THE EFFECT OF ETHANOL ON LIVER GLYCOGEN OF FED ANIMALS

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ABSTRACT

A hyperglycemic effect of ethanol has been reported in fed animals, but is poorly documented and in general, little work has been done on the effects of ethanol on carbohydrate metabolism in the fed state. This study is a further extension of research investigating the effect of ethanol on liver carbohydrate metabolism, as liver is a major source of glucose output in fed animals. It has been suggested that the hyperglycemic condition might be caused by an ethanol-stimulated liver glycogenolysis.

Because it was possible that the actions of ethanol were a direct effect on carbohydrate stores rather than an effect mediated by hormones, ethanol was tested on a simple unicellular organism *Ochromonas danica* where hormonal mechanisms are absent. It appears that ethanol does cause a reduction of *Ochromonas* carbohydrate stores in the absence of hormones. The major difficulty in using this organism was that its carbohydrate content could change according to the osmotic pressure in the external environment which therefore had to be strictly controlled.

Following the initial work using *Ochromonas danica*, further experiments were carried out using fed rats to assess the effects of ethanol on tissue glycogen stores. Sprague-Dawley rats were administered with an acute dose of ethanol (6g/kg). The effect of ethanol on the liver glycogen content of the animals was examined at 45, 90 and 180 minutes after the dose given. It appears that ethanol would lead to a significant decrease in liver glycogen content in both male and female rats at any given time. However, the decrease was not as much as that reported in the literature. Presumably this is due to the differences in ethanol administration, assays of liver glycogen and the strains of animals used in the experiment. The glycogen content in other tissues such as heart, kidney and muscle was also investigated but little difference was observed with ethanol treatment except in muscle, which showed some increase in glycogen content especially in the males. It is interesting that the free glucose concentrations in these tissues were not elevated as might have been expected if liver glycogen breakdown had occurred. Moreover, ATP levels were also observed to be unchanged.

The female rats were found to metabolise ethanol at a slower rate than males. The ethanol concentration in their extrahepatic tissues was similar to the calculated theoretical value for initial ethanol absorption. However in male rats, it is lower than the theoretical value. This indicates that the ethanol clearance curve for these tissues was not linear, and this implies that other factors such as delayed absorption or a first-pass effect (Lieber et al., 1994) might occur.

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ABBREVIATIONS

GENERAL

ATP	adenosine-5'-triphosphate
BSA	bovine serum albumin
cAMP	cyclic adenosine 3',5'-monophosphate
EDTA diNa	sodium ethylenediamine tetra acetic acid
FRS	free reducing sugar
H^+	hydrogen ion
H_2O	water
HCl	hydrochloric acid
$KHCO_3$	potassium hydrogen carbonate
$KClO_4$	potassium perchlorate
KOH	potassium hydroxide
$MgCL_2$	magnesium chloride
NAD^+	nicotinamide adenine dinucleotide (oxidised form)
NADP	nicotinamide adenine dinucleotide phosphate (reduced form)
OAA	oxaloacetate
PCA	perchloric acid
PEG	polyethylene glycol
RS	reducing sugar
αKG	α-ketoglutarate

ENZYMES

ADH	alcohol dehydrogenase
AGS	amyloglucosidase
G6PD	glucose 6-phosphate dehydrogenase
GP	glycogen phosphorylase
GS	glycogen synthase
HK	hexokinase
MDH	malate dehydrogenase
PhK	phosphorylase kinase
PKA	protein kinase A
PP1G	protein phosphatase 1G

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