there was obtained 9.5 g. (83%) of the amide from 11.45 g. of the required propionic acid,[5] 10.6 g. of phosphorus pentachloride, 75 cc. of chloroform and 150 cc. of ammonia water; m. p. 160–161° after recrystallization from benzene.

Anal. Calcd. for $C_{14}H_{16}ON_2$: C, 73.66; H, 7.07; N, 12.27. Found: C, 73.63; H, 7.08; N, 12.18.

(b) To 0.41 g. of the acid azide (described below), dissolved in 50 cc. of ether, there was added 25 cc. of concd. ammonia water. The mixture was stirred and allowed to remain at room temperature for ten hours in a beaker in order that part of the ether might evaporate slowly. The solid material was filtered, and washed with water; yield 0.37 g. (99%); m. p. 157–159°.

β-[2-(1-Methyl-5-phenyl)-pyrryl]-propionhydrazide.—A mixture of 23.3 g. of methyl β-[2-(1-methyl-5-phenyl)-pyrryl]-propionate,[5] 100 cc. of methyl alcohol and 22.6 g. of 85% aqueous hydrazine hydrate were refluxed for five hours, the mixture cooled, the colorless, crystalline precipitate filtered and washed with methyl alcohol; yield 19.7 g. (84%); m. p. 150–151°. The melting point was not changed after recrystallization from alcohol.

Anal. Calcd. for $C_{14}H_{17}ON_3$: C, 69.11; H, 7.04. Found: C, 68.95; H, 7.07.

The hydrazide is converted into the acetone condensation product, merely upon recrystallization from acetone; m. p. 133–134°. However, in order to obtain a pure sample for analysis, 1.2 g. of the hydrazide and 20 cc. of reagent acetone were refluxed for one hour, 10 cc. of alcohol added, and the mixture concentrated to a volume of 10 cc. The solution was cooled whereupon 1.2 g. (86%) of the product precipitated in the form of colorless needles; m. p. 133–134°.

Anal. Calcd. for $C_{17}H_{21}ON_3$: C, 72.05; H, 7.47. Found: C, 71.91; H, 7.52.

β-[2-(1-Methyl-5-phenyl)-pyrryl]-propionazide.—A solution of 24.3 g. of the hydrazide in 400 cc. of acetic acid and 100 cc. of water was placed in a 1000-cc., 3-necked flask, fitted with a stirrer and a thermometer, and cooled with an ice–salt mixture to about −5°. The solution was stirred and maintained at this temperature while 7.6 g. of solid sodium nitrite was added during a fifteen-minute period. The mixture was then stirred for fifteen minutes longer. During this time the azide began to separate in crystalline form. The material was poured into a four-liter beaker and enough water (about 3000 cc.) was added to completely precipitate the azide. The yellow product was filtered, washed with water and dried. The azide was mixed with 300 cc. of ether, filtered from insoluble material (3.8 g.), the filtrate shaken several times with 2% bicarbonate solution, then with water, dried with fused sodium sulfate, and the ether removed from the solution in a stream of air; yield 21.6 g. (85%).

2-(1-Hydroxy)-propylamide of β-[2-(1-Methyl-5-phenyl)-pyrryl]-propionic Acid.—To 12.7 g. of the azide, dissolved in 350 cc. of absolute ether and cooled to 0°, there was added 7.5 g. of 2-aminopropanol, dissolved in 100 cc. of the same solvent. The latter solution was not cooled because of the relative insolubility of the amino alcohol. The mixture became turbid immediately, and after one-half hour lemon-yellow crystals began to precipitate. After three hours at 0°, and twelve hours at room temperature, the precipitated material was heated with 75 cc. of water in order to dissolve the hydrazoic acid salt of the amino alcohol, the liquid decanted, and the process repeated. The amide (10.2 g.) was recrystallized twice from benzene; yield 8 g. (56%); m. p. 133–135°.

Anal. Calcd. for $C_{17}H_{22}O_2N_2$: C, 71.30; H, 7.74; N, 9.78. Found: C, 71.13; H, 7.72; N, 9.90.

2-(1,3-Dihydroxy-2-methyl)-propylamide of β-[2-(1-Methyl-5-phenyl)-pyrryl]-propionic Acid.—From 19.6 g. of the azide, dissolved in 200 cc. of acetone, and 16.2 g. of 2-amino-2-methyl-1,3-propanediol, dissolved in 40 cc. of water, there was obtained 19 g. (78%) of crude amide. The latter was recrystallized from 115 cc. of benzene, and then four times from 75 cc. of 30% alcohol. The colorless amide then weighed 9.3 g.; m. p. 125–127°.

