Influence of Graded Levels of Protein in the Uric Acid Excretion of Young Nigerian Women

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ABSTRACT *Twelve healthy female subjects aged between 21 and 32 years were fed graded levels of protein in form of the habitual diet to which they were accustomed, in order to differentiate effects of this dietary component on urinary and plasma uric acid excretion. Urinary uric acid increased significantly with increase in the level of protein intake. The average daily uric acid excretion at the four levels of protein tested were 297.7 ± 44.5, 282.9 ± 45.0, 304.6 ± 31.8 and 331.4 ± 26.5 mg/day for 15.7, 21.4, 27.4 and 32.7g protein/day respectively. Thus urinary uric acid increased linearly by 2.14 mg/g protein. There is, therefore, a positive correlation between the amount of protein vitamin and urinary uric acid excretion (r = 0.34). However, plasma uric acid did not change with increase in dietary protein. This was attributed to a possible increase in renal clearance.*

Keywords: *Graded Level of Protein, Uric Acid.*

INTRODUCTION

In man, the end product of nucleic acid metabolism especially the purine portion is uric acid, which has a low solubility at the pH of body fluids, and is relatively poorly excreted by the kidney. In cases of elevated blood levels, crystals are formed in joints as in gout, and with excessive renal clearance loads, stones may be deposited in the urinary tract.

Urinary and plasma uric acid levels have been shown to be greatly affected by the levels of protein and nucleic acid in the diet (1-5). In most of the studies the few subjects studied were fed refined, formula diets. The work of Nugent and Tyler (5) using nucleic acid as supplement to the normal diet of their subjects ignored the fact that there is a possible increase in protein when less refined sources of nucleic acid were fed. However, Walsein, Calloway and Margen (1) evaluated the effect of protein as well as nucleic acid separately on uric acid excretion using carefully controlled formula diet.

In the present study, we have evaluated the effect of changes in the protein level of a habitual mixed, unrefined diet which could be termed "low purine" diet, on the uric acid excretion. The diet was used basically to estimate the protein requirement of young adult female Nigerians (6).

MATERIALS AND METHODS

Twelve healthy female undergraduates ranging in age from 21 to 32 year, in height from 154 to 170.5 cm and in weight from 45 to 63kg. were used for this study. All subjects were free living and lived in hostels on the University Campus. They were given their habitual diet based on a combination of root tubers, grain cereals, vegetables and animal products. Complete minerals and vitamin supplements were added to ensure no vitamins or minerals were lacking. The food was adequate and constant in all known essential nutrients except the protein that was varied (Table 1). Caloric needs to maintain constant body weights were met by additions or removal of orange drinks. All subjects were allowed free access to water.

Table 1
Ingredients and Nutrient Composition of the Experimental Diets

Ingredients	Amounts taken in g			
	Diet 1	Diet 2	Diet 3	Diet 4
Bread	90	90	90	90
Refined Cane Sugar	30	30	30	30
Margarine	30	30	30	30
Pepper (dried)	4	4	4	4
Tomatoes	80	80	80	80
Onion	40	40	40	40
Palm Oil	60	60	60	60
Cassava (grated)	100	100	100	100
Beef	10	20	50	95
Vegetable	20	20	20	20
Yam (cooked)	200	-	-	200
Rice (cooked)	-	300	300	-
Orange Drink (Bottles)	2	2	2	2
Nutrients:				
Protein (g)	15.7	21.4	27.4	32.7
Caloric (kcal)	2168.4	2217.0	2224.0	2202.0

Their health status was evaluated on the basis of medical history, physical examination and routine laboratory tests. No medication was taken nor did any surgical procedure occur

during the study and all subjects remained essentially healthy.

The effect of variation in protein intake at four levels from 15.7, 21.4 and 32.7g protein/day was evaluated in all subjects. Each dietary level of protein was administered for 10 days, with a three days interval between levels. The first day of every dietary level was an essentially protein free diet to bring all subject to the same level. The first 5 days were allowed for adjustment to the changed intake. Data on urinary uric acid represent the averages of individually pooled 24 hours output for the last 5 days of the study, and plasma uric acid concentrations are in fasting bloods drawn on the final morning of each period.

