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Glycogen Formation from Amino Acids.

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One lot of control rats was kept on stock diet until killed in order to establish the glycogen and lipid contents of the liver without a starvation period. A second lot of control rats was starved for 24 hours before killing, from which group the fasting level was derived.

The remaining rats were starved 18 hours, then fed the amino acid to be investigated, and killed 6 hours later. Forced feeding was resorted to, except in the case of tyrosine. This amino acid, suspended in water, was applied to the rats' hair about the head and neck region. The animals cleaned it off nicely, thereby getting practically all of it into the gastro-intestinal tract. The other amino acids used did not lend themselves readily to this method of feeding, in which studies, feeding was performed by means of a medicine dropper. The disadvantage of the latter method lies in the rather large amount of water which must be introduced in keeping the amino acid conveniently suspended. The amount of amino acid fed in each case was approximately 2 gm.

The amino acids were purchased from the Eastman Kodak Company. They were d-l alanine, l-cystine, d-glutamic acid (practical), glycine, and l-tyrosine.

The results are presented in Table I. The mean body weight, liver weight, liver weight expressed as % of body weight, % of liver glycogen, and % of liver lipid are tabulated. In each case the results for the males are shown first, those for the females second, and those for the sexes combined, finally. The number of each sex studied is indicated in the first column. Lipid determinations were not made in every case.

Owing to the small number of cases, the statistical method of analysis proved impractical. The group fed alanine contained several young animals, which accounts for the lower body weight, and

TABLE I.

Procedure and Number	Mean body weight (gm.)			Mean liver weight (gm.)			Liver as % of body weight			Mean liver glycogen (%)			Mean liver lipid (%)		
	Males	Females	Combined	Males	Females	Combined	M.	F.	C.	M.	F.	C.	M.	F.	C.
Unstarved 4 M.—4 F.	269	236	252	7.508	6.490	6.992	2.81	2.74	2.78	4.11	3.35	3.73	3.20	3.83	3.52
Starved 4 M.—4 F.	337	233	285	7.932	5.619	6.776	2.35	2.40	2.37	0.37	0.20	0.28	5.24	—	—
Alanine 7 M.—10 F.	250	152	192	6.919	5.092	5.845	3.17	3.56	3.40	1.02	1.61	1.37	6.45	5.03	5.69
Cystine 3 M.	443	—	—	10.307	—	—	2.34	—	—	0.77	—	—	5.49	—	—
Glutamic Acid 2 M.—5 F.	420	263	308	8.593	5.617	6.468	2.08	2.25	2.20	0.53	0.22	0.31	6.37	8.82	8.12
Glycine 4 M.—4 F.	285	215	250	6.895	5.112	6.003	2.85	2.37	2.61	0.13	0.53	0.33	5.26	5.61	5.43
Tyrosine 3 M.—5 F.	351	251	289	7.593	5.994	6.593	2.15	2.37	2.29	0.75	0.79	0.77	5.10	—	—

for the higher value of the liver expressed as per cent of body weight. The lowest glycogen content was found in the fasting group, but the values for the glutamic acid- and glycine-fed animals are so slightly above the fasting level, that we may consider no glycogen to be formed from either of these acids in the present method of investigation.

Glycogen was readily formed from alanine, as expected, and the feeding of cystine was likewise followed by definite glyconeogenesis.

The surprising result was the evident formation of glycogen from tyrosine. This amino acid is treated as ketogenic, in diabetic diet calculations, but under the conditions of our experiments, it appears to be antiketogenic.

The total lipid content of the liver is low in the unstarved rats, quite high in those fed glutamic acid, and between 5 and 6% in the other groups.

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Correction for Undercooling in Material of High Solid Content.

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As a solution is cooled in a freezing-point determination, crystallizing does not start at the freezing temperature. The temperature falls below the freezing-point, to an extent varying in different cases, before the freezing process commences. As soon as ice does start to form, the temperature climbs rapidly toward the freezing-point. The heat for this rise of temperature is derived from the freezing process, the latent heat of fusion of ice being 80 calories. The formation of ice is equivalent to the removal of water, and hence the solution will be concentrated. The freezing-point observed will, therefore, represent a solution more concentrated than the original solution; or, to express the fact differently, the freezing-point depression observed will be greater than the true depression for the solution.

The solution, if the amount of solid present is so small that it can be neglected, will be concentrated s u/1 times for u degrees of undercooling (Jones[1]), where s equals the specific heat of the solu-

[1] Jones, H. C., *Z. f. Phys. Chem.*, 1893, **12**, 624.