ETHANOL METABOLISM IN HUMANS

A thesis presented in partial fulfilment
of the requirements for the degree of
Master of Science
in
Biochemistry
at Massey University

Kenneth G. Couchman
1974

SUMMARY

Alcohol metabolism in humans has been studied by examining blood, urine and breath samples taken at frequent intervals for 3 hours after an alcohol load of 0.5ml/kg in a fasting condition.

A gas chromatographic method was developed for the simultaneous estimation of acetaldehyde, ethanol and acetone levels in blood and urine specimens and various column packings were investigated. Porapak Q was the most suitable material and the method finally adopted used the headspace gas phase over urine or perchlorate precipitated blood specimens to which had been added sodium sulphate to displace the volatile components from the aqueous phase. Protein precipitation was necessary in order to prevent the loss of acetaldehyde from the blood samples. A gas sampling valve was fitted to enable similar determinations in breath samples but was not used in this study.

Assays by ezymatic methods were developed for lactate, pyruvate, β-hydroxybutyrate, glucose and glycerol utilising the changes in concentration of NADH which was measured by fluorometry and the merits of converting NAD^+ to a fluorescent compound was examined. Twenty male and eight females volunteered for the study. Blood samples were obtained from an intravenous catheter, a procedure supervised by a physician. Blood alcohol levels were monitored by breath tests with an electrochemical device, (an Alcolimiter) for detecting ethanol.

There were considerable variations in the peak alcohol levels and in the time taken for equilibration in the body. Estimates of

the rate of metabolism of ethanol and of body content were in agreement with those published in the literature. Breath testing was found to be a satisfactory means of estimating blood alcohol concentration in the post-absorptive phase. The Alcolimiter gave readings that were on an average 10mg/100ml low, but this could be corrected by recalibration. Blood acetaldehyde levels rose to 0.1mg/100ml and occasionally to 0.2mg/100ml.

A fall in blood pyruvate level, which remained low throughout the test period, was seen to coincide with the increase in blood alcohol. There was a tendancy for lactate to rise at the same time. This was not consistent, but the ratio of lactate to pyruvate increased 2 or 3-fold in most cases which reflected the change in cytoplasmic redox ratio.

Small increases were observed in blood glucose even though the alcoholic drink was free of sugar. There were increases in blood glycerol levels in all subjects and some of these were quite large. These findings were contrary to some reports which have appeared in the literature.

The excretion of electrolytes was examined in the urine but the results were difficult to interpret.

Alcohol concentrations in urine samples were measured and compared to the blood levels and the diuretic effect of alcohol was noted. These findings, together with those reported in the literature have been discussed together with their significance in interpreting disturbances of metabolism when alcohol is consumed.

More assays are thought to be required including those for blood acetate, blood triglycerides with free fatty acids and some hormones. It is considered that the use of labelled compounds could add a new dimension to the *in vivo* investigations on human volunteers.

ACKNOWLEDGMENTS

I am indebted to my supervisor, Professor R. D. Batt for his continuing interest in the study and help with the preparation of the manuscript for the thesis. I am also grateful to Dr L. Bieder for his medical supervision of the work with volunteers and assistance in formulating the protocol. My appreciation is due and acknowledged to Terry Braggins for technical assistance, Dr R. Greenway both for advice and the assays of electrolytes, Dr R. Brooks for help with estimations using atomic absorption spectroscopy; and to all the members of the team working on alcohol research in the department for continual advice and discussion of the project.

The thesis was typed and copied by Ms Marion Trevor to whom I am indebted for her patience and care at all stages of preparing the final manuscript.

LIST OF CONTENTS

LIST OF FIGURES

LIST OF TABLES