

The complete disappearance of nucleic acids from the chromosomes in preparations where materials treated with trichloroacetic acid are subjected to further treatment with *N* hydrochloric acid brings out clearly the property of the latter in detaching the nucleic acid from its combination with proteins. The results demonstrate the importance of trichloroacetic acid in the Feulgen reaction, as well as the reactivity of that acid and *N* hydrochloric acid with the nucleic acids.

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Oct. 27.

¹ Schneider, W. C., *J. Biol. Chem.*, **161**, 293 (1945).

² Levan, A., *Hereditas*, **32**, 449 (1946).

³ Feulgen, R., and Rossenbeck, H., *Z. physiol. Chem.*, **135**, 203 (1924).

⁴ Overend, W. G., and Stacey, M., *Nature*, **163**, 538 (1949).

An Industrial Dermatitis due to Enzyme Action

LABOURERS in factories in South Malaya who cut up pineapples by hand for canning invariably show an abnormality of those parts of the body which are exposed to slight pressure and pineapple juice, notably the palmar surfaces of the fingertips and the periphery of the palms. At the beginning of the canning season, the left hand, which comes more into contact with the fruit than the knife-holding hand, becomes sore and small superficial raw areas on the fingertips are often seen. Within several days, however, these heal, and the skin ceases to be sore. The labourers state that this tolerance to the pineapple juice is due to the development of an abnormality of the skin, which in the affected area becomes bluish-white and so smooth that fingerprints may be completely lost. Deep cracks are sometimes seen in the region of the skin creases. These often stay raw and bleeding for a long time, and show no clinical signs of infection, presumably because of removal of dead tissues by enzymatic action.

The rapid development, universal occurrence and localization of the lesion to areas exposed to juice suggested that the dermatosis was due to a direct irritant and not to a sensitizer. Among other things, pineapple juice contains sugar (8.2–15.2 per cent), citric acid (0.3–1.1 per cent)¹ and the papain-like proteolytic enzyme bromelin, 0.16 per cent².

Samples of palmar stratum corneum from twelve labourers were stained by Gram's method, and cleared in aniline oil and examined microscopically for yeasts and fungi. Unlike the situation in certain Californian fruit-canning factories, where a yeast is responsible for lesions of the hands³, yeasts were found in small numbers only in four cases out of twelve, from which it was thought that they played no important part in the development of the dermatosis.

Efforts were made to determine the factor in pineapple juice responsible for the lesions. Pineapple juice rubbed on the skin of the forearm or thigh, using a controlled method which, by itself, is sufficient only to induce mild erythema, produces a marked stinging itch followed by erythema and leading to the formation within fifteen minutes of a raw, bleeding area with whealing and weeping of fluid. Filtering

the juice, which removes the needle-like crystals of calcium oxalate found in the pineapple, does not prevent the lesions; however, they are prevented if the juice has previously been boiled for ten minutes.

Citric acid is not thought to play an important part, since it produces no effect when rubbed on to intact skin as a six per cent aqueous solution.

Bromelin, prepared by Prof. J. W. H. Lugg of this University, was found to produce the same changes when rubbed on to the skin as does whole pineapple juice. Papaya latex with its high papain content produces similar but more severe lesions.

These enzyme-containing solutions do not exert any action when placed on the skin for so long as twenty-four hours without rubbing, whereas marked changes are rapidly produced with gentle rubbing. The continuous immersion in water raised the question as to whether this was a contributory factor, and to test this out the hands of scrap-rubber millers and sheet-rubber washers were examined. These labourers work with hands continually wet with water, and in contact with somewhat dirty rubber. Epidermal ridges were present and none of the changes found in pineapple labourers was seen. Circular erosions spreading peripherally from the palmar flexures were commonly seen, in the walls of which were found large quantities of fungal hyphae.

The observations described lead to the conclusion that the dermatosis of pineapple cutters is due to bromelin, with mild mechanical force applied to the hand as a necessary accessory factor. Histologically, there are some differences from normal skin. The stratum granulosum is poorly developed, and when overstained with Delafield's haematoxylin and treated with glacial acetic acid, alternating layers of the stratum corneum are seen which are still stained deeply with haematoxylin, resembling keratohyalin in this respect.

It is probable that other dermatoses due to proteolytic attack on the skin occur in other industries, notably among people engaged in gutting mackerel and among slaughterhouse workers. The dermatosis here reported leads to little discomfort and no loss of working time, and could be prevented if the workers always wore the gloves provided for them.

An epithelium which for a large part of the day is developing in contact with a proteolytic enzyme is a complex system which might provide a useful experimental situation for students of skin and of protein chemistry. The nature of the change responsible for the histological difference of the skin of the labourers, and for the habituation of the workers to pineapple juice at the beginning of each season, is obscure. It is likely that the changes which lead finally to the production of keratin are modified, and that some of the non-keratin protein of the skin has been removed by digestion.

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