

# A note on the influence of diet in West Africa on urinary pH and excretion of amphetamine in man

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The urinary excretion of amphetamine was examined after the oral administration of (+)-amphetamine sulphate to two groups of subjects whose urinary pH fluctuated about mean acidic or alkaline values due to their different diets. The group with a balanced protein diet giving acidic urine, excreted much more drug unchanged than the group with a low protein diet giving alkaline urine. A small increase in protein intake in the group with alkaline urine made their urine pH acidic in a few days and increased their excretion of amphetamine to the same level as the group with acid urine.

The effect of diet on the urinary pH in man was reported by Wesley-Hadzija (1969). This work is now extended to examine the effect of different urinary pH values, arising from varying dietary customs, upon the excretion and reabsorption of amphetamine.

## METHODS

Urine from males, 20-30 years, either on a balanced diet with adequate protein\* (students; group 1) or on a low protein† diet (laboratory assistants; group 2) was collected every 2 h for 16 h starting at 7.0 a.m. on four successive days, and the pH of each collection was measured.

Additional proteins (one egg and half a pint of milk) were also given to three subjects of group 2 with their usual diet at 6.30 a.m. for four days and urine collection and measurement were continued for three succeeding days.

An oral dose of 5 mg of amphetamine sulphate (3.7 mg amphetamine base) was administered in the morning of the fourth day to all subjects.

After amphetamine, the volume and pH of urine samples were measured and then those samples taken from 0-8 h and 8-16 h were separately pooled. The pH and volume of the pooled urine of each of several subjects from each group over a 36 h period, was also measured. pH measurements were usually made immediately after urine collections; a few samples were stored at 4°, and the pH measured within 24 h.

The amphetamine content of the urine was determined by gas liquid chromatography (Beckett & Rowland, 1965b).

\* Diet: Group 1. Breakfast 6.30 a.m., coffee with milk (approx. 250 ml), bread (approx. 200 g) with butter or margarine (approx. 30 g) and marmalade (approx. 30 g), rice or gari (150-200 g) boiled in water, fruit (approx. 100 g). Twice a week the fruit is replaced by one egg. Snack 10.00 a.m., coffee with milk (approx. 250 ml) and coffee cake (approx. 100 g). Lunch 1.00 p.m., meat (approx. 200 g) with vegetable and rice, beans or yam (approx. 200 g). Afternoon drink 4.30 p.m., squash (approx. 250 ml). Dinner 6.30 p.m., fish or meat (150-200 g) as stew with rice, yam, plantain or cassava (approx. 200 g), ice cream, fruit salad or cake (approx. 100 g) and cacao (approx. 250 ml).

† Diet: Group 2. Breakfast 6.30 a.m., gari, rice or corn (approx. 200 g) boiled in water. Lunch 1.00 p.m., groundnuts (approx. 50 g), 1-2 bananas, fried plantain or kenkey (approx. 200 g). Dinner 6.30 p.m., fish or meat (approx. 100 g) as stew and rice, yam, plantain or cassava as "fufu".

## RESULTS

Amphetamine was recovered quantitatively from urine; other substances did not interfere with the assay.

The mean urinary pH values for each 2 h collection for 16 h on each of four days for the two groups of subjects were different (Wesley-Hadzija, 1969). Those of group 1 fluctuated about a mean of 5.9 ( $\pm 0.56$ ) and those of group 2 about 7.5 ( $\pm 0.25$ ); no overlap of the two groups occurred. None of the urine from group 1 subjects was more alkaline than pH 6.9 and all the samples from group 2 were more alkaline than this.

For the pooled urines collected over 36 h, the average pH value for group 1 subjects was 5.9 (range, 5.45–6.4) and for group 2 subjects it was 7.5 (range, 7.3–7.7). The ingestion of amphetamine did not alter the fluctuation and the range of pH observed in the two groups.

In group 2 subjects given additional protein, the urinary pH became acidic ( $\approx$ pH 5) after the second breakfast with supplementary protein. Within a day of the supplementary protein diet being discontinued the urine pH rose to 6.7 or above.

In a separate experiment with six subjects of group 2, half a pint of milk at breakfast was sufficient to change the average pH of urine of the group to the acid side (Fig. 1).

