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CHANGES IN BLOOD PRESSURE AND PLASMA URATE INDUCED BY THE METABOLISM OF ALCOHOL IN HUMANS

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ABSTRACT

Changes in blood pressure (BP) and plasma urate produced by the bio-transformation of a moderate dose (0.75ml(20%) ethanol/kg body weight) of alcohol were determined after 1h, 6h (oxidation phase) and 12h (post oxidation phase) of consuming the alcohol dose. Twenty healthy Nigerians (ten males and ten females) were randomly selected for the study after their informed consent. Statistical analyses of the results using ANOVA showed a significant decrease ($p<0.05$) in BP and plasma urate in both sexes during the initial oxidation phase. These values, however, significantly increased at the post-oxidation stage ($p<0.05$) irrespective of sex. The changes in BP and plasma urate at the two different phases studied, showed a positive correlation, demonstrated to be stronger amongst the male subjects. However, no such relationship was demonstrated during the control exercise. This investigation implicates the increase in plasma urate, a remote metabolite of alcohol oxidation, as yet another risk factor for hypertension, known to be common amongst habitual ethanol drinkers. Further research is however, required to establish the mechanism (s) involved in such relationships.

Keywords: Blood pressure, plasma urate, hypertension, alcohol.

INTRODUCTION

When consumed, alcohol is absorbed passively by simple diffusion and distributed throughout the total body water without modification (Eckardt, *et al.*, 1998). The liver is the major site of ethanol metabolism, hence it is faced with the highest concentrations during absorption which makes it highly vulnerable to ethanol toxicity (Lieber, 1997).

The hepatic oxidation of ethanol to ethanal (acetaldehyde) and then, to ethanoate (acetate) is via metabolic reactions successively catalysed by alcohol dehydrogenase (ADH) and aldehyde dehydrogenase (ALDH), respectively. The generated acetate is in turn converted to carbon (IV) oxide (CO_2) and water (H_2O) as the end products of ethanol metabolism (Collin, 1992). ADH exists in multiple molecular forms and is located primarily in the liver and stomach (Schmidt and Schmidt, 1970). Its NAD^+ - dependent reaction occurs in the cytosol of hepatocytes, and the ability of the liver to oxidise ethanol is largely influenced by its capacity to re-oxidize NADH. When an acute dose of ethanol is taken, the NADPH-dependent microsomal ethanol oxidizing system (MEOS), a fraction of the cytochrome P_{450}, could be induced to augment the activity of ADH (Lieber, 1988).

Ethanol is consciously consumed by most people in order to presumably conquer fret, anxiety and induce a state of euphoria (Onyesom and Chukwuka-Offor, 1999). At low or moderate doses, alcohol is benign to most body tissues, but because body tolerance, response and adjustment to intake vary from individual to individual, it thus, becomes imperatively difficult to clearly define the quantity or dose that would produce the desired minimal effects. Thus, its use could be abused. Ethanol abuse induces a wide range of biochemical disturbances and organic lesions in man ((O'Connor and Schottenfeld, 1998) and this represents the influence of ethanol on intermediary metabolic pathways.

The increased concentration of NADH produced during ethanol metabolism elevates plasma lactate, which competes with urate, thus, reducing the capacity of the kidneys to excrete urate. This situation, compounded by the alcohol-enhanced catabolism of purine nucleotides (Faller and Fox, 1982) promotes hyperuricemia. As such this hyperuricemic condition is presently used as a biological marker in the assessment of ethanol abuse (Beghi, *et al.*, 1995).

This study attempts to establish the relationship between this novel marker and BP induced by the metabolism of a moderate dose of alcohol.

MATERIALS AND METHODS

Twenty healthy Nigerian subjects (ten males, ten females) of average height, (1 6 m) and weight (60 kg), between the ages of twenty-

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two and twenty-six years and who have no traceable record of alcohol intake for more than five years, were randomly selected. The consenting individuals were then tested on four different occasions.

On the first occasion, the participants were gathered, and 0.75 ml normal saline/ kg body weight was orally administered in single dose after about a 4h fasting period. Two millilitres of venous whole blood was collected from each subject at 1h, 6h and 12h post administration, into lithium heparin zed tubes and centrifuged at 1200 x g for 5 min at room temperature using Jouan C-400-54 model centrifuge. The resulting supernatant (plasma) was stored frozen in bijou bottles for analysis.

The urate concentrations in the plasma samples were determined by the uricase method described by Caraway (1963), using commercially prepared reagents supplied by Randox Laboratory, Ardmore, United Kingdom.