Anal. Calcd. for $C_{18}H_{24}O_3N_2$: C, 68.33; H, 7.64; N, 8.86. Found: C, 68.19; H, 7.67; N, 8.83.

2-(1-Hydroxy)-butylamide of β-[2-(1-Methyl-5-phenyl)-pyrryl]-propionic Acid.—After 20.3 g. of the azide, dissolved in 500 cc. of absolute ether, and 14.2 g. of 2-aminobutanol, dissolved in 50 cc. of ether, had been treated in the described manner, the ether layer was decanted from the yellow, crystalline amide. The latter was triturated four times with 100-cc. portions of hot water, dried, boiled with 175 cc. of benzene for ten minutes, and filtered. The product (17.9 g.) was then recrystallized twice from 75 cc. of 66% alcohol, and four times from 95% alcohol. The colorless amide weighed 13.6 g.; m. p. 133–134°.

Anal. Calcd. for $C_{18}H_{24}O_2N_2$: C, 71.97; H, 8.05; N, 9.33. Found: C, 71.81; H, 8.08; N, 9.32.

Summary

The preparation of the amides and a variety of N-(hydroxyalkyl) substituted amides of β-[2-(1,5-diphenyl)-pyrryl]- and β-[2-(1-methyl-5-phenyl)-pyrryl]-propionic acid has been described.

ANN ARBOR, MICHIGAN RECEIVED SEPTEMBER 1, 1944

[CONTRIBUTION FROM THE LEDERLE LABORATORIES, INC.]

A New Synthesis of 2-Aminopyrimidine

BY ROBERT W. PRICE AND ANTHONY MOOS[1]

A few months after the announcement of sulfadiazine,[2] investigations in this Laboratory yielded a new method of synthesizing 2-aminopyrimidine, the N^1-moiety[3] of the sulfadiazine molecule.

β-Ethoxyacroleindiethylacetal,[4] prepared in two steps from acrolein dibromide, condensed readily with a guanidine salt in acid solution under varying conditions to yield the desired pyrimidine salt.

It is rather surprising in view of the ease of preparation and interesting properties of β-ethoxyacroleinacetal, that this substance has not been utilized more in chemical syntheses.

Experimental

α-Bromo-β-ethoxypropionaldehydediethylacetal was prepared from acrolein dibromide according to the method described by Fischer[5]; yield 54%, b. p. 104–107.5° (13 mm.), (recorded b. p. 103–104° (14 mm.)).

β-Ethoxyacroleindiethylacetal was obtained from the above acetal by treatment with alcoholic potassium hy-

(1) Present address: R. H. Macy & Co., Inc., Drug Dept., New York City, N. Y.

(2) R. O. Roblin, *et al.*, THIS JOURNAL, **62**, 2002 (1940).

(3) E. H. Northey, *Chem. Rev.*, **27**, 91 (1940).

(4) L. Claisen, *Ber.*, **36**, 3670 (1903).

(5) E. Fischer and G. Giebe, *ibid.*, **30**, 3056 (1897).

droxide according to the method indicated, but not described by Claisen.[4] To 125 g. of potassium hydroxide in 400 cc. of absolute alcohol was added 198 g. of α-bromo-β-ethoxypropionaldehydediethylacetal and the mixture refluxed in an atmosphere of nitrogen for two hours. Insoluble solids were filtered off and the filtrate distilled under vacuum. The residue from the distillation was extracted with ether and the extract concentrated and combined with the first distillate. Redistillation yielded 110 g. (80%) of the desired product, b. p. 94–96° (20 mm.).

Anal. Calcd. for $C_9H_{18}O_3$: C, 62.1; H, 10.35. Found: C, 61.68; H, 10.51.

2-Aminopyrimidine.—A solution of 3.80 g. (0.04 mole) guanidine hydrochloride in 100 cc. of absolute alcohol was saturated with anhydrous hydrogen chloride at 0°. To this was added dropwise 3.48 g. (0.02 mole) of the acetal in 25 cc. of absolute alcohol over a period of one hour with stirring and continued cooling. The resulting orange colored solution was again saturated with hydrogen chloride, stirred at room temperature for one and one-half hours and finally warmed to 70–80° under reflux for an hour. The solvent and excess acid were removed under vacuum and the residue made strongly alkaline with 10 cc. of 50% aqueous sodium hydroxide. The liberated 2-aminopyrimidine was extracted with hot benzene, the extract dried ($MgSO_4$) and the pyrimidine hydrochloride precipitated by bubbling in hydrogen chloride; yield, 1.37 g. (53%); m. p. hydrochloride, 194–196° (recorded 197–198°); m. p. free base, 122–126° (recorded 126°); m. p. picrate, 239–241° (recorded 237°).

