Effect of a "Fast Food" Diet on the Urinary Excretion of Maillard Reaction Products

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Abstract: The impact of a diet consisting mainly of "fast food" on the urinary excretion of glycation compounds compared to a usual diet was studied. 9 volunteers followed a well defined diet, starting with one day of individual diet of choice followed by four days of "fast food" embedded in two day periods of MRP-free diet. 24 h-urine samples were collected and analysed for contents of free Amadori product and pyrraline. Urinary excretion of the glycation compounds decreased by 70% to a basic level as a consequence of the MRP-free diet. The following "fast food diet" lead to an increase in excretion of both lysine derivatives, giving evidence for no significant differences between the urinary MRP contents after the individual diets and the "fast food diet". In summary, our data confirm, that urinary excretion of glycation compounds is affected by the daily diet. Consumption of a "fast food diet" did not lead to an increased urinary excretion of MRPs compared to the diets usually followed by the participants.

Keywords: glycation; pyrraline; Amadori product; nutrition; AGEs

INTRODUCTION

It is generally accepted that increased levels of Maillard reaction products (MRPs) such as *N*-ε-carboxymethyllysine (CML), pyrraline and pentosidine in urine and plasma are indicators for certain diseases like diabetes mellitus, uremia and vascular defects (Vlassara & Palace 2002; Henle 2003). Due to a lack of reliable data about MRP contents in foods and only limited information concerning the metabolic transit of these derivatives, the role of food derived MRPs as contributors to the pool of circulating glycation products is still under debate. Nevertheless, dietary recommendations with respect to avoid thermally processed foods high in fat and protein are given to decrease the body load of the so-called "glycotoxins" (Koschinsky *et al*. 1997; Goldberg *et al*. 2004; Uribarri *et al*. 2005).

In preceding studies, we demonstrated that the urinary excretion of individual MRPs is affected by the intake of individual food items containing MRPs with varying bioavailability (Förster *et al*. 2005). The aim of the actual study was to investigate whether a diet consisting mainly of "fast food" has a significant impact on the urinary excretion of MRPs.

MATERIALS AND METHODS

A dietary study with 9 healthy women aged between 20 and 30 years was performed. Participants had to collect 24 h urine samples for 9 days (days 0 to 8). There were no dietary restrictions on day 0 followed by two days of a diet virtually free of MRPs (mainly raw fruits and vegetables, no heated foods like dairy or bakery products, coffee or beer). Starting with day three, a well defined diet including a menue consisting of a burger, french fries and a soft drink from a fast food restaurant (Table 1) was supplied each day for lunch until day six. Protein and energy intake was balanced 63 to 69 g per day and 2200 to 2300 kcal, respectively. Samples of 24 h-urine were collected and stored at –18°C until analysis. Analysis of low-molecular MRPs in the urine samples was carried out after ultra filtration (cutoff 5 kDa). Pyrraline was

determined via reversed-phase HPLC with UV-detection at λ = 297 nm (Förster & Henle 2003). The determination of free lysine Amadori product as furosine was carried out after acid hydrolysis using reversed-phase HPLC with UV-detection at λ = 280 nm (Förster *et al*. 2005) and calculating fructoselysine from the furosine values according to Krause *et al*. (2003).

RESULTS AND DISCUSSION

Nine healthy volunteers (all female, 20 to 30 years of age) were asked to collect 24 h urine samples and to follow a well defined diet for 9 days. Starting without dietary restrictions the first day was defined as day 0 and represented the individual dietary habits of the participants. On day 1 and 2, a diet virtually free of Maillard reaction products was supplied, followed by 4 days of a "fast food diet", based on a standardised lunch from a fast food restaurant. On days 7 and 8, participants returned to the MRP-free diet. 24 h-urine samples were collected on days 0 to 8 and contents of free Amadori product (AP), measured as furosine and calculated as fructoselysine, and pyrraline were determined. For the urinary excretion of MRPs on day 0 amounts of 6.5 ± 2.4 mg/day for Amadori products 5.4 ± 2.2 mg/day for pyrraline were measured (Figure 1), which is in good agreement with our previously published data (Förster *et al*. 2005). In consequence of the MRP free diet, the excreted amounts for both MRPs decreased within 48 h by 80% for the Amadori product and 60% for pyrraline to a basic level of 1.7 ± 1.2 mg/day for Amadori products and 2.3 ± 1.8 mg/day for pyrraline on day 2. Similar results were observed on day 8 after the second MRPfree period. This result confirms data obtained in earlier studies and underline that the diet directly influences the excretion of MRPs (Förster *et al*. 2004).

