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June 26, 1953

Final Report - Contract No. N7-ONR 397-4 T.O. IV
between
The Biochemistry Branch, Office of Naval Research
and
The University of Maryland
College Park, Maryland

The primary objective of this research project was to obtain degradation of the lignin molecule through use of either enzyme preparations or by direct attack with microorganisms. Subsequently, the degradation products would be characterized and used for elucidation of the structure of lignin. From a more practical standpoint, since lignin is a major constituent of wood, it might be feasible to design more satisfactory means of wood preservation if knowledge were available as to the mechanism of lignin deterioration. Finally, lignin represents a waste substance encountered in tremendous quantities and might serve as a useful raw material in some microbiological fermentation process if an organism could be discovered capable of attacking this material.
The problem was approached by isolating a type of lignin (native lignin) which according to best authority represents the lignin as it occurs in situ. Many obstacles were inherent in this process and one was the extremely small yield. This isolated lignin was used as a substrate and incorporated into media of numerous types which were then inoculated with many kinds of microorganisms. A quantitative method of analysis for the fate of lignin in such culture conditions was formulated. It is believed that the scheme developed contributes a new approach for adequate interpretation of data in this field of investigation.

The limited utilization of lignin obtained under the best cultural conditions did not result in accumulation of any intermediates that could be isolated and the assumption is that utilization was quantitative, CO₂ and mold mycelium being the end products.

Enzyme preparations from various microbial sources appeared to effect some peripheral oxidation of the lignin molecule. Many of the fungi responsible for lignin disappearance in wood, in situ, were found to possess enzyme(s) of the phenol-oxidase type. An extensive study has been made of this enzyme system; its qualitative occurrence and quantitative activity characteristics on suspected lignin constituents would indicate the involvement of this enzyme system somewhere in the pathway of lignin degradation.

A species of bacteria was isolated which was capable of degrading the lignin related material, alpha-conidendrin. A polysaccharide was synthesized during this process and its characteristics were determined.
Personnel participating in project:

Investigating staff

Sidney Gottlieb May 1948 - August 1951
Jerry H. Geller August 1948 - June 1951
William C. Day June 1948 - January 1952
Fletcher P. Veitch September 1948 - April 1950
Michael J. Pelczar July 1948 - August 1951
Walter A. Konetzka June 1951 - May 1952
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Pamela Ludford October 1951 - April 1952
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Stenographical help

T. B. Green July - September 1948

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E. Ruiker April - June 1950
C. Raabe June 1951 - April 1952
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E. Angullo December 1950 - May 1951
J. Tuono August 1951 - April 1952
G. Rawlings April - September 1949

Project reports

/ Status Report September 1 - November 1, 1948
/ Status Report November 1, 1948 - Jan. 1, 1949
/ Status Report January 1 - March 1, 1949
/ Status Report May 1 - July 1, 1949
\ Technical Summary Report May 1, 1948 - May 1, 1949
\ Status Report July 1, September 1949
\ Status Report September 1 - November 1, 1949
\ Annual Research Report January 1 - December 31, 1950
/ Semi Annual Research Report January 1 - June 30, 1951
/ Annual Research Report January 1 - December 31, 1951
/ Semi Annual Progress Report January 1 - June 30, 1952
/ Semi Annual Progress Report June 30 - December 31, 1952
/ Final Report June 26, 1953
Publications:


Papers presented:


This research project has resulted in the development of a new experimental design for evaluation of microbial degradation of lignin. Previous claims by others of lignosulfonate utilization were shown to be in error because of inadequate analyses.

It has been established that some microorganisms are capable of unequivocal but limited utilization of native lignin. The partial utilization of any given amount of lignin may be due to one of several factors such as inhomogeneity of isolated native lignin, complete lignin degradation might be dependent upon some simultaneously occurring biochemical transformation in wood, deficiency of some catalytic chemical entity, etc.

The difficulty in isolating appreciable quantities of lignin plus the uncertainty of its chemical identity to the material in situ represent major obstacles in this field of investigation.
Enzymes of the phenol oxidase type found in the wood rotting fungi have been characterized as to spectrum of activity and other chemical and physical characteristics. This information may contribute to elucidation of enzyme types in the phenol oxidase - laccase group.