Measurement of BP was done *paripassu* with blood collection in a well-seated position using digital aneroid sphygmomanometer.

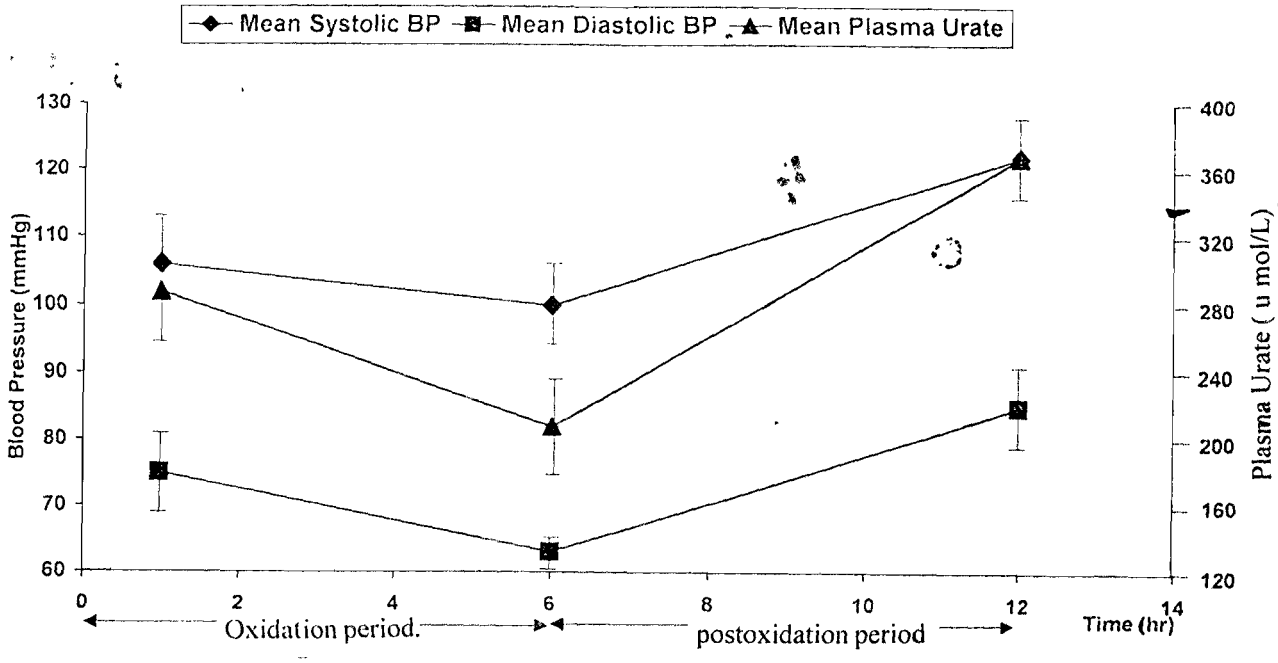

Fig. 1 Changes in males' mean systolic BP, diastolic BP and plasma urate values induced by the consumption of 0.75ml (20%) ethanol/kg body

