The ethereal solution, upon washing, drying, and evaporating left 1.21 g. of solid which, after recrystallization from ethanol–benzene–ligroin, yielded 0.18 g. of the phenolic ketone, m.p. 184–186°.

Anal.[9] Calcd. for $C_{18}H_{20}O_2$: C, 80.58; H, 7.53. Found: C, 80.52; H, 7.83.

The acetoxy derivative was prepared in the usual manner.[12]

Anal.[9] Calcd. for $C_{20}H_{22}O_3$: C, 77.41; H, 7.15. Found: C, 77.59; H, 7.54.

Attempts to Acylate I by a Friedel-Crafts Reaction. (a) **With Acetylglycolyl Chloride.**—A solution of 2.00 g. of I (0.007 mole) and 1.06 g. (0.007 mole) of acetylglycolyl chloride in 50 ml. of carbon disulfide was chilled to 5°. Over a period of 20 minutes 2.77 g. (0.021 mole) of anhydrous aluminum chloride was added with mechanical stirring. The mixture was allowed to come to room temperature and then heated under reflux for 5 hours. It was then cooled and poured into 40 ml. of 10% hydrochloric acid. The layers were separated, the aqueous solution was extracted twice with carbon disulfide. The combined organic layers were dried and evaporated. The residue (1.8 g.), after recrystallization from ethanol, yielded 1.66 g. of solid, m.p. 98–100°, giving no depression in a mixture melting point with I.

(b) **With Chloroacetyl Chloride.**—The reaction was carried out as described above. The residue (1.8 g.) remaining after the evaporation of the carbon disulfide was heated *in vacuo* to distill out unchanged I. The residual sirup, after several crystallizations from alcohol–water, yielded 0.88 g. of III, m.p. 78–80°, giving a positive Beilstein halogen test. Analysis showed 3.50% of chlorine instead of the anticipated 9.88%.

(12) Reference 11, p. 138.

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Some Amides of Tuberculostearic Acid

BY DAVID A. SHIRLEY AND GUSTAV A. SCHMIDT[1]

Tuberculostearic acid or 10-methyloctadecanoic acid is a naturally occurring fatty acid of unique structure isolated by Anderson and Chargaff[2] from the human tubercle bacillus. In an earlier paper[3] we have described an improved method of synthesis of *dl*-tuberculostearic acid.

As a part of a general program of examination of certain derivatives of long chain fatty acids as anti-tubercular chemotherapeutic agents, we have introduced the *dl*-tuberculostearic acid fragment into several biologically active amines such as *p*-aminosalicylic acid and 4,4′-diaminodiphenyl sulfone.

Biological evaluation of these amides is being conducted by the Eli Lilly Co. of Indianapolis and we are grateful to Dr. R. G. Jones for arranging the tests.

We would also like to express appreciation to the Research Corporation of New York for a grant which supported this work.

Experimental[4]

***p,p′*-Bis-(10-methyloctadecanamido)-diphenyl Sulfone.**—Four grams (0.0135 mole) of *dl*-10-methyloctadecanoic acid was converted to the acid chloride by thionyl chloride as mentioned previously.[3] To the acid chloride was added a solution of 1.6 g. (0.0065 mole) of *p,p′*-diaminodiphenyl sulfone in 15 ml. of pyridine. The mixture was refluxed for 4 hours, cooled and poured into 200 ml. of water. The precipitated solid was dissolved in acetone, decolorized with charcoal and recrystallized from ethanol to give 4.5 g. of product melting in the range 80–86.5°. Two additional recrystallizations from ethanol and one from a mixture of benzene and petroleum ether (b. p. 60–80°) gave 1.0 g. (20%) of the amide melting at 86.5–88°.

Anal. Calcd. for $C_{50}H_{84}N_2O_4S$: N, 3.46; C, 74.4; H, 10.2. Found: N, 3.48, 3.54; C, 74.2; H, 10.2.

***p*-(10-Methyloctadecanamido)-salicylic Acid.**—The acid chloride from 2.0 g. (0.0068 mole) of 10-methyloctadecanoic acid was added to a solution of 1.0 g. (0.0067 mole) of *p*-aminosalicylic acid in 20 ml. of pyridine. After standing 1 hour, the reaction mixture was poured into excess water and acidified with hydrochloric acid. The precipitated material solidified on standing and was separated and recrystallized once from ethanol, two times from 70% aqueous ethanol and two times from benzene to give 1.4 g. (48%) of the amide melting at 170–172°.

Anal. Calcd. for $C_{26}H_{43}NO_4$: N, 3.23; C, 72.2; H, 9.93. Found: N, 3.30; C, 72.0; H, 9.95.

