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URINARY EXCRETION OF ISOFLAVONOID PHYTOESTROGENS IN CHINESE AND ANGLO-CELTIC POPULATIONS IN AUSTRALIA

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ABSTRACT

The purpose of this cross-sectional study was to compare the urinary excretion of phytoestrogens in Australians of Chinese and Anglo-Celtic origins. Urine samples from individuals already participating in two cross-cultural studies on food habits and health status, were used in order to measure excretion of the two isoflavonoid phytoestrogens genistein and daidzein. The mean (± SEM) 24 h excretion of genistein and daidzein, was 614 ± 202 nmol and 688 ± 218 nmol in the Chinese population and 107 ± 31 nmol and 164 ± 63 nmol in the Anglo-Celtic population ($p<0.001$) respectively. Differences were also observed in food consumption where cereal and legume consumptions were significantly higher in the Chinese population ($p<0.0001$). The urinary excretion of phytoestrogen in the Melbourne Chinese and Anglo-Celtic is consistent with excretion rates of other populations.
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KEY WORDS: Phytoestrogen, genistein, daidzein, Chinese, Anglo-Celtic.

INTRODUCTION

Phytoestrogens are weak estrogenic compounds that display structural homology to human estrogens. They are found in a variety of plant foods such as fruits, legumes and grains with some 300 plants having been described to contain some kind of estrogen-like activity (1,2). Being similar in structure to endogenous human estrogens, phytoestrogens compete for the estrogen receptor and have been reported to display both estrogenic and anti-estrogenic activity(3). High concentrations of phytoestrogens are especially found in soy and linseed (4,5). Phytoestrogens are classified in three main categories: 1) isoflavones, 2) coumestans, and 3) lignans. Isoflavones and coumestans make up the largest group of phytoestrogens, the isoflavonoids and lignans, or mammalian lignans are products of plant lignans metabolised by gut microflora. Phytoestrogens have

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been implicated in a wide range of health conditions ranging from menopause to cardiovascular disease and cancer (6-11). Urinary excretion of phytoestrogens (genistein and daidzein)have been previously reported to vary in different cultures with Japanese having 10 to 100 fold higher levels of urinary excretion of phytoestrogens compared to European and American populations (12).

High urinary excretion of phytoestrogens may be reflective of a protective mechanism for certain diseases. The aim of the present study, was to measure the urinary excretion of phytoestrogens in populations of different ethnic backgrounds.

MATERIALS AND METHODS

Subjects

The study design was cross-sectional and considered two populations of different ethnic backgrounds, Chinese (n=95 - 53 males and 42 females) and Anglo-Celtic (n=80 - 32 males and 48 females). The subjects were part of two on going cross-cultural studies on food habits and health status at the Department of Medicine at Monash Medical Centre - The Melbourne Chinese Health Study and The Anglo-Celtic Study. The subjects were representative of both Chinese and Anglo-Celtic populations living in the inner suburbs of Melbourne. The population characteristics are listed in Table 1. As part of the study, the subjects were asked to complete a self-administered food frequency questionnaire in order to estimate various food and nutrient intakes.

Table 1

Population characteristics of Chinese and Anglo-Celtic[1].

	Chinese	Anglo-Celtic
Sample Size	95	80
Age (years)	45 (1.3)	54 (1.5)
Weight (kg)	59 (1.1)	70 (1.2)
Body Mass Index(kg/m^2)	22.8 (0.3)	25.4 (0.3)

[1]Mean ± standard error in parentheses. Chinese and Anglo-Celtic are significantly different $p<0.001$ for all the variables.

Analysis of Urinary Phytoestrogens

Extraction of phytoestrogens followed a previously described method (13). PE were isolated by reverse-phase high performance liquid chromatography (Shimadzu system LC 10A) following a method developed by Eldridge (14). Detection was by dual wavelength UV absorbance at 250 nm and 262 nm. The percentage recovery for the

urinary extraction procedure varied between 70-75%. The intra-assay coefficient of variation for the HPLC analysis of the samples was 1.3% with a sensitivity of 1.0 ng for both genistein and daidzein. All the urine samples were processed in one assay.

Statistical Analysis

Data analysis was performed using a commercially available statistics package (Statgraphics version 4.0, STSC, Rockville, MD, USA). Wilcoxons' tests were used to compare the urinary phytoestrogen excretion levels and food and nutrient intake of the two populations. The data are presented as mean ± SEM.

