

**THE SYNTHESIS OF VITAMIN C
BY RICE MOTH LARVÆ
(CORCYRA CAPHALONICA STAINI)**

THE synthesis of vitamin C by certain lower forms of life, e.g., *B. prodigiosus*,¹ marine algæ² and the orthopterous insect *Blatella germanica*³ has been reported. In the present communication evidence is brought forward to show that rice moth larvæ can synthesise the vitamin.

The larvæ were grown (a) on whole wheat and (b) on a synthetic diet consisting of starch, wheat protein, ether extract of wheat, dried yeast and salt mixture. The larvæ were killed at various stages of growth, minced and extracted according to the method of Bessey and King⁴ employing 8 per cent. trichloroacetic acid. Vitamin C was estimated in the extract by the chemical method using the indophenol dye. The larvæ, though grown on diets practically devoid of vitamin C, were found to contain the vitamin in significant amounts, ranging from 0.07-0.12 mg. per g. of body weight (or 2.4-4.0 mg. per g. of dry weight). The validity of these results was confirmed by various chemical procedures which are summarised in the following table:—

Treatment of the trichloroacetic acid extract of larvæ	% vitamin C remaining after treatment	Remarks	
1. Nil	100	Reversible oxidation of vitamin C by Norit. Incomplete recovery probably due to partial adsorption of the vitamin by Norit.	
2. Norit (Fox and Levy ⁵)	0		
3. Filtrate from (?) treated with H ₂ S. H ₂ S driven out by current of CO ₂ ..	80		
4. Mercuric acetate (Emmerie and van Eckelen ⁶) ..	100	Removal of interfering substances, e.g., cystine and glutathione.	
5. Oxidation at pH 5.3 by the specific enzyme from drumstick (Sreenivasan ⁷)	0	Complete oxidation of vitamin C by the enzyme.	
a. Extract + enzyme	Inhibited at 37°C. for 5 minutes	Inhibition of the enzyme by KCN.	
b. ,, (boiled)			100
c. ,, + KCN 10 ⁻³ M			100

These results indicate that the dye-reducing substance in the larvæ extract is vitamin C. On the inclusion of vitamin C in the synthetic diet the growth of the larvæ as well as their vitamin C content did not show any significant increase, indicating that the larvæ do not depend on an extraneous source of the vitamin for growth. This, together with the ease with which the larvæ can be grown on any solid diet, suggests a possibility of using them as experimental animals for the study of precursors of vitamin C. Experiments have been carried out in which various sugars were included in the basal diet at a 5 per cent. level, but so far no significant effect on the synthesis of vitamin C has been observed.

P. S. SARMA,

KAMALA BHAGVAT.

Nutrition Research Laboratories,
Indian Research Fund Association,
Coonoor,

October 3, 1942.

¹ Buising and Peters, *Biochem. Ztschr.*, 1940, **304**, 134.

² Norris, Simeon and Williams, *Jour. Nutr.*, 1937, **13**, 425.

³ Wollman, Giroud and Ratsimamanga, *C.R. Soc. Biol.*, 1937, **124**, 434.

⁴ Bessey and King, *Jour. Biol. Chem.*, 1933, **103**, 687.

⁵ Fox and Levy, *Biochem. Jour.*, 1936, **30**, 208.

⁶ Emmerie and van Eckelen, *Ibid.*, 1934, **28**, 1153.

⁷ Sreenivasan, *Ibid.*, 1936, **30**, 2077.

**SYNTHESIS OF POSSIBLE LIPOPHILIC
CHEMOTHERAPEUTICALS OF THE
SULPHANILAMIDE GROUP**

ALTHOUGH the compounds of the sulphanilamide group already evolved have provided medical science with one of the most potent weapons for the effective conquest of a number of intractable diseases of bacterial origin, there is still a long list of bacterial infections uninfluenced by the newer chemotherapeutics; among the latter, leprosy and tuberculosis continue to constitute some of the major posers to chemotherapy. This justifies further exploratory work both on compounds closely related to

the effective substances already known and on their structural allies but with other substituents with the possibility of an extension of their range of therapeutic usefulness so as to include infections caused by the acid fast mycobacterium.