Urine was quantitatively collected with the addition of 10mls of 1M HCl and stored at - 5°C until analysed. Plasma was also collected in plastic containers and stored -5°C. Urinary and plasma uric acid were determined by the automated phosphotungstate method of Wheat (7). Vitamin and mineral supplements are in the form of a capsule prepared by Ricker Laboratories, Loughborough, England, United Kingdom.

The pattern of urinary uric acid excretion from pooled data of each dietary group are shown with standard deviation in fig. 1. Excretion pattern of individual subjects shown that the urinary uric acid excretion was stabilized during the last five days of each study period. The slope (Fig.1) of the graph was not statistically different from zero. The average daily urinary uric acid excretion at the four levels of protein tested were 297.7 ± 44.5, 282.9 ± 45.0, 304.6 ± 31.8 and 331.4 ± 26.5 mg for 1.5,21.4, 27.4 and 32.7g protein intake per day respectively (Table 2).

It is worth noting that the only source of protein in the diet is beef, which usually has a high level of nucleic acids thus the source of urinary uric acid could be from the breakdown products of the nucleic acids in the diet and not from the protein per se. The fact that plasma uric acid remained constant at different levels of 'protein' intake shows that there is a mechanism for controlling plasma uric acid levels while excreting the dietary excess in the urine.

The increase observed in urinary uric acid with increase in protein intake was statistically significant, though there are overlaps in the range values. Individual excretion value was used to compute the regression equation as shown in Fig. 2. Plotted in this was, the relationship between dietary protein and urinary uric acid is linear. In all the subjects, urinary uric acid increased linearly (r = + 0.34) by an average of 2.14 mg/g protein.

Plasma uric acid concentration did not show significant differences along the levels of protein intake. (Table 2).

DISCUSSION

The diet used in this study is the typical mixed diet, common among most Nigerians. The diet is made up of moderate amounts of meat, cereals, tubers and vegetables and thus can be classified as a "low" purine diet as it contain less than 2g of purine bases (1.3g at the highest protein level). The diet was basically composed to evaluate the protein requirement of adult young Nigerian women.

Table 2
Urinary and Plasma Uric Acid Levels of Healthy Young Women Fed Graded Portions of Protein

Protein Intake, g/day	Urinary Uric Acid mg. Uric acid/day	Plasma Uric Acid mg Uric acid/100ml
15.7	297.7±44.5	4.58±0.47
21.4	282.9±45.0	4.63±0.66
27.4	304.6±31.8	4.25±0.75
32.7	331.4±26.5[a]	4.26±0.72[b]

Mean±SD (n = 12) plasma
[a]Values are statistically different, plasma along the protein levels ($P < 0.05$,2 way ANOVA).
[b]There were no significant differences ($P > 0.05$,2 way ANOVA) among the protein levels.

Data obtained from this study, showed that urinary uric acid excretion of our subjects fed the mixed diet is within the range of values for men receiving low purine diets (8). Urinary uric acid excretion of our subjects, was observed to increase significantly with increase in the dietary protein, inspite of the broad range and overlapped values. The increase is quite linear with a change of 2.14mg uric acid/g protein ingested. The correlation is positive r = 0.34 and is significant. This is in agreement with the observation of Waslwin et al (3) who fed a predominantly purine free diet at graded levels of protein. The elevation of urinary uric acid was attributed to a possible increase in endogenous synthesis of uric acid which occurs with high levels of dietary protein (2). Further explanation to such increase observed in our study could also be as a result of possible increase in the purine content of the diet as protein was increased, since our major source of protein is meat. Waslein et al (4) also observed a linear increase in urinary uric acid with increase in the dietary nucleic acid of their subjects.