1,4-Bis-(10′-methyloctadecanamido)-benzene.—The acid chloride from 2.5 g. (0.0084 mole) of 10-methyloctadecanoic acid and 0.4 g. (0.0037 mole) of *p*-phenylenediamine was treated in general accordance with the procedures used above except an overnight reflux period was used. There was obtained 1.0 g. (40%) of the diamide, m. p. 155–156°.

Anal. Calcd. for $C_{44}H_{80}N_2O_2$: N, 4.19; C, 79.1; H, 12.0. Found: N, 4.14; C, 79.1, 78.9; H, 12.1, 12.1.

4-(*p*-Nitrobenzenesulfonamido)-acetanilide.—Nine grams (0.0407 mole) of *p*-nitrobenzenesulfonyl chloride was added to a solution of 5.5 g. (0.037 mole) of *p*-aminoacetanilide in 30 ml. of anhydrous pyridine. After standing 1 hour, the mixture was poured into excess water and the precipitated solid (8.0 g.) recrystallized three times from ethanol. The product melted at 242–242.5° and weighed 6.0 g. (48%).

Anal. Calcd. for $C_{14}H_{13}N_3O_5S$: N, 12.54. Found: N, 12.60.

4-(*p*-Nitrobenzenesulfonamido)-aniline.—The acetanilide derivative above (1.6 g. or 0.0048 mole) was hydrolyzed by a two hour reflux with 30 ml. of 6*N* hydrochloric acid and 15 ml. of ethanol. The mixture was filtered and the filtrate neutralized with sodium acetate. The precipitated amine (1.1 g. or 80%) was recrystallized once from ethanol to give small plates, m. p. 201–202°.

Anal. Calcd. for $C_{12}H_{11}N_3O_4S$: N, 14.33. Found: N, 14.40.

4-*p*-Nitrobenzenesulfonamido)-1-(10′-methyloctadecanamido)-benzene.—Reaction of 1.0 g. (0.0034 mole) of the above amine with the acid chloride from 1.4 g. of 10-methyloctadecanoic acid in general accordance with the procedures used above gave 0.8 g. (42%) of the amide, m. p. 170.5–172°. The product was recrystallized four times from ethanol and once from a 1:1 mixture of benzene and hexane.

Anal. Calcd. for $C_{31}H_{47}N_3O_5S$: N, 7.35. Found: N, 7.55.

RICHARDSON CHEMICAL LABORATORY
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(1) Frederick G. Cottrell Research Fellow, 1949–1950.

(2) Anderson and Chargaff, *J. Biol. Chem.*, **85**, 77 (1929).

(3) Schmidt and Shirley, THIS JOURNAL, **71**, 3804 (1949).

(4) All melting points reported were taken on a Fisher melting point block and are uncorrected.

Replacement of Vitamin B_{12} by Desoxynucleotides in Promoting Growth of Certain Lactobacilli

BY WILLIAM SHIVE, MARGARET E. SIBLEY AND LORENE L. ROGERS[1]

Thymidine,[2a,b] hypoxanthine desoxyriboside[3] and other purine desoxyribosides[4,5,6] replace vitamin

(1) Eli Lilly and Co. Post-doctorate Fellow.

(2) (a) Shive, Ravel and Eakin, THIS JOURNAL, **70**, 2614 (1948); (b) Wright, Skeggs and Huff, *J. Biol. Chem.*, **175**, 475 (1948).

(3) Shive, papers presented at Conference on Development and Uses of Antimetabolites, New York Acad. Sci., Feb., 1949, *Ann. N. Y. Acad. Sci.*, **52**, 1212 (1950).

(4) Kocher and Schindler, *Intern. Z. Vitaminforschl.*, **20**, 441 (1949).

(5) Kitay, McNutt and Snell, *J. Biol. Chem.*, **177**, 993 (1949).

(6) Hoff-Jorgensen, Abstr. 1st Intern. Congr. Biochem., 292 (Cambridge, 1949).

B_{12} in promoting growth of *Lactobacillus lactis* and *Lactobacillus leichmanni;* however, these desoxyribosides do not replace this vitamin in reversing the toxicity of sulfanilamide for *Escherichia coli* under conditions such that methionine synthesis is the limiting factor for growth.[3] In the present investigation the phosphorylated derivatives of the desoxyribosides have been found to be approximately as effective as the desoxyribosides for the Lactobacilli. Also, the desoxynucleotides (100 γ per 10 cc.) are inactive for *Escherichia coli* under the conditions for assay of vitamin B_{12}.[3] Desoxycytidylic acid frequently stimulated greater early growth of the lactobacilli than did the other desoxynucleotides. This suggests the possibility that desoxycytidylic acid is more closely related to the immediate product of the functioning of vitamin B_{12} in the biosynthesis of desoxyribosides than are the other desoxynucleotides; however, the delay in obtaining a maximal response with certain desoxynucleotides, particularly desoxyadenylic acid and thymidylic acid, may be the result of the inhibitory activity of these compounds on related systems.

