why Ragi can flourish in soils where many other plants cannot thrive.

My thanks are due to Mr. M. Sreenivasaya for guidance in these studies.

Section of Fermentation Technology,
Indian Institute of Science,
Bangalore, (MISS) K. PADMASINI.
June 13, 1947.

AEROBIC SPORE-FORMING BACTERIA IN BOILED MILK

GROUPS of aerobic spore-formers in milk have been described by foreign workers.[1-4] Since milk is generally boiled in India a knowledge of the distribution and characteristics of the aerobic spore-formers present in indigenous samples of milk is of practical importance. In the course of studies on organisms associated with spoilage of boiled milk, the authors have isolated and studied the characteristics of a number of strains of aerobic spore-formers from samples of milk collected from various sources.[5] The most frequently occurring strains mainly responsible for the deterioration of boiled milk seems to fall under four distinct types.

The organisms included under the first three types are mesophiles with their optimum temperature at 40°-45° C., and maximum at 55° C. They are gram positive, highly motile rods forming central to sub-terminal oval spores; they are able to utilize nitrate as a source of nitrogen and produce ammonia both from peptone and nitrate broths; they ferment dextrose and sucrose with the production of acid but no gas. Indol is not formed by any of them. On the basis of its morphology, characteristic growth in laboratory media and action on milk the first type bears a close resemblance to *B. subtilis* Cohn., except for its inability to ferment maltose and hydrolyse starch and its higher optimum temperature, *viz.*, 45° C. It does not produce acetyl-methyl-carbinol in glucose phosphate water, but it is actively proteolytic, turning milk alkaline and peptonising it within 24 hours, often without showing any apparent signs of curdling. The change is sometimes detected only after close examination. The second type resembles *B. cereus*, Frankland, in most respects. It ferments maltose but does not produce acetyl-methyl-carbinol; and starch hydrolysis is slight or doubtful. Milk is curdled and proteolysed by it within 24 hours; and the curd is completely peptonised in three days. The third type, which is a lactose-fermenter, corresponds to *B. albolactis* Migula. It ferments maltose and also produces acetyl-methyl-carbinol, but starch is not hydrolysed to any appreciable extent. It forms a firm acid curd with slight whey formation within 24 hours at 27°-30° C. and thereafter the curd is slowly proteolysed. When growing in boiled milk the proteolysis is more rapid.

The fourth type appears to be an obligate thermophile with its optimum at 60°-63° C. and growth range extending from 50° to 80° C. It is a gram negative and sluggishly-motile rod forming terminal, ellipsoid to cylindrical spores. It reduces nitrates to nitrites; produces ammonia only from peptone broth, and does not form indol or acetyl-methyl-carbinol. It ferments dextrose, sucrose, salicin and sorbite but not maltose or lactose, and hydrolyses starch. It resembles *B. kaustophilus* Pricket, except in its reaction to Gram's stain. This type is comparatively less frequent and does not grow at ordinary temperatures. When boiled milk is kept at elevated temperatures (above 50° C.) it can grow well, slowly peptonising the milk, and when the temperature is near its optimum (60°-65° C.) a rennet curd is produced in 24 hours which is gradually digested.

The heat resistance shown by the above organisms even in broth and milk cultures (which are expected to contain only vegetative forms) appears to be remarkably high. The organisms of Type I are killed only after boiling for 10 minutes, and of types II and III after half an hour. But Type IV survives all these treatments. When pH is brought down to 6·0 by the addition of lactic acid, Types I, II and IV are killed by boiling for 5 minutes, but Type II survives even boiling for 10 minutes, and curdles milk in 24 hours. After they are grown in milk for 4 hours in association with pure cultures of organisms like *B. coli*, *S. lactis*, and *L. bulgaricus*, only Types I and III survive boiling for 10 minutes.

Imperial Dairy Research Institute, Bangalore, KERALA VARMA.
July 12, 1947. H. LAXMINARAYANA.

1. Ford, *et al.*, *J. Bact.*, 1916, **1**, 273 and 283. 2. Pricket, N. Y. St. *Agr. Expt. Sta. Tech. Bul.* **147**, 1928. 3. Bergey, *et al.*, Manual of Determinative Bacteriology, 1939, V Ed., Balliere Tindal & Co., London. 4. Wilson and Miles, Principl es of Bacteriology and Immunity III Ed., 1946, Edw. Arnold & Co., London. 5. Manual of Methods for Pure Culture Study of Bacteria, 1944, *Soc. Amer Bacteriol gists*, Geneva, N.Y.

IS THE MACRONUCLEUS OF CILIATES ENDOPOLYPLOID?

ENDOPOLYPLOIDY was recently demonstrated in fermenting yeast cells.[1] The question arose whether, in spite of the different evolutionary origins of yeasts[2] and Protozoa, similar phenomena occur in other unicellular organisms? Since endopolyploid nuclei usually have no genetical future at all, one is naturally attracted to the macronucleus of Ciliates, which has been supposed to subserve a purely physiological function.[3,4]

The macronucleus takes its origin from the micronucleus and its nuclear nature itself is inferred only because of its above origin. It divides at every vegetative division, usually by amitosis, and disintegrates after a varying number of divisions, being regenerated either by endomixis or by division of the synkarion after conjugation.

It is this necessity for the renewal of the macronucleus from time to time that has led to the supposition that it controls the physiological functions. Sonneborn[4] concludes that while the macronucleus is essential and indispensable since it controls the physiological activities of the cell, the micronucleus could be lost with impunity.

Though the structure and behaviour of the macronucleus has attracted considerable attention, Protozoologists do not seem to have cared to consider whether it is endoploid. Long