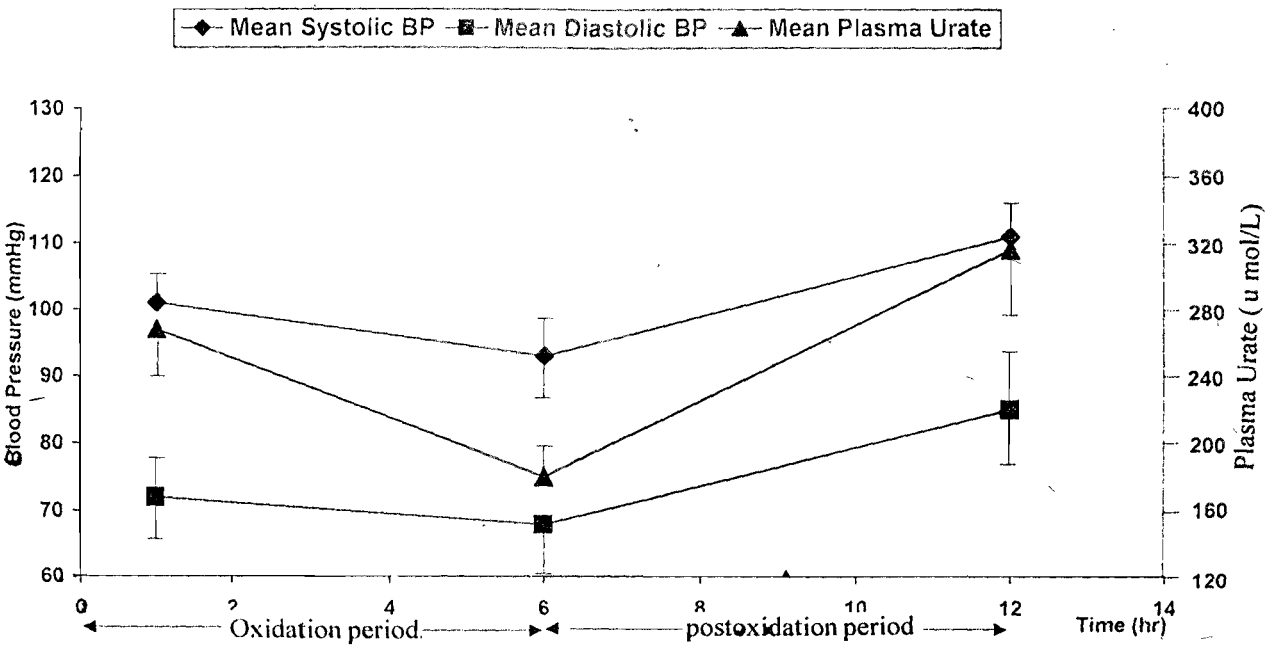

Fig. 2 Changes in females' mean BP, diastolic BP and plasma urate values induced by the consumption of 0.75ml (20%) ethanol/kg body weight.

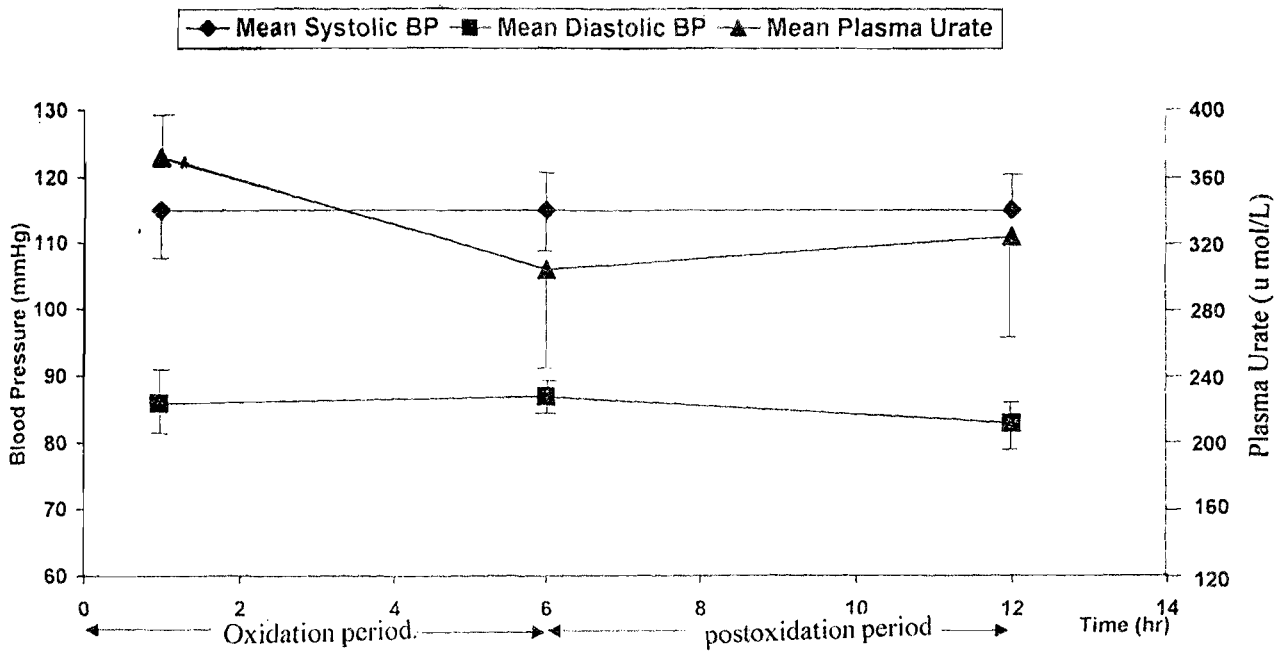

Fig. 3 Changes in males' basal mean systolic BP, diastolic BP and plasma urate values

