The Formation of *d*-Ribomethylose.

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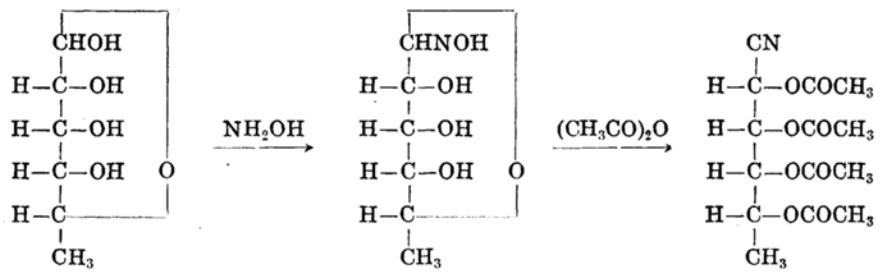
About the formation of *d*-ribomethylose it was already reported by F. Micheel,[1] who prepared it by hydrolizing the sirupy diacetyl *d*-ribomethylose obtained from digitoxoseen diacetate. It was, however, obtained only in the form of osazones, the derivatives, which were the same as those of *d*-arabomethylose. In the course of our investigations on monoses,[2] attempts were made to prepare this sugar. For this purpose, *d*-allomethylose, which is obtained from *l*-rhamnose by Levene's[3] method, is used as the starting substance. That is, *l*-rhamnose is shaken with acetone, containing sulphuric acid, and 2,3-monoacetone *l*-rhamnose thus obtained is tosylated with *p*-toluene sulphonyl chloride to 5-tosyl 2,3-monoacetone *l*-rhamnose. And the latter is transformed into 2,3-monoacetone methyl *d*-allomethyloside by inversion with sodium methylate. It is purified by tosylation followed by detosylation, and hydrolized to *d*-allomethylose.

d-Allomethylose is degraded by Wohl's method[4] to *d*-ribomethylose. Namely *d*-allomethylose is added to methyl alcohol containing hydroxylamine, and the mixture is warmed for a short while to dissolve the sugar, and filtered, if necessary, after being kept standing overnight, and concentrated under the diminished pressure to thick sirup. On adding a small quantity of methyl alcohol, it soon crystallizes into fine colourless needles, melting point, 146–146.5°C. (corrected). It mutarotates in aqueous solution. The specific rotatory power, $[\alpha]_D^{18}$, is +54° (6 minutes after being dissolved.) It changes to +5° after 2 hours and then to −4° after 4 hours (in equilibrium).



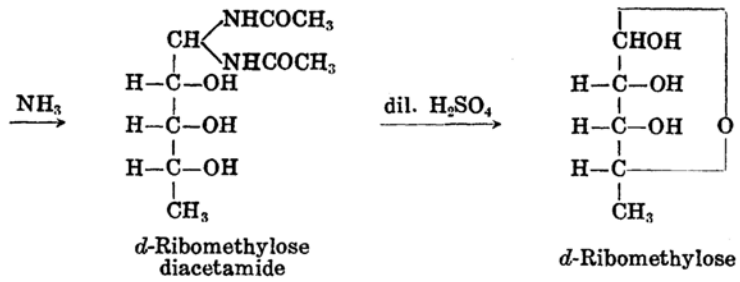
d-Allomethylose — *d*-Allomethyloxime — Tetracetyl *d*-allomethylonic nitrile

(1) F. Micheel, *Ber.*, **63** (1930), 347.

(2) K. Iwadare, S. Fukunaga, and B. Kubota, *This Bulletin*, **12** (1937), 116; K. Iwadare and B. Kubota, *Sci. Pap. Inst. Phys. Chem. Research*, **34** (1938), 183.

(3) P. A. Levene and J. Compton, *J. biol. Chem.*, **116** (1936), 169.

(4) A. Wohl, *Ber.*, **26** (1893), 730, **30** (1897), 3101; **32** (1899), 3666.



d-Ribomethylose diacetamide

d-Ribomethylose

d-Allomethyloxime is acetylated with acetic anhydride and anhydrous sodium acetate. Tetracetyl *d*-allomethylonic nitrile thus prepared is obtained in crystals, melting point, 166.5~167° (corrected). Ammonia water is added to the crystals and the mixture is warmed for a short time to obtain a clear solution, and, after being kept standing for 3 hours, concentrated under the diminished pressure to thick sirup, which is again dissolved in ammonia water and reconcentrated. On adding alcohol the sirup crystallizes into long colourless needles, melting point, 191° (corrected). The specific rotatory power, $[\alpha]_D^{18}$, of *d*-ribomethylose diacetamide is +7.4° in aqueous solution.