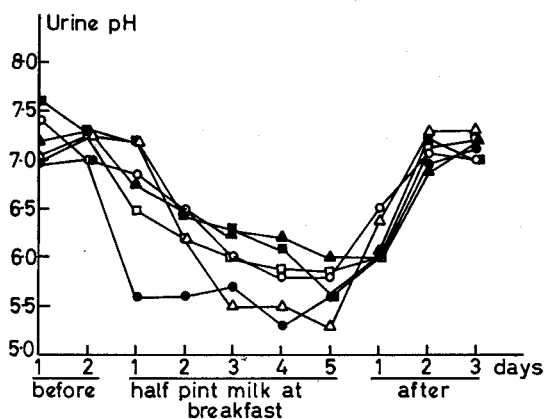


FIG. 1. Urine pH of pooled collections (7 a.m.–11 p.m.) of subjects on low protein diet—before (2 days), during administration of half a pint of milk at breakfast (5 days), and after return to low protein diet (3 days).

Group 1 subjects after an oral dose of 5 mg (+)-amphetamine sulphate excreted in their acidic urine 23 to 56% of unchanged amphetamine in 0 to 8 h and 5 to 13% from 8 to 16 h (Fig. 2).

Group 2 subjects after amphetamine excreted only 2 to 6% in 0 to 8 h and 0.5 to 3.0% in 8 to 16 h of unchanged drug after amphetamine administration (Fig. 2). Addition of protein to their diet for four days, at breakfast, resulted in acidic urine and the excretion of unchanged drug in amounts comparable to those obtained from group 1 subjects. Discontinuation of the protein supplement led to a reversion to alkaline pH and reduction in the amount of amphetamine excreted (Fig. 2).

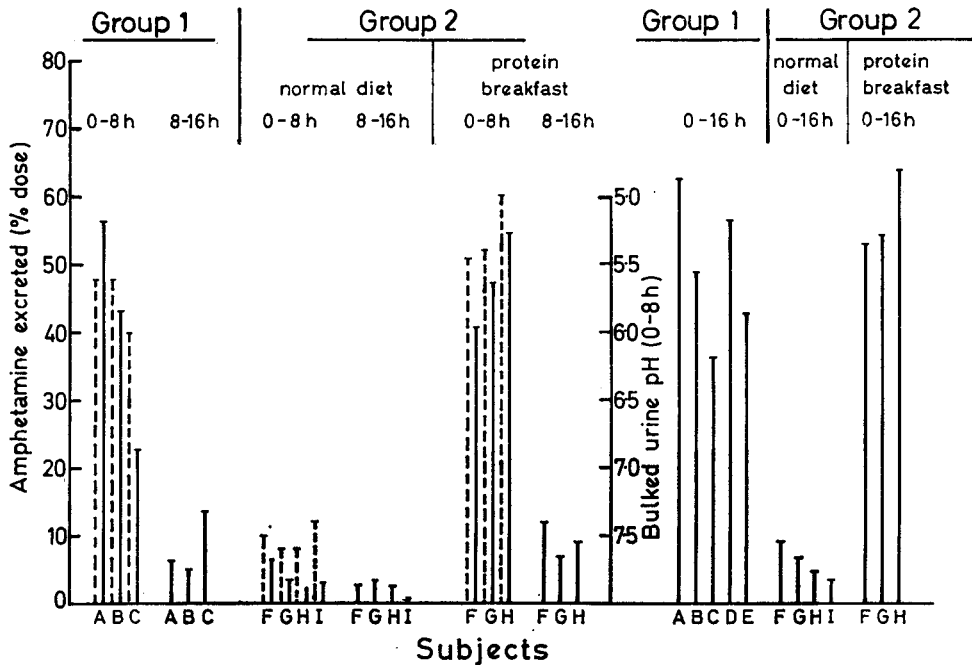


FIG. 2. Urinary excretion of amphetamine in students (Group 1) on balanced diet and also laboratory assistants (Group 2) on normal carbohydrate diet and then on a carbohydrate plus protein diet for four days. —, Excretion of amphetamine; - - - Urinary pH.

The two groups on different diets excreted amphetamine to different extents (Fig. 2) in a manner similar to that observed (Beckett & Rowland, 1964, 1965a) in excretion studies on subjects in U.K. whose urine was deliberately made acidic or alkaline by the oral administration of ammonium chloride or sodium bicarbonate respectively.

Thus diets can influence the excretion of amphetamine and therefore its biological half-life and duration of action in man. Since it has been shown that the excretion of many partially ionized drugs (Milne, Scribner & Crawford, 1958; Beckett & Brookes, 1969) and the ratios of metabolites to unchanged drugs (Beckett, 1969) are affected by making the urine acidic or alkaline with ammonium chloride and sodium bicarbonate respectively, it is probable that changes in diet which influence pH will have comparable effects.

#### Acknowledgement

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