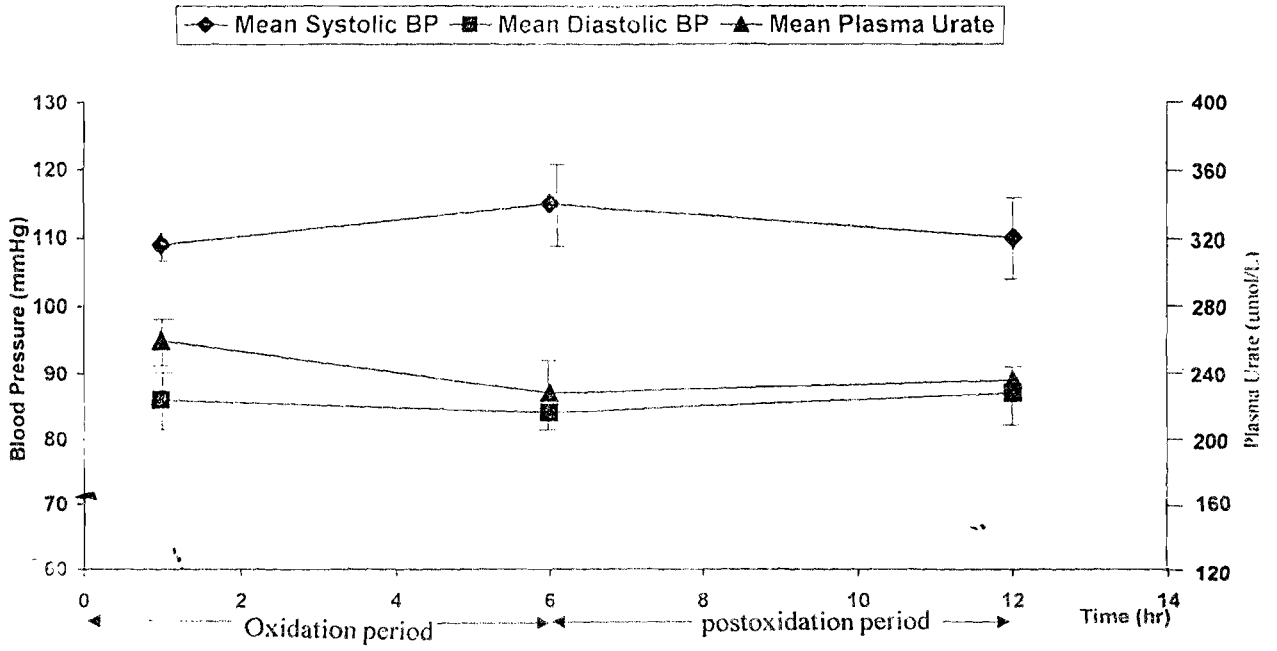

Fig. 4 Changes in females basal mean systolic BP, diastolic BP and plasma urate values.

On the second occasion, the experiment was repeated as described earlier using the same volunteers after three days.

On the third occasion separated by two weeks, the experimental exercise was performed again, but this time, the same participants were given the equivalent volume of ethanol (0.75m (20%) ethanol/kg body weight, after diluting to 20% with orange squash) in lieu of normal saline Then, the participant's individual average BP and plasma urate values were calculated and recorded. This was again repeated during the fourth occasion, conducted after three days of the third.

The first two occasions served as the control experiments during which the basal values were obtained.

ANOVA and Spearman's rank correlation were used to analyse the data obtained, and statistically significant difference was established at the 5% probability level.

RESULTS.

The results obtained from the investigation are shown in Figures 1-4. Statistical analyses of the data so obtained indicate a significant decrease ($p<0.05$) in mean plasma urate and BP

measurements, 6h after alcohol ingestion (oxidation phase) in both male (Fig. 1) and female (Fig. 2) subjects. Meanwhile, statistically significant increases ($p<0.05$) in mean plasma urate and BP values were witnessed after 12h of ethanol consumption (post oxidation phase) irrespective of the sex. There was a strong positive correlation between plasma urate and BP values obtained from the male ($r=0.860$; $p<0.05$), and female ($r=0.993$; $p<0.05$) participants during the oxidation phase. But at the post oxidation period, the correlation coefficient, 'r' values changed to 0.930 and 0.668, respectively, for males and females at the same 5% probability level. However, such relationship and statistical inference could not be established during the control trial in both the male (Fig. 3) and female (Fig. 4) subjects.

