Pectin
Tobacco
Smoking
Methanol

THE PECTIC SUBSTANCES

By Z. I. KERTESZ, *New York State Agricultural Experiment Station, Cornell University, Geneva, N. Y.*

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time. Hajo[2001] reviewed the role of enzymes in the enzymic retting of flax. An enzyme mixture named Hiparol, secreted by *Thielaviopsis paradoxa* (DeSeynes) V. Hohn appears to be more active than bacterial enzymes in the retting of jute and coconut husk fibers.[2002] Watson and Baruah[2003] compared the effectiveness of Hiparol with that of bacterial enzymes on six fiber plants important in India. Prevot and Raynaud[2004] compared the pectolytic properties of *Cl. corallinum* with those of other similar species. Bonnet[2005] used bacterial enzymes to remove pectic constituents and proteins from linen and cotton.

In summary, it may be said that thorough reconsideration of the role, as well as the use, of pectolytic enzymes in the retting of plant fibers would be most desirable. With improved understanding of the structure of pectic substances, increased knowledge of at least some pectolytic enzymes, and especially with the much more exact methodology of pectic enzymes which has been developed recently, such further research may easily result in better understanding and improvement of retting processes. After all, there are other outstanding examples, such as the tanning industry, to illustrate what properly developed enzymes and controlled enzyme action can do for an industry.

V. ROLE OF PECTIC ENZYMES IN "FERMENTATION" OF TOBACCO, TEA, AND COCOA AND COFFEE BEANS

These subjects are noted here because of the probability that *pectic* enzymes participate in these processes. However, as will be shown below, this is still more of an assumption than an established fact.

After drying, tobacco leaves are placed in heaps and are dampened to attain a moisture content of 20–25%. Thereupon, fermentation takes place which may raise the temperature of the leaves as high as 158°F. (70°C.), although it is usually kept at about 122°F. (50°C.) by repacking the heaps. Bacteria of the *Escherichia coli* type are said to play a major role in this fermentation,[2006] but this has not been convincingly demonstrated and it is not clear just what does happen. From our standpoint, the important fact is that the pectic constituents of the tobacco leaves undergo

[2001] Hajo, *Melliand Textilber.*, 21, 536 (1940); through *C. A.*, 36, 7326 (1942).
[2002] P. Baruah and H. K. Baruah, *Science and Culture*, 11, 369 (1946); through *C. A.*, 40, 7645 (1946).
[2003] C. M. Watson and H. K. Baruah, *Textile Mfr.*, 72, 434 (1946); through *C. A.*, 40, 7645 (1946).
[2004] A. R. Prevot and M. Raynaud, *Compt. rend.*, 222, 1531 (1946).
[2005] L. Bonnet, *Teintex*, 8, 175 (1943); through *C. A.*, 38, 6104 (1944).
[2006] A. C. Thaysen, in *A System of Bacteriology in Relation to Medicine*. H.M. Stationery Office, London, 1929.

changes. Tobacco leaves are a rich source of pectin-methylesterase (see Chap. XIV) and apparently during certain phases of fermentation, this enzyme acts on the pectinic acids which are naturally present in the leaves, causing the formation of free methanol.[2007] This mixing of the enzyme and substrate may occur through partial plasmolysis resulting from exposure to the comparatively high temperatures. Neuberg and Scheuer[2008] and Neuberg and Kobel[2009] discovered this reaction by tracing the origin of the methanol found in fermented tobacco leaves. It seems, however, that during fermentation some hydrolysis of the pectic constituents also occurs and, since pectolytic enzymes seem to be absent from the leaves, such hydrolysis probably occurs because of the presence of bacterial enzymes. There now seems to be revived interest in this subject.[2009a]

The changes which occur in the pectic constituents of tea leaves during their curing or fermentation are suspected rather than known. Roberts[2010] states that changes in the pectic constituents are probable but have been investigated very little.

After the cacao pods are picked, the seeds are removed and scooped into heaps or placed in baskets or boxes in which they are then "fermented" or "cured." The raw seeds are encased at this time in a mass of white, mucilaginous pulp which must be removed. It seems that attempts to perform this operation with enzymes or pure cultures of microorganisms have thus far been unsuccessful. The fermentation takes 2–7 days during which most of the liquefied mucilaginous mass oozes away.[2011] The yeast *Saccharomyces theobroma* is supposedly involved in this process,[2012] but it is almost certain that several organisms participate when the fermentation takes a desirable course. The process now depends on chance infection. Acetic, lactic, and butyric acids, ethanol, esters, and no doubt many other compounds are formed during the process.[2007] Most investigators emphasize the several pronounced changes which occur in the odor emanating from the heap, which seems to indicate a succession of dominant microorganisms during different periods of the fermentation.[2011]

The suggestion has also been made that fermentation is the result

[2007] G. Gabel and G. Kiprianoff, *Biochem. Z.*, 212, 337 (1929).
[2008] C. Neuberg and M. Scheuer, *Biochem. Z.*, 243, 461 (1931).
[2009] C. Neuberg and M. Kobel, *Biochem. Z.*, 189, 232 (1927); 229, 455 (1930).
[2009a] W. G. Frankenburg, in F. F. Nord, ed., *Advances in Enzymology*, Vol. X. Interscience, New York, 1950.
[2010] E. A. H. Roberts, in F. F. Nord and C. H. Werkman, eds., *Advances in Enzymology*. Vol. II, Interscience, New York, 1942, p. 113.
[2011] W. T. Clarke, "Chocolate and Cocoa," in R. E. Kirk and D. F. Othmer, eds., *Encyclopedia of Chemical Technology*, Vol. III, Interscience, New York, 1949, p 889.
[2012] A. Preyer, *The Fermentation of Cacao*. London, 1913.