, New Delhi, from Oct 27 to 30, 2014. **Poster Presentation.**
5. 'Lignin mediated novel route for the synthesis of silver nanoparticles', presented in International Conference on Polymer: Vision and Innovations (APA-2014), organized by Department of Textile Engineering, Indian Institutes of Technology-Delhi, New Delhi February 19-21, 2014. **Poster Presentation.**
6. 'Synthesis and characterization of *Acacia* lignin based resin,' presented in International Conference on Chemical and Bioprocess Engineering-India (ICCBPE-IN, 2013), organized by Department of Chemical Engineering, National Institutes of Technology-Warangal, Andhra Pradesh, November 16, 17, 2013.

7. 'Development of novel biodegradable polymeric composites from *Acacia* (Babool) waste' presented in XI Chhattisgarh Young Scientist Congress-2013 from 28<sup>th</sup> Feb to 1<sup>st</sup> March, 2013. **Oral Presentation**
8. Controlled drug release study of synthesized lignin-alginate copolymer, National conference on 'Microbial Diversity: Exploration, Conservation & Application' organized by Department of Botany, Govt. Science college, Bilaspur, from 14-17<sup>th</sup> March, 2013. **Oral Presentation**
9. 'Study of antioxidant activities of lignin extracted by various methods,' presented in National seminar on Plant Biology & it's role in Sustainable food & Energy Production, from March 17-18, 2012, organized by Department of Botany, Guru Ghasidas Vishwavidyalaya, Bilaspur, CG. **Poster presentation.**