DISCUSSION

This study demonstrates that ethanol metabolism reduces plasma urate and accordingly, BP in both sexes (Figs. 1&2) during the first 6h (the oxidation period). This observation agrees with the reports of other researchers, who showed that BP was lowered during the first three hours after alcohol ingestion (Moreira, *et al.,* 1998). Nonetheless, plasma urate and BP values were correspondingly raised during the post oxidation phase (beyond 6.0). Other workers have also reported increased plasma urate (Redetzki, *et al.,* 1972; Onyesom, *et al.,* 2001) and BP (Curtis, *et al.*, 1997; Onyesom and Atakuo, 1998) as consequences of ethanol metabolism. Therefore postconsumption time affects BP and plasma urate homeostasis, though this could be influenced by frequency of consumption, type of alcoholic beverage consumed, change in $NAD^+/NADH$ ratio, intoxicative stress and increased amounts of alcohol metabolites (Itoh, *et. al.*, 1997).

The lowering effect of ethanol oxidation on plasma urate and BP, and the attendant increase observed during the hangover period, is difficult to explain. Notwithstanding, this study has in addition to other aetiologic factors, implicated the alcohol induced hyperuricemia to be yet another risk factor of high BP, and possibly hypertension, prevalent in especially male drinkers of ethanol in amounts considered 'high' (Itoh, *et al.,* 1997).

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REFERENCES

Beghi, E., Boglium, G. and Cossop, P., 1995. Stroke and alcohol intake in hospital population: a case-control study. Stroke, 26 (4): 1691-1696

Caraway, W. T., 1963. Quantitative determination of uric acid. Clin. Chem. 4: 239-243.

Collin, D., 1992. Therapeutic Drugs. Churchill Livingstone, London.

Curtis, A. B., James, S. A., Strogatz, D. S., Raghunathan, T. E. and Harlow, S., 1997. Alcohol consumption and changes in blood pressure among Africa Americans, the Pitt County Study. Am. J. Epidemiol. 14((9): 727-733.

Eckardt, M. J., File, S.E., Gessa, G.L., Grant, K.A., Guerri, G., Hoffinan ,P.L., Kalant, H., Koob, G.F., Li, T-K. and Tabakoff, B., 1998. Effect of moderate alcohol consumption on the central nervous system. Alcohol. Clin. Exp. Res. 22 (5): 998-1040

Faller, J. and Fox, I.H., 1982. Evidence for increased urate production by activation of adenine nucleotide turnover. N. Engl. J. Med. 307:1598-1602

Itoh, T., Matsumoto, M. and Nakamura, M., 1997. Effects of daily alcohol intake on blood pressure differ depending on an individual sensitivity to alcohol :Oriental flushing as a sign to stop drinking for health reasons. J.Hypertens. 15 (11): 1211-1217.

Lieber, C. S., 1988. The influence of alcohol on nutritional status. Nutri. Rev. 46 (7):241-254.

Lieber, C. S. 1997. Ethanol metabolism, cirrhosis and alcoholism. Clinica Chimica Acta, 257 (1): 59-84.

Moreira, L.B., Fuchs, F.D., Moraes, R.S., Bredemeier, M. and Duncan B. B., 1998. Alcohol intake and blood pressure: the importance of time elapsed since last drink. J. Hypertens. 16 (2): 175-180.

O' Connor, P. G. and Schottenfeld, R. S., 1998. Patients with alcohol problems .N. Engl. J. Med. 338:592-602.

Onyesom, I. and Atakuo, E. O., 1998. An investigation into the relationship between alcohol-induced changes in serum triacylglycerol and blood pressure. Nig. J. Biochem. Mol. Biol. 13:79-83.

Onyesom, I. and Chukwuka -Offor, H. C., 1999. An investigation into the major health risks associated with the permissive sociocultural use of alcohol among the inhabitants of the Edo-Delta Region of Nigeria. J. Med. Lab. Sci. 8:122-127.

Onyesom, I., Oriero, E.C., Achuba, F. I. and Onyesom, H.C., 2001. Changes in plasma glucose and uric acid induced by oral ethanol administration: gender difference. Int' l J. Res.. Sci. Edu. 1(1): 68-72.

Redetzki, H.M., kdener, T.A., Hughes, J. R. and Smith, A.G., 1972. Osmometry in the evaluation of alcohol intoxication. Clin. Toxicol. 5:343-363.

Schmidt, E. and Schmidt, F. W., 1970. Enzyme activities in human liver. Enzymol. Biol. Clin. 11:67-129.