The place of long chain fatty acids, particularly those derived from the chaulmoogra and hydnocarpus oils, in the treatment of leprosy and tuberculosis has, at the present time, been established. Systematic study of the numerous acyl derivatives of the sulphonamides hitherto synthesised has disclosed a few members effective in combating experimental coccal infections in mice associated with a low order of toxicity¹; some of them have also passed actual clinical trials² with some measure of success. However, with the sole exception of N¹-dodecanoyl sulphanilamide which is uncertainly reported on³, none of the fatty acid derivatives of the sulphonamides appear to have been investigated as to their efficacy in tuberculosis or leprosy.

Increased oil and fat solubility associated with lipophilic properties may be expected to be conferred on the resulting compounds consequent to the introduction of fatty acid residues in the molecules of the sulphonamides. It is possible to conceive with some justification^{3,4} of a deleterious action of such fatty acid derivatives on the "waxy" capsules of the ubiquitous tubercular and leprosy bacilli resulting in a break down of their first line of defence and that the damaged or stripped bacilli may subsequently be rendered susceptible to the further action of the acyl derivatives themselves or the parent sulphonamides or whatever *active* products that may be developed *in vivo*. The present preliminary communication, wherein the nomenclature of Crossley, Northey and Hultquist⁵ has been conveniently adopted, is an essay in this direction. Synthesis has, therefore, been effected of the 23 compounds, listed below, with their melting points. They do not seem to have been so far reported in literature.

- (1) N⁴-Cyclohexoyl sulphanilamide 238° C.
(2) N⁴-*n*, Caproyl, N¹-acetyl S.A.* 166°-69° d.

- C. (3) N⁴-*n*, Caproyl, N¹-*n*, butyryl S.A. 164°-68° C. (4) N⁴, N¹-Di (*n*, caproyl-) S.A. 164°-72° C. (5) N⁴-*n*, Caproyl, N¹-*n*, heptoyl S.A. 148°-52° C. (6) N⁴-*n*, Caproyl, N¹-cyclohexoyl S.A. 185°-87° C. (7) N⁴-*n*, Caproyl, N¹-palmityl S.A. 123°-26° C. (8) N⁴-*n*, Caproyl, N¹-stearyl S.A. 127°-30° C. (9) N⁴, N¹-Di (*n*, butyryl-) S.A. 217°-20° C. (10) N⁴, N¹-Di (*n*, heptoyl-) S.A. 131°-34° C. (11) N⁴-*n*, Butyryl sulphapyridine 206° C. (12) N⁴-*n*, Caproyl sulphapyridine 197° C. (13) N⁴-*n*, Heptoyl sulphapyridine 193° C. (14) N⁴-*n*, Butyryl sulphathiazole 244°-46° d.C. (15) N⁴-*n*, Caproyl sulphathiazole 198°-99° C. (16) N⁴-*n*, Heptoyl sulphathiazole 202°-03° C. (17) N⁴-Cyclohexoyl sulphathiazole 222°-23° d.C. (18) N⁴-Palmityl sulphathiazole 140°-47° C. (19) N⁴-Stearyl sulphathiazole 148°-50° C. (20) N⁴-*n*, Butyryl sulphathiazoline 224-25° C. (21) N⁴-*n*, Caproyl sulphathiazoline 181°-82° C. (22) N⁴-*n*, Heptoyl sulphathiazoline 175°-76° C. (23) N⁴-Cyclohexoyl sulphathiazoline 220° C.
S.A.* = Sulphonamide.

The N⁴-acyl sulphonamides (Nos. 1, 11-23) were prepared by condensation of the requisite acid chloride on the respective sulphonamides in the presence of pyridine. For the preparation of the N⁴-N¹-disubstituted derivatives of sulphanilamide (Nos. 2, 3, 5-8), N⁴-*n* caproyl sulphanilamide—reported⁶ to be as antistreptococcal as sulphanilamide itself but possessing much lower toxicity—constituted the starting material: the condensations with the desired acid chlorides were carried out in pyridine medium. The remaining N⁴-N¹-disubstituted sulphanilamides (Nos. 4, 9, 10) resulted directly by the operation of slightly more than 2 mols. of the appropriate acid chloride on sulphanilamide itself in pyridine solution. The condensation products, obtained by dilution of the reaction mixture with excess of water, were severally purified through precipitation from their dilute NaOH solutions (decolourising carbon) by acidification. They were mostly recrystallised from alcohol when they separated out in colourless needles with the exception of Nos. 14 and 15, which were obtained as slightly pale plates or prismatic needles. The yields of the final products were, in all instances, good.