RESULTS

To determine whether the Chinese and Anglo-Celtic populations displayed different excretion levels of urinary phytoestrogens, the compounds of interest were measured using HPLC. The level of urinary phytoestrogens excreted was significantly higher for both genistein (614 ± 202 nmol vs 107 ± 31 nmol) and daidzein (688 ± 218 nmol vs 164 ± 63 nmol) in the Chinese compared to the Anglo-Celtic population ($p<0.001$) (Figure 1). Analysis of the diets demonstrated that they were significantly different from each other; the Chinese consumed larger amounts of cereal and legumes, where as the Anglo-Celtic consumed higher levels of meat and dairy products. This is reflected in the overall consumption of plant versus animal products being more than two times higher in the Chinese compared to the Anglo-Celtic (Table 2).

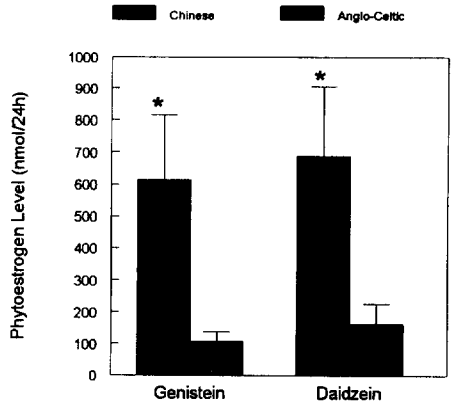

FIG. 1. Mean (+ Standard Error) 24h urinary excretion of phytoestrogens in Chinese and Anglo-Celtic populations. Chinese population (n=95) had significantly higher levels of phytoestrogens compared to the Anglo-Celtic population (n=80) (*$p<0.001$).

Table 2

Differences in food consumption (g/day) between Chinese and Anglo-Celtic[2].

	Chinese	Anglo-Celtic
Total food	1260 (27.1)	1292 (18.0)
Plant	996 (21.7)	775 (15.8)
Animal	263 (11.1)	517 (8.3)
Plant:animal ratio	5.3 (0.2)	2.0 (0.2)
Meat	109 (4.0)	177 (4.5)
Fish	38 (1.6)	21 (0.8)
Dairy	116 (9.6)	318 (7.0)
Vegetables	166 (5.9)	210 (6.1)
Fruit	260 (10.9)	307 (10.5)
Cereal	539 (15.7)	116 (5.2)
Legumes	30 (2.0)	14 (1.8)

[2]Mean ± standard error in parentheses. Chinese and Anglo-Celtic are significantly different $p<0.0001$, except for Total food.

DISCUSSION

This study examined the urinary phytoestrogen excretion difference between two populations with different eating habits. The Melbourne Chinese population excreted four to five times higher concentration of phytoestrogens than the Anglo-Celtic population.

These results are consistent with previous findings. The levels of excretion in the Anglo-Celtic population is comparable to recently published data in white women living in the San Francisco Bay Area. Levels of genistein and daidzein in this population were 130 nmol/24h and 190 nmol/24h respectively. Other populations assessed in this study included women of African American, Latina and Japanese backgrounds. Their levels of phytoestrogens, all varied between the levels detected in the two populations of this current study (15). Similar ranging daidzein levels have also been detected in omnivorous women in Boston and Helsinki (320 nmol/24h and 219 nmol/24h respectively), as well as basal levels of genistein and daidzein in men and women in Minnesota (330 nmol/24h and 100 nmol/day respectively(16,17).

Phytoestrogen excretion in urine, is reflective of phytoestrogen intake in the diet (13,17). The higher intake of cereal and legumes in the Chinese are two of the potential food sources that would account for their higher phytoestrogen

excretion compared to the Anglo-Celtic population. Although the level of phytoestrogen excretion in the Chinese population is two to five times higher than the above populations, it is still four to five times lower than levels measured in Japanese and macrobiotics populations, suggesting that the consumption of phytoestrogens by the Melbourne Chinese is still much lower than the latter two populations (12,16).

As mentioned earlier, phytoestrogens are involved in a number of disease states. Looking at the epidemiological data, Asian populations ie consuming higher levels of phytoestrogens, have a low incidence of menopausal symptoms, low rates of estrogen dependent cancer and also cardiovascular disease (18-20). Eating habits certainly play a role in these disease pattern differences and phytoestrogens may be a factor contributing to it.

The data from this study adds to the small number of population based studies that have assessed urinary excretion of phytoestrogens. Differences in excretion rates between populations can be identified and are associated with differences in diet that are consistent with altered phytoestrogen intake. With the rapid increase in interest in the field of phytoestrogens, and an increasing number of intervention studies with phytoestrogens, multi-centre comparative studies are a very interesting option given some of the similarities in excretion rates between populations.

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