Plasma uric acid did not change as dietary protein increased, though within the acceptable normal range. This observation in plasma uric acid with increase in urinary uric as dietary protein increases can be ascribed to increased renal clearance of uric acid (9). However, Waslein et al (3) also when 2g of yeast RNA was added to the diet but with higher yeast RNA, of about 8g, about four of their subjects attained abnormally high levels of plasma uric acid. They did not feed graded levels of protein that showed slight increases in nucleic acid content.

Uric acid metabolism of our subjects on the habitual diet is within normal limits and range. The limits to which caution has

to be taken in protein increment with meat is quite safe too, since we observed a relatively low increase in urinary uric acid level per 1g of protein added. Thus the diet composed can be safely utilized for metabolic studies.

Figure 1

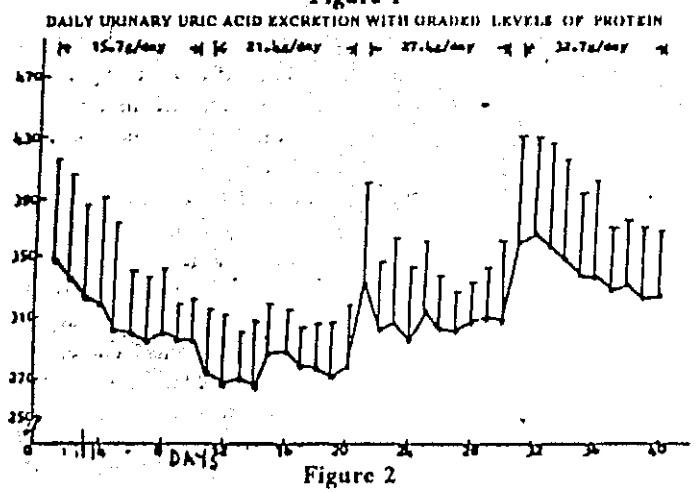
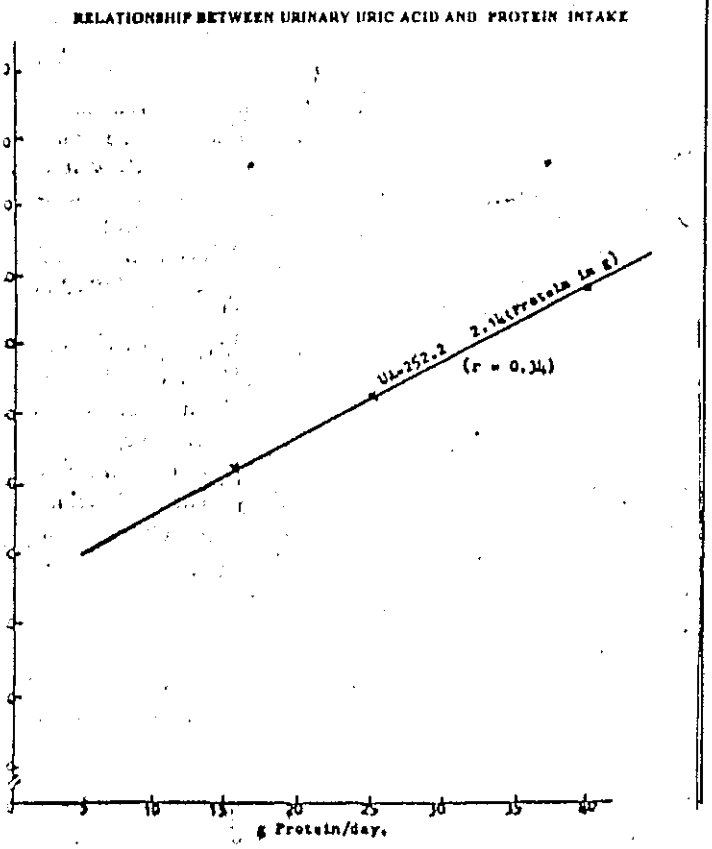


Figure 2



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