

this rich algal flora promises to be of great interest, both from the stratigraphical and the palæobotanical points of view.

We are deeply indebted to the authorities of the Burmah Oil Company Ltd., for letting us have samples of these limestones for study and for permitting us to publish these results.

L. RAMA RAO.
K. SRIPADA RAO.

University of Mysore,
Department of Geology,
Central College,
Bangalore,
November 9, 1939.

Effect of Anti-oxidants on the Stability of Vitamin-A in Ghee exposed to Sunlight

THE action of light, particularly ultra-violet rays, on butterfat (ghee) has been studied by several workers. Banerjee and Dastur¹ have shown that the destruction of vitamin-A in ghee when exposed to sunlight is considerable, especially when ghee is exposed in thin layers to direct sunlight. They have also shown that when the ultraviolet and heat rays are cut off the extent of vitamin-A destruction is somewhat reduced. This, and the researches of various workers on pro- and anti-oxidant properties of various substances (Olcott,² Mattill,³ Lea,⁴ and others), led us to study the effect of some of the anti-oxidants on the vitamin-A potency of ghee. Hydroquinone, sodium citrate and sodium tartrate were found to retard the rate of auto-oxidation in ghee, hydroquinone being the most effective anti-oxidant. It was considered probable that these anti-oxidants might also serve to minimise the detrimental effect of light on the vitamin potency of ghee.

Accordingly, an experiment was conducted under controlled conditions on the same lines as those adopted by Banerjee and Dastur (*loc. cit.*). All exposures were performed between 11 a.m. and 1 p.m. so as to allow vertical rays of the sun to fall directly on the materials. The layers of ghee were of 1-2 mm. thickness. Hydroquinone was added in amounts

equal to 0.03 per cent. of the ghee (the quantity specified by the League of Nations' Health Organisation). Saturated solutions of sodium citrate and sodium tartrate (to which no objection can be raised) were added in quantities to make up 0.2 per cent. in the ghee. Vitamin-A determinations were made colorimetrically using the B.D.H. Lovibond tintometer and expressed as Blue Values in Lovibond Units per gram of ghee.

Cow and Buffalo ghees (vitamin-A content 17.4 and 15.4 B.V. respectively) were exposed to direct sunlight for 10 minutes with and without the anti-oxidants and their vitamin contents determined. The vitamin (estimated on 0.2 ml. fraction of unsaponifiable matter) was found to be absent in all the samples.

The experiment was repeated with the time of exposure shortened to 2 minutes. In this experiment also the almost total destruction of the vitamin was observed. Even with 1 ml. fraction of unsaponifiable extract, only a trace of blue colour was observed.

The results indicate that the presence of any of these anti-oxidants does not retard or minimise the destructive action of light on the vitamin content of ghee. The identical results obtained with Cow and Buffalo ghees when exposed to sunlight indicate that the natural colouring matter, *carotene*, which is present in larger amounts in Cow ghee, appears to have no protective action against the destructive effect of light on the vitamin-A.

It is, therefore, concluded that in order to preserve the nutritive growth-promoting factor of ghee, great care should be taken to avoid unnecessary exposure to sunlight.

N. S. DOCTOR.
B. N. BANERJEE.

Department of Biochemistry,
Indian Institute of Science,
Bangalore,
November 9, 1939.

¹ Banerjee and Dastur, *Agric. & Livestock in India*, 1936, **6**, 433.

² Olcott, *J. Amer. Chem. Soc.*, 1934, **56**, 2492.

³ Mattill, *J. Biol. Chem.*, 1931, **90**, 141.

⁴ Lea, *Rept. Food Investigation Board* (Brit.), 1934, p. 38.