Although vitamin B_{12} is approximately 10,000 to 30,000 times as effective as the desoxynucleotides in stimulating growth of the lactobacilli in test-tubes, the effect of the desoxynucleotides cannot be accounted for on the basis of contamination with vitamin B_{12}, because the desoxynucleotides are inactive in the *Escherichia coli* assay, are, relative to vitamin B_{12}, more effective in plate assays than in tube assays with the lactobacilli, and migrate differently on paper chromatograms.

On paper chromatograms in several different solvents the desoxynucleotides were found to move much more slowly than the corresponding desoxyribosides. Since the R_f values for these phosphorylated compounds fall within the range of those for vitamin B_{12}, these substances may give abnormally high values when the vitamin B_{12} content of natural materials is determined by paper chromatographic methods.

The results of the studies are indicated in Table I.

TABLE I

REPLACEMENT OF VITAMIN B_{12} BY DESOXYNUCLEOTIDES

Supplements	Quantity γ per 10 cc.	R_f[a] Value	Galvanometer readings[b] *Lactobacillus leichmanni*	Galvanometer readings[b] *Lactobacillus lactis*	Plate method[c] *Lactobacillus lactis*
None			4	3.5	13.2
Vitamin B_{12}	0.0001	0.17–0.29	27	28	
	.0002		41	41	
	.0005		55	60	
	.001		62	70	
	.002				15.8
	.005				17.6
	.01				20.3
	.02				22.7
	.05				25.2
Desoxycytidylic acid	.3	.14–0.16	11	8	
	1		22	22	19.7
	3		44	52	23.4
	10		56	73	27.8
Desoxythymidylic acid	0.3	.21–0.29	7.5	7	
	1		17	12	18.7
	3		33	29	22.6
	10		53	39	26.8
Desoxyguanylic acid	0.3	.12–0.16	12	9	
	1		22	30	20.2
	3		43	47	24.5
	10		56	73	28.5
Desoxyadenylic acid	0.3	.16–0.23	10	6	
	1		23	19	20.4
	3		38.5	41	24.0
	10		52	61	27.9
5-Methyldesoxycytidylic acid	0.3	.10–0.18	10	11	
	1		21	24	
	3		35	44	
	10		50	60	
Thymidine	0.3	.73–0.88	14	9	
	1		26	19	19.4
	3		45	40	24.6
	10		54	65	28.5

[a] Paper chromatographs with 2,6-lutidine. [b] A measure of culture turbidity; distilled water reads 0, an opaque object, 100. [c] Diameter of zones of growth in mm. Paper disc is 13.1 mm. in diameter.

Experimental

The desoxynucleotides used in this work were kindly supplied by Drs. Waldo E. Cohn[7] and C. E. Carter.

The organisms used in this work were *Lactobacillus leichmanni* 313 and *Lactobacillus lactis* Dorner 8000.

The tube assays were carried out on either the medium described by Shive, *et al.*,[2a] and Wright, *et al.*,[2b] or a modification of the medium described by Caswell, Koditschek and Hendlin.[8] In the latter case, two grams of Tween 80 per liter of final medium was added, and the phosphate content was increased. The organisms responded equally well on either medium, but that of Caswell, *et al.*,[8] was used preferentially because of its definite chemical composition.

For the plate assays, 10-cc. portions of the above sterilized medium containing 2% agar and inoculated with *Lactobacillus lactis* were poured into sterile Petri dishes and allowed to harden. A 13.1 mm. disc of filter paper was laid with forceps on the hardened medium, and an aliquot (an amount just sufficient to moisten the entire disc) of the proper dilution of each substance to be tested was delivered to the paper disc from a special pipet delivering a constant volume of 0.1 cc. Four different dilutions were usually assayed on each plate. After the plates were incubated for 16 hours at 37°, diameters of zones of growth were determined.

The capillary ascent method of Williams and Kirby[9] was employed for the paper chromatograms, 65% 2,6-lutidine being the solvent used. The resulting filter paper strips were dried and placed on a hardened agar medium identical with that used for the plate assays. After 15 to 30 minutes the paper strips were removed and the plates were incubated for 16 hours at 37°. The R_f values were calculated from the position of the zones of growth.

(7) Volkin, Khym and Cohn, unpublished work, Oak Ridge National Laboratory.

(8) Caswell, Koditschek and Hendlin, *J. Biol. Chem.*, **180**, 126 (1949); Shorb, *Science*, **107**, 397 (1948).

(9) Williams and Kirby, *Science*, **107**, 481 (1948).

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The Mutual Solubility of Mercury and Gallium

BY WILLIAM M. SPICER AND HENRY W. BARTHOLOMAY

Little is known about the mutual solubility of gallium and mercury. Ramsay[1] in a study of the

(1) W. Ramsay, *J. Chem. Soc.*, **55**, 521 (1889).