LETTERS TO THE EDITORS

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Ornithine Transaminase

A TRANSAMINASE, accomplishing the transfer of amino-nitrogen from l-ornithine to the ketonic acids, pyruvic, oxalacetic and α-ketoglutaric acid, occurs in mammalian and avian liver. There is little in the literature to indicate that such a reaction may play a part in liver metabolism, and it is the purpose of this short statement to indicate that this reaction may occupy a significant place in hepatic amino-acid metabolism. The literature will be reviewed in a more extensive publication in which full experimental details and results will be given.

The technique adopted in this investigation consisted in incubating amino-acids together with sodium pyruvate in the presence of tissue homogenates, under aerobic conditions, at 37° C. The incubations were carried out in presence of sodium azide to depress the oxidative disappearance of pyruvate. The changes of pyruvate concentration, brought about by the presence of the amino-acids, were measured manometrically, using yeast carboxylase as an enzymic means of decomposing the pyruvate. The alanine formed from the pyruvate by transamination was separated on filter paper by paper chromatography, and it was estimated colorimetrically by elution from the paper after the development of colour by application of the ninhydrin reaction.

A few typical experimental results showing the equivalence of pyruvate disappearance and alanine formation in a rat liver homogenate in presence of ornithine and sodium pyruvate are given in Table 1.

Table 1. EQUIVALENCE OF PYRUVATE DISAPPEARANCE AND ALANINE FORMATION IN A RAT LIVER HOMOGENATE

Reactions were carried out in 25-ml. conical flasks in air at 37° C. Each vessel contained 0·8 ml. rat liver homogenate, 0·1 ml. of 2 per cent sodium azide, 0·3 ml. of 0·2 *M* sodium pyruvate, 0·6 ml. of 0·1 *M* l-ornithine and water to a total volume of 3 ml. *p*H 7·4. 1 hr. incubation. Theoretically, for disappearance of 1 mgm. pyruvic acid there should arise 1·01 mgm. alanine

Experiment	mgm. pyruvic acid disappeared	mgm. alanine formed
1	1·35	1·09
2	1·24	1·39
3	1·47	1·42
4	1·71	1·67

Figures indicating the presence of ornithine and glutamic transaminases are shown in Table 2. The term percentage transamination is defined by the ratio :

$$\frac{\text{Pyruvate disappeared in presence of the amino-acid}}{\text{Pyruvate present (in the absence of the amino-acid)}} \times 100.$$

Figures are given, too, in this table indicating that arginine apparently undergoes transamination in presence of pyruvate.

It will be noted that ornithine transamination takes place in rabbit, rat or pigeon liver, in rat, rabbit and guinea pig kidney, and to little or no extent in rabbit or pigeon muscle. It is absent from rabbit or rat brain, and also from such plants as bean sprouts. It is thus distinct from glutamic transamination which, as is well known, occurs in brain tissue and in a variety of plants, including bean sprouts. Arginine

Table 2. Transaminations effected by various homogenized tissues in the presence of arginine and sodium pyruvate, or of ornithine and sodium pyruvate, or of sodium glutamate and sodium pyruvate. Experimental conditions as in Table 1

Homogenized tissue	Percentage transamination		
	Arginine-pyruvate	Ornithine-pyruvate	Glutamic-pyruvate
Rabbit liver	—	22·7	54·0
Rabbit kidney	—	21·9	65·6
Rabbit brain	—	0·0	30·2
Rabbit muscle	—	6·1	32·3
Rat liver	37·3	38·5	35·6
Rat brain	0·0	0·0	18·7
Rat kidney	17·2	31·0	—
Pigeon liver	2·9	43·8	26·2
Pigeon breast muscle	3·3	0·0	30·7
Guinea pig kidney	5·4	19·6	—
Bean sprouts (fresh)	0·0	0·0	32·1

transamination, in contrast to that of ornithine, seems not to take place in pigeon liver.

The evidence would indicate that transamination does not take place with arginine itself, and that a breakdown to ornithine must occur before transfer of an amino-group is obtained. This is shown by the fact that tissues lacking arginase show no ability to form alanine from pyruvate in presence of arginine, and that the presence of arginase inhibitors (borate, arsenite) inhibit transamination from arginine but not from ornithine.

L-Citrulline is found to be almost incapable of transamination, with the tissues investigated and under our experimental conditions.

Additional evidence that the ornithine and glutamic transaminases are apparently distinct enzymes comes from the fact that mixtures of the two amino-acids in presence of a rat liver homogenate give additive effects ; that is, they react independently of each other.

Reactions of ornithine with oxalacetic and α-ketoglutaric acids in presence of rat liver may be shown by identification of the corresponding amino-acids, aspartic and glutamic acid respectively, by unidimensional chromatography. These reactions do not seem to be quantitatively as important as that with pyruvate under the experimental conditions employed.

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A Possible Structure for Codecarboxylase

THE thermostable factor which functions in the enzymatic decarboxylation of a number of amino-acids is known as codecarboxylase. Its recognition as a phosphorylated derivative of pyridoxal was confirmed by the preparation of a highly active material through direct phosphorylation of pyridoxal with phosphoryl chloride[1]. Elementary analysis of the synthetic product indicated the presence of one phosphate group in the molecule; but the exact location of this group was uncertain.

The purified preparation no longer showed phenolic properties and the absorption maximum exhibited by pyridoxal at 3000 A. was absent. On acid hydrolysis, both the absorption maximum and phenolic reactions reappeared, together with the release of one mole of phosphoric acid and disappearance of