The equilibrium rotation of *d*-ribomethylose is determined by hydrolizing the known quantity of *d*-ribomethylose diacetamide with 5% sulphuric acid. And the specific rotatory power $[\alpha]_D^{20}$ is found to be +20° *d*-Ribomethylose is obtained as sirup. On heating, it reduces Fehling's solution strongly, and, when heated with phenylhydrazine, phenylhydrazone, melting at 170°C., is obtained.

Experimental. l-*Allomethylose.* This substance was obtained by Levene's method[3] from 2,3-monoacetone *l*-rhamnose which was prepared by E. Fischer[5] from anhydrous *l*-rhamnose. But now more convenient method of preparing monoacetone *l*-rhamnose was suggested in this experiment. That is, 100 g. of *l*-rhamnose hydrate were added to 3.5 l. of acetone containing 35 c.c. of concentrated sulphuric acid, and the mixture was vigorously shaken for a short while to dissolve the sugar. Then, after 5 hours standing, the solution was neutralized with anhydrous sodium carbonate, and filtered. The filtrate was evaporated into a small volume at ordinary pressure and then into thick sirup in vacuum. The sirup (115 g.) thus obtained was dissolved in 1 l. of dry ether and the *l*-rhamnose, separated overnight, was filtered. The filtrate was evaporated into sirup and again dissolved in 500 c.c. of ether. To this solution, an equal volume of petroleum ether was added and the oily substance, which separated soon on adding, was removed. The solution was concentrated to sirup, which consisted mainly of 2,3-monoacetone *l*-rhamnose. This sirupy acetone-sugar (80 g.) was dissolved in 400 c.c. of dry pyridine, cooled at 0°C., and 80 g. of *p*-toluene sulphonyl chloride, dissolved in 200 c.c. of chloroform, was added to it. The mixture was kept at 0°C. for 1 hour and at room temperature overnight. Then, water (15 c.c.) was added to it and after half an hour the mixture was diluted with

(5) E. Fischer, *Ber.*, **28** (1895), 1162.

200 c.c. of chloroform, and washed twice with water, thrice with ice-cooled 10% sulphuric acid to remove pyridine, twice with ice-cooled saturated sodium bicarbonate solution and then twice with water. The chloroform solution was dried with calcium chloride and evaporated under the diminished pressure; toluene was added to it, and reconcentrated. The sirup was dissolved in a small quantity of toluene and petroleum ether was added to turbidity. Crystallization of 2,3-monoacetone 5-tosyl *l*-rhamnose began immediately, and it was filtered after being kept on standing overnight in a refrigerator. Yield, 33 g. And the oily substance (30 g.), which had been separated from ether solution of acetone-sugar on adding petroleum ether, was dissolved in 150 c.c. of ether and the equal quantity of petroleum ether was added. The separated oil was removed and the solution was concentrated into sirup. The sirup was treated in the same way as described above, and 8 g. of the tosyl derivative was obtained. Thus, the total yield of 2,3-monoacetone-5-tosyl *l*-rhamnose from 100 g. of *l*-rhamnose hydrate amounted to 41 g. This substance was treated just like Levene's method. Namely, 40 g. of it were dissolved in 800 c.c. of methanol which contained 12 g. of sodium methylate. After being kept on standing overnight, excess of methylate was decomposed with carbon dioxide and the solution was evaporated to dryness under the reduced pressure. The residue was extracted with ether and evaporated into sirup. This sirup (20 g.) was dissolved in 30 c.c. of pyridine and 30 g. of *p*-tosyl chloride was added to it. After being kept on standing overnight, 10 c.c. of water at first and then 200 c.c. of sodium bicarbonate solution were added. Separated crystals were filtered and recrystalized from methanol. Yield, 34 g.

5-Tosyl monoacetone methyl-*d*-allomethylofuranoside (30 g.) was dissolved in 1500 c.c. of 80% methanol and 600 g. of 2.5% sodium mercury amalgam was added to it in order to hydrolize it reductively to monoacetone methyl-*d*-allomethyloside. When the reaction ended, the mixture was separated from mercury, filtered, and evaporated to dryness. The residue was extracted with ether, dried, and distilled. The sirup of monoacetone methyl-*d*-allomethyloside (15 g.) was hydrolized by warming it with 300 c.c. of 1.5% sulphuric acid on a water-bath. It was neutralized with barium carbonate, filtered, and concentrated into sirup. On adding alcohol, crystallization occurred at once. Yield, 10 g.

