

Bacteria Responsible for the Retting of Brazilian Flax

J. A. ROSEMBERG

Laboratory of Industrial Microbiology, National School of Chemistry, University of Brazil, Rio de Janeiro, Brazil

Received for publication 13 July 1965

ABSTRACT

ROSEMBERG, J. A. (University of Brazil, Rio de Janeiro, Brazil). Bacteria responsible for the retting of Brazilian flax. *Appl. Microbiol.* **13**:991-992. 1965—Twenty-two species of bacteria were isolated from *Linum usitatissimum* stored for retting. *Achromobacter parvulus*, *Clostridium beijerinckii*, *C. saprogenes*, *C. saccharoacetoperbutylicum*, *C. perenne*, and *Pseudomonas aeruginosa* and its achromogenic variety are retting agents. The last species mentioned performs the retting in only 72 hr. This is the first time *A. parvulus* has been shown to be a retting agent.

Microbiological processes are used for liberation of the fibers of linen (*Linum usitatissimum*), which is widely grown in Southern Brazil. Retting is carried out in tanks, where some of the bacteria derived from soil act upon the pectic materials covering the fibers, thus freeing them from the bundles.

For jute and linen, Ali (1958) and Potter and McCoy (1955) reported *Bacillus polymyxa* as retting agent; Prescott and Dunn (1949) and Sliber (1958) reported the use of *Clostridium butyricum* and *C. felsineum*, and Allen (1946a, b) reported the use of strains of *B. subtilis*, *B. macerans*, and *B. licheniformis*. Betrabet and Bhat (1958) found species of *Pseudomonas* to be able to ret *Malachra capitata* and *Hibiscus cannabinus*.

The linen industry is important in Brazil, and our research was directed toward the obtention of microbiological data, so far nonexistent, which could help in developing the technology. In our study, special consideration was given to the Brazilian climate and soil conditions, which differ from those in the countries where the above-mentioned investigations were conducted.

We endeavored to study the species commonly found with linen stored for retting, and to select those promoting the liberation of fibers in the shortest time possible.

MATERIALS AND METHODS

Samples of *L. usitatissimum* were obtained from four plantations in the state of Santa Catarina (Southern Brazil).

For each sample, the dry stalks were cut in pieces 8 cm long, placed in 40 sterilized tubes (120

by 15 mm), and covered with sterile physiological solution. Upon incubation at 32 C for 72 hr, considerable bacterial growth occurred, due to nutritive substances which are extracted from the stalks.

TABLE 1. Isolated aerobic and anaerobic bacteria and their capacity for promoting retting

Species	Retting
<i>Achromobacter parvulus</i>	+
<i>Aerobacter cloacae</i>	-
<i>A. aerogenes</i>	-
<i>Bacillus brevis</i>	-
<i>B. cereus</i>	-
<i>B. megaterium</i>	-
<i>B. sphaericus</i>	-
<i>B. subtilis</i>	-
<i>Clostridium butylicum</i>	-
<i>C. beijerinckii</i>	+
<i>C. saprogenes</i>	+
<i>C. sartagoformum</i>	-
<i>C. saccharoacetoperbutylicum</i>	+
<i>C. perenne</i>	+
<i>Escherichia coli</i>	-
<i>Gaffkya tetragena</i>	-
<i>Pseudomonas aeruginosa</i>	+
<i>P. aeruginosa</i> , achromogenic variety	+
<i>P. pseudomallei</i> , achromogenic variety	-
<i>Paracolobactrum aerogenoides</i>	-
<i>Serratia plymuthica</i>	-
<i>Staphylococcus epidermidis</i>	-

Techniques used for isolation, culture, and identification of aerobic and anaerobic bacteria were those described by Spray (1936) and Smith (1955), and in *Bergey's Manual* and the *Manual of*