From day three on, participants followed the "fast food diet", which was characterised by consumption of a standardised lunch consisting of a burger, french fries and 0.5 l of a soft drink from a fast food restaurant. Breakfast and supper were based on bread and other bakery products with ham, cheese, jam or hazelnut spread. Potato crisps were given as snack. No additional fruits or vegetables were allowed. As beverages, water, fruit tee and defined volumes of soft drinks, sparkling and red wine were permitted. Energy and protein intake ranged between 2200 and 2300 kcal and 63 to 69 g of protein, respectively (Table 1).

As shown in Figure 1, the change to the "fast food diet", which is relatively high in fat and protein, lead to an increase in the urinary excretion of APs and pyrraline, on day 5 reaching 5.6 ± 2.5 mg/day for AP and 7.7 ± 1.9 mg/day for pyrraline, which is for both MRPs comparable with day 0. In other words, urinary excretion of neither early nor advanced Maillard products differs significantly

Table 1. Menu of the "fast food diet"

	Day 3	Day 4	Day 5	Day 6
Breakfast	1 Roll with hazelnut spread	1 Pretzel	Croissant with strawberry jam	2 slices of toast with cream cheese
Lunch	Mc Chicken, french fries, ketchup, 0.5 l Sprite	Big Mac, french fries, ketchup, 0.5 l Coke	Chicken Gourmet, french fries, ketchup, 0.5 l sparkling apple juice	Hamburger Royal TS, french fries, ketchup, 0.5 l Fanta
Supper	2 slice of bread, 1 with ham, 1 with Edamer	2 Toast Hawaii (slices of toast with pineapple and ham, gratinated with processed cheese)	See day 3	See day 4
Snacks	40 g of potato crisps	40 g of potato crisps	40 g of potato crisps	40 g of potato crisps
Additional beverages	0.2 l red wine	0.33 l Fanta	0.2 l sparkling wine	0.33 l Coke
Calories	2300 kcal	2200 kcal	2250 kcal	2250 kcal
Protein	63 g	69 g	65 g	69 g
Fat	95 g	86 g	89 g	98 g
Carbohydrates	271 g	288 g	262 g	266 g

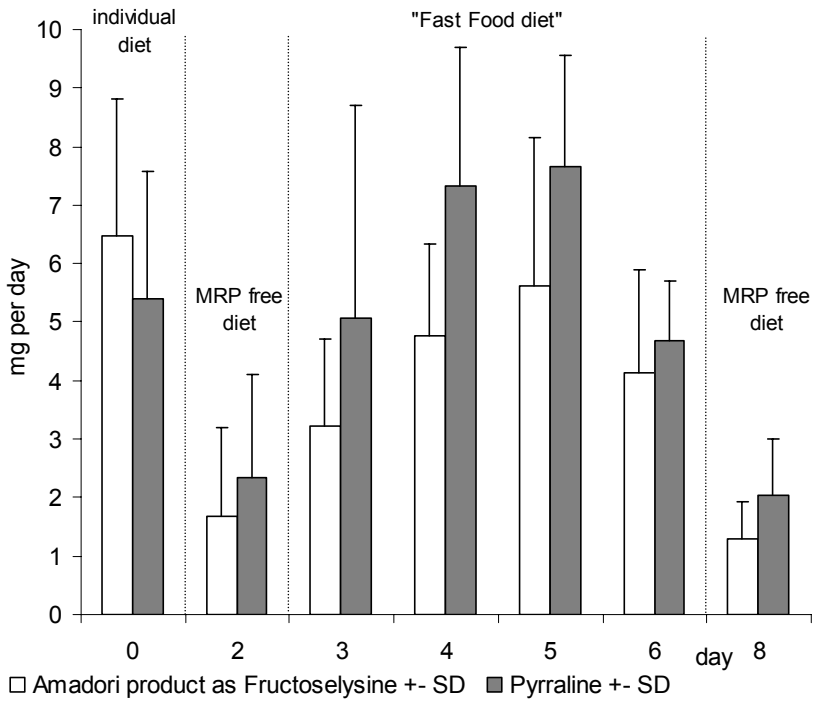

Figure 1. Urinary excretion of free Amadori product and pyrraline, data given in mg/day ± standard deviation (SD)

after 4 days of "fast food diet" (days 3 to 6) when compared to a individual and non restricted diet (day 0). It can be concluded, that a fast food diet should not have a greater impact on the body load of possibly toxic MRPs than a common diet. Nevertheless, this should not be understood as argument for excessive fast food consumption. However, it can be stated that other risk factors due to a fast food diet, like high fat content, low amount of unsaturated fatty acids, low dietary fibre etc. seem to be significantly more remarkable with respect to possible dietary risks than the content of glycation compounds.

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