d-*Allomethyloxime*. 5 g. of hydroxylamine hydrochloride were dissolved in 3 c.c. of hot water, and neutralized (phenolphthalein) with 6% sodium methylate solution. The mixture was cooled and filtered. 10 g. of allomethylose were dissolved in this solution. After being kept on standing overnight, it was filtered, if necessary, and evaporated into sirup. On adding methanol, it crystallized soon into colourless needles. It was recrystallized from 90% alcohol. Melting point, 146–146.5°C. (corrected). It showed mutarotation in aqueous solution. *d*-Allomethyloxime (0.1639 g.) was dissolved in water, and the volume of the solution was made up to 10 c.c. Its rotations were as follows:—

Time after dissolution	Direct reading	$[\alpha]_D^{18}$
6 min.	+0.88°	+54°
22 min.	+0.68°	+49°
2 hrs.	+0.08°	+ 5°
4 hrs.	−0.06°	− 4°
20 hrs. (in equilibrium)	−0.06°	− 4°

(Found: N, 7.98. Calculated for $C_6H_{13}O_5N$: N, 7.81%)

*Tetracetyl-*d*-allomethylonic nitrile.* *d*-Allomethyloxime (2 g.) was dissolved in 3 c.c. of dioxane and 2 g. of anhydrous sodium acetate were added to the solution. To this mixture 10 c.c. of acetic anhydride was added in several portions. On adding each portion, the mixture was warmed on a water bath for a short while. After the whole quantity of acetic anhydride was added, the solution was warmed on a water-bath for 1 hour. Then it was poured over the cracked ice, and sodium bicarbonate solution was added in order to neutralize acetic acid. The mixture was extracted with ether, and, on evaporating the solvent, tetracetyl-*d*-allomethylonic nitrile was obtained as yellow sirup. On adding alcohol, the sirup crystallized into big colourless plates, melting point 166.5–167°C. (Found: N, 4.57. Calculated for $C_{14}H_{19}O_8N$: N, 4.25%).

d-*Ribomethylose diacetamide.* Tetracetyl-*d*-allomethylonic nitrile (2 g.) was dissolved in 40 c.c. of concentrated ammonia solution by warming it slightly on a water-bath at 50°C. After being kept on standing for 3 hours it was evaporated under the diminished pressure and the obtained sirup was redissolved in ammonia and reconcentrated. To remove water from the residue, alcohol was added to it and it was evaporated under the diminished pressure. The residue was obtained as crystalline mass. A small quantity of alcohol was added to it, and fine colourless needles were obtained. It was recrystallized from 95% alcohol. Melting point, 191°C. (corrected). The specific rotatory power, $[\alpha]_D^{18}$, of *d*-ribomethylose diacetamide is +7.4° in aqueous solution. (Found: N, 11.92. Calculated for $C_9H_{18}O_5N_2$: N, 11.96%).

Equilibrium rotation of d-*ribomethylose.* To get the equilibrium rotation of *d*-ribomethylose, known quantity of the *d*-ribomethylose diacetamide was hydrolized with 5% hydrochloric acid. Namely, 0.3056 g. of *d*-ribomethylose diacetamide was dissolved in about 5 c.c. of 5% hydrochloric acid, and warmed on a water-bath at 100°C for 1 hour. The hydrolized solution was made up to 10 c.c. with water, and the rotatory power of the solution was measured. Thus the specific rotatory power, $[\alpha]_D^{20}$, of *d*-ribomethylose was found to be +20° (calculated from the weight of *d*-ribomethylose formed, the direct reading being +0.36°).

d-*Ribomethylose.* *d*-Ribomethylose diacetamide (1 g.) was hydrolized with 0.8 N sulphuric acid by warming the solution on a water-bath at 100°C. It was continuously extracted with ether for 24 hours to remove acetic acid and neutralized with excess of barium carbonate. The mixture

was filtered, evaporated into sirup, and dissolved in absolute alcohol. The solution was filtered and evaporated. Thus the sirup of *d*-ribomethylose was obtained. On heating, it reduced Fehling's solution strongly. Its phenylosazone was obtained in usual method. Melting point, 170°C.

Summary.

d-Allomethylose is obtained from *l*-rhamnose by a little modification of Levene's method. And *d*-ribomethylse is prepared from *d*-allomethylose by Wohl's method of degradation, obtaining on the way *d*-allomethyloxime (melting point, 146–146.5°, and $[\alpha]_D^{18}$, +54°, 6 minutes after dissolution and −4° in equilibrium), tetracetyl d-allomethylonic nitrile (melting point 166.5~167°), and *d*-ribomethylose diacetamide (melting point, 191°, and $[\alpha]_D^{18}$, +7.4°). Equilibrium specific rotation, $[\alpha]_D^{20}$, of *d*-ribomethylose is found to be +20°.

In conclusion the author wishes to express his hearty thanks to Prof. B. Kubota for his kind advice for this experiment.

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