TABLE 2. Liberation time for the retting bacteria*

Species	Time (hr)				
	24	48	72	96	120
<i>Achromobacter parvulus</i>	-	-	-	±	+
<i>Clostridium beijerinckii</i>	-	-	±	+	OR
<i>C. saprogenes</i>	-	-	±	+	OR
<i>C. saccharoacetoper-butylicum</i>	-	-	-	±	+
<i>C. perenne</i>	-	-	±	+	OR
<i>Pseudomonas aeruginosa</i>	-	±	+	OR	OR
<i>P. aeruginosa</i> , achromogenic variety.....	-	-	±	+	OR

* Symbols: -, no signs of fibers liberation; ±, beginning of liberation; +, complete liberation; OR, over-retted.

Microbiological Methods (Society of American Bacteriologists, 1957).

A 24-hr culture of the isolated and identified organisms was used to inoculate tubes containing sterilized stalks, covered by sterile water. Incubation was at 32 C for 120 hr, with inspection of the fibers every 24 hr. The retting capacity was determined by the methods of Greenhill and Conchman (1947).

RESULTS AND DISCUSSION

The results obtained are summarized in Tables 1 and 2. Not all bacteria isolated from linen promoted retting. Most of the species found have as their usual "habitat" air, soil, and polluted waters, thus agreeing with our source of isolation. *Gaffkya tetragena* and *Staphylococcus epidermidis* are bacteria found in mucous membranes and on the skin, and their presence is most likely due to contamination during the handling of linen stalks.

Biochemically, such retting organisms have pectic-digesting enzymes that act upon the pectin which cements the fiber bundles. The hydrolysis performed may carry the pectin to various degradational stages, the last one being the formation of free galacturonic acid.

Various species of *Clostridium* and *Pseudomonas*

act as retting agents. In this work, we recorded for the first time the retting activity of a strain of *Achromobacter parvulus*.

As shown in Table 2, the fastest retting was obtained with *P. aeruginosa*. This fact may have economic importance, and a process performed with this bacterium is currently under study in our laboratory.

ACKNOWLEDGMENT

I wish to thank Francisca Pessoa de França, pharmaceutical chemist, for her efficient collaboration during this work.

LITERATURE CITED

- ALI, M. M. 1958. Aerobic bacteria involved in the retting of jute. *Appl. Microbiol.* **6**:87-89.
- ALLEN, L. A. 1946a. Recent developments in the microbiology of retting. Part I. The microbial flora in different systems of retting. *J. Soc. Chem. Ind.* **65**:365-372.
- ALLEN, L. A. 1946b. Recent developments in the microbiology of retting. Part II. The part played by bacteria in retting the flax and purifying the liquor. *J. Soc. Chem. Ind.* **65**:373-376.
- BETRABET, S. M., AND J. V. BHAT. 1958. Pectin decomposition by species of *Pseudomonas* and their role in the retting of malvaceous plants. *Appl. Microbiol.* **6**:89-93.
- GREENHILL, W. L., AND J. F. CONCHMAN. 1947. The water retting of flax. Council for Scientific and Industrial Research, Commonwealth of Australia, Bull. 211.
- POTTER, L. F., AND E. MCCOY. 1955. The fermentation of pectin and pectic acid by *Bacillus polymyxa*. *J. Bacteriol.* **70**:656-662.
- PRESCOTT, S. C., AND C. G. DUNN. 1949. Industrial microbiology. McGraw-Hill Book Co., Inc., New York.
- SLIBER, G. 1958. Russian use of bacterial ferments in flax retting. The linen trade circular and new fibers Rev. **44**(34):16.
- SMITH, L. DS. 1955. Introduction to the pathogenic anaerobes. Univ. of Chicago Press, Chicago.
- SOCIETY OF AMERICAN BACTERIOLOGISTS. 1957. Manual of microbiological methods. McGraw-Hill Book Co., Inc., New York.
- SPRAY, R. S. 1935. Semisolid media for cultivation and identification of the sporulating anaerobes. *J. Bacteriol.* **32**:135-155.