I am thankful to Col. S. S. Sokhey and Prof. R. C. Shah for their interest and to the

Lady Tata Memorial Trust for the award of a scholarship.

S. RAJAGOPALAN.

Haffkine Institute,
Bombay,
October 2, 1942.

- ¹ Miller *et al.*, *J.A.C.S.*, 1939, **61**, 1198.
Crossley *et al.*, *Ibid.*, 1939, **61**, 2950.
Moore *et al.*, *Ibid.*, 1940, **62**, 2097.
Cooper *et al.*, *Proc. Soc. Exp. Biol. Med.*, 1940, **43**, 491.
Feinstone *et al.*, *J. Bact.*, 1940, **39**, 47.
Moore and Miller, *J.A.C.S.*, 1941, **63**, 2781.
Hampil *et al.*, *J. Pharm. Exp. Therap.*, 1941, **71**, 52.
Richard and Henderson, *Ibid.*, 1941, **73**, 170.
Robson and co-workers, *Nature*, 1942, **149**, 581 ;
B.M.J., 1942, June 6, 687.
Dewing *et al.*, *J.C.S.*, 1942, 239.
² Welebir and Barnes, *J.A.M.A.*, 1941, **117**, 2132.
Maxwell and Bazalis, *Ibid.*, 1941, **117**, 2238.
Parentiss and Kanealy, *J. Urol.*, 1942, **47**, 11.
³ Crossley *et al.*, *loc. cit.*
Steinbach and Duca, *Proc. Soc. Exp. Biol. Med.*, 1940, **44**, 133.
⁴ Bergmann and Haskelberg, *J.A.C.S.*, 1941, **63**, 2243.
⁵ Crossley, Northey & Hultquist, *Ibid.*, 1938, **60**, 2217.
⁶ Miller *et al.*, *loc. cit.*

CHLOROPHÆITE BEARING BASALTS FROM THE CUDDUPAH TRAPS (PRE-CAMBRIAN)

IN the course of a detailed examination of the basaltic lava flows associated with the rocks of the Cuddapah system (Pre-cambrian) in South India, the presence of chlorophæite has been noticed. Since all the occurrences of chlorophæite so far recorded in India are from the comparatively much younger basalts such as those of the Rajamahal series¹ (lower to middle Jurassic) and the Deccan traps² (early Tertiary), the present find of this mineral in rocks so old as the Pre-cambrian is of some interest.

Chlorophæite occurs in the top basaltic flows of both the Papugnee and the Cheyair divisions of the Cuddapah system. The Vempally basalt is composed of labradorite, augite and iron ores. Chlorophæite occurs as amœboid patches in the interstices, is bottle green

in colour, and has a refractive index *higher* than canada balsam. It also occurs as pellets or spherules infilling cavities, and is then



FIG. 1

Cuddupah Basalt, showing a large spherule of chlorophæite. Also shows irregular patches of chlorophæite in the groundmass.

bordered by spherulitic chalcedony. These spherules sometimes contain needles of epidote. The Banganapalli basalts show similar patches or spherules but the colour is yellow or brownish yellow, and has a refractive index *lower* than canada balsam. Chlorophæite is here accompanied by calcite.

The chlorophæite in these basalts has developed at the expense of the primary minerals as has already been observed in the case of the Deccan and the Rajamahal traps—felspar being the last mineral to be palagonitised, as microscopic fibres of chlorophæite are found surfeiting the felspars.

M. R. SRINIVASA RAO.

Department of Geology,
Central College,
Bangalore,
October 7, 1942.

¹ Middlemiss, "On some Palagonite bearing Traps of the Rajamahal Hills and Deccan," *Rev. G.S.I.*, **22**.

² Fernor, "On Basaltic Lavas of Bhusaval," *Ibid.*, **58**.
Fernor and Fox, "Deccan Trap Flows of Linga," *Ibid.*, **47**.

Wadia, "Palagonite bearing Dolerite from Nagpur," *Ibid.*, **58**.