Anal. Calcd. for free base, $C_4H_5N_3$: C, 50.51; H, 5.30; N, 44.2. Found: C, 51.31; H, 5.46; N, 43.97.

Anal. Calcd. for hydrochloride, $C_4H_6ClN_3$: Cl, 26.95. Found: Cl, 27.47.

The results of a number of experiments designed to determine optimum conditions for accomplishing the condensation reveal that a medium of saturated alcoholic hydrogen chloride was the most favorable tried. Dilute aqueous mineral acids gave poor yields of about 10–12%; while concentrated acids resulted in intermediate yields of about 36%. Little or no condensation apparently occurred in alkaline solutions. Yields were considerably better when double the theoretical requirement of guanidine salt was used.

Summary

A new method is described for synthesizing 2-aminopyrimidine by condensing guanidine with β-ethoxyacroleindiethylacetal in acid medium.

PEARL RIVER, N. Y. RECEIVED NOVEMBER 17, 1944

[CONTRIBUTION FROM THE EASTERN REGIONAL RESEARCH LABORATORY[1]]

Polymerizable Esters of Lactic Acid. α-Carbalkoxyethyl Acrylates and Methacrylates

BY C. E. REHBERG, MARION B. DIXON AND C. H. FISHER

The acrylates and methacrylates of the lower aliphatic alcohols have been studied and used extensively as resin intermediates,[2,3] but the corresponding esters prepared from alcohols substituted with carbalkoxy groups have received little attention. This paper describes the conversion of alkyl lactates[4] into carbalkoxyethyl acrylates (I) and methacrylates (II) and the properties and polymerization of these unsaturated esters.

$$CH_2{=}CHCOOCH(CH_3)COOR$$
I

$$CH_2{=}C(CH_3)COOCH(CH_3)COOR$$
II

The carbomethoxymethyl and α-carbomethoxypropyl esters of methacrylic acid have been prepared by heating potassium methacrylate with methyl chloroacetate and methyl α-bromobutyrate.[5] α-Carbomethoxypropyl acrylate has been made from potassium acrylate and methyl α-bromobutyrate.[5] The reaction between glycol dilactate and methacrylic anhydride has been used to prepare glycol α-methacryloxypropionate.[5]

In the present work unsaturated esters of lactic acid were prepared[6] by acylating various lactic esters with acrylyl chloride, methacrylyl chloride, or methacrylic anhydride. The resulting acrylates and methacrylates (Table I) were colorless liquids that exhibited the expected tendency to polymerize.

The acrylates and methacrylates of Table I were polymerized, and the resulting resins were examined briefly. The esters having only one olefinic linkage yielded thermoplastic polymers. The acrylates prepared from alkyl lactates yielded polymers that were roughly similar in hardness and general appearance to the corresponding polyalkyl acrylates.[2] Comparison of polyethyl acrylate with polymerized carbomethoxyethyl acrylate indicates that substituting the carbomethoxy group for hydrogen in ethyl acrylate hardens the polymer and raises its brittle point.

The hardest and softest thermoplastic polymers of the present work were made from the methacrylate of methyl lactate and the acrylate of *n*-butyl lactate, respectively. Since alkyl glycolates, lactates, and α-hydroxyisobutyrates may be regarded as primary, secondary, and tertiary alcohols, polymerized glycolate acrylates and hydroxyisobutyrate acrylates would be expected to be softer and harder, respectively, than the corresponding polymeric acrylates prepared from alkyl lactates.[2,7] The methacrylate of methyl α-

(1) One of the laboratories of the Bureau of Agricultural and Industrial Chemistry, Agricultural Research Administration, United States Department of Agriculture. Article not copyrighted.

(2) H. T. Neher, *Ind. Eng. Chem.*, **28**, 267 (1936).

(3) (a) D. E. Strain, R. G. Kennelly and H. R. Dittmar, *ibid.*, **31**, 382 (1939); (b) D. E. Strain, *ibid.*, **32**, 540 (1940).

(4) Lee T. Smith and H. V. Claborn, *ibid.*, **32**, 692 (1940).

(5) D. E. Strain, U. S. Patent 2,141,546, December 27, 1938.

(6) E. M. Filachione of this Laboratory has made carbomethoxymethyl acrylate by treating methyl glycolate with α-acetoxypropionyl chloride and pyrolyzing the ester thus obtained.

(7) C. E. Rehberg, W. A. Faucette and C. H. Fisher, THIS JOURNAL, **66**, 1723 (1944).