

Distribution of 3-Methylglucose in Organs of Rat.* (24056)

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We reported that in the rat 3-methylglucose is eliminated unchanged almost quantitatively in urine within 24 hours. However, even after this time traces of 3-methylglucose could be found and identified by paper chromatography in brain and muscle but not in plasma and liver(1). This apparent retention by some tissues and the fact that 3-methylglucose is a non-metabolized compound(2) prompted a detailed study of the distribution of this substance in tissues of the rat.

Materials and methods. Sprague-Dawley male rats were kept on standard laboratory diet and starved 24 hours prior to experiments. 3-methylglucose was the same preparation used in previous study(1). The Nelson copper reduction method was used to determine 3-methylglucose(3). Glucose was previously removed from plasma by treatment with washed suspension of Baker's yeast(4). **Preparation of tissue extracts for quantitative studies.** The excised tissue was weighed and homogenized in methanol and the resulting suspension was adjusted with methanol to known volume and filtered. An aliquot of filtrate was evaporated to dryness in vacuum at 60°C. The residue was dissolved in known small amount of water and subjected to chemical assay. Water content of organs was determined by drying to constant weight in electric oven at 105°C.

Results. *Distribution of 3-methylglucose in tissues of nephrectomized rats.* Both kidneys were removed in ether anesthesia. The 3-methylglucose solution was injected into exposed femoral vein. Following injection, the blood level of this sugar became constant in about 2 hours. At this time animals were bled from abdominal aorta into syringes containing heparin. 3-methylglucose was assayed in plasma and in the following organs: brain,

liver, gastrointestinal tract, cardiac and voluntary muscles. Values obtained have been corrected for non 3-methylglucose reducing substances which are present in tissue extracts of normal animals.

Table I presents the calculation of "apparent volume of distribution" or "3-methylglucose space" based on plasma analyses. This value is 35-37% of body weight. More detailed information can be obtained if distribu-

TABLE I. Apparent Volume of Distribution (r) of 3-Methyl Glucose in 3 Nephrectomized Rats.

Wt, g	3-methyl glucose, mg	Plasma conc., mg %	r , % body wt
190	380	536	37.3
218	440	573	35.2
208	420	556	36.3
		Avg	36.3

tion of 3-methylglucose in various organs is calculated as is shown in Fig. 1. The values on this chart are relative: the 3-methylglucose content of plasma water is expressed arbitrarily as 100. Liver and myocardium water contain about the same concentration of 3-methylglucose as plasma-water, whereas brain, gastrointestinal tract and leg-muscle water contain only about $\frac{1}{3}$ to $\frac{1}{4}$ as much.

Elimination of 3-methylglucose from organs of rat. Four g/kg 3-methylglucose were injected intravenously into intact animals. They

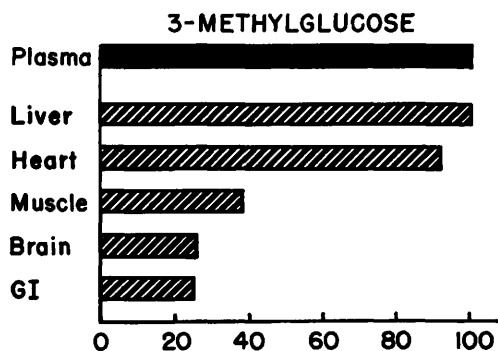


FIG. 1. Relative distribution of 3-methyl glucose in the water of various organs from nephrectomized rats. Concentration in plasma is expressed arbitrarily as 100. GI = gastrointestinal tract.

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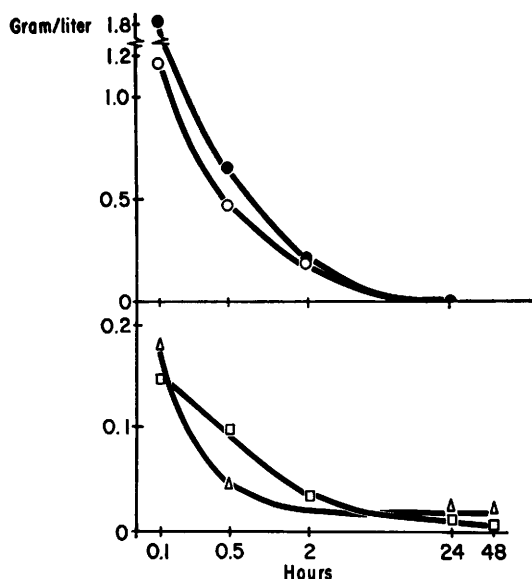


FIG. 2. 3-methyl glucose concentrations in tissue water of rats following intrav. injections. Ordinate: sugar concentrations; abscissa: time following inj. ●—● kidney, ○—○ liver, □—□ brain, △—△ leg muscle. Note difference in scale on ordinate of the upper and lower curves.

were then killed at intervals of 5 minutes, 30 minutes, 2 hours, 24 hours, and 48 hours. The organs were extracted and assayed for 3-methylglucose as described above. Fig. 2 illustrates results obtained in 4 organs including kidneys. Liver and kidney are shown on same coordinate as the concentration of 3-methylglucose, as their tissue water was rather high initially and then fell rapidly to reach 0 at 24 hours. With voluntary muscle and brain, the original concentration was low but elimination was slower.

Discussion. The apparent volume of distribution of 3-methylglucose in rats is about 35-37% of body weight. For glucose a value of 30-31% was calculated in intact rab-

bbits(5). Distribution is uneven; some organs, like liver and cardiac muscle, reach equilibrium with plasma, whereas, in other tissues, the rate of passage of 3-methylglucose is slow in both directions. The latter organs thus still contain small amounts of 3-methylglucose 24 or even 48 hours following single intravenous injection. The difference in glucose uptake between cardiac and voluntary muscle was pointed out by Cori *et al.*(6) and was thought to be due to a larger number of open capillaries in heart muscle than in leg muscle. However, the finding that 1-methyl fructose penetrates more readily into leg muscle than into the myocardium points rather to specific functions of the membranes of corresponding muscles.

The 3-methylglucose space in muscle is larger than, for example, the chloride space. Moreover, slow release of this sugar by muscle tissue indicates that a part of 3-methylglucose is in the intracellular water of the muscle.

Summary. The apparent volume of distribution of 3-methylglucose in rats is 35-37% of body weight. Liver and myocardium water reaches equilibrium with plasma water; other organs are less permeable to this sugar.

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