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L-Glutamic Acid Content of Fresh and Processed Foods

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ABSTRACT

The glutamic acid content (non-protein) of 23 fresh and 39 processed foods was determined using an enzymic method of analysis. The concentrations of glutamic acid in fresh foods ranged from 6·7 mg/100 g in zucchini (marrow) to 658 mg/100 g in walnuts. The glutamic acid content increased from 50·3 to 292 mg/100 g during the ripening of fresh tomatoes. The concentrations in processed foods ranged from 0·05 mg/100 g in cottage cheese to 6·8 g/100 g in beef stock cubes.

INTRODUCTION

L-glutamic acid is a non-essential amino acid present in foods as the free and protein-bound forms. In the free form, glutamic acid enhances the flavour of food and may be added as monosodium glutamate (MSG) during processing (Furia, 1981). However, there have been several reports of the adverse effects of dietary MSG on susceptible individuals (Schaumberg *et al.*, 1969; Olney, 1979; Allen & Baker, 1981). The major disorders of concern are Chinese restaurant syndrome and MSG induced asthma. It is the aim of the present study to determine the glutamic acid content in a number of fresh and processed foods.

MATERIALS AND METHODS

Samples of fresh and processed foods were purchased from local food markets and prepared for analysis. Dry samples were ground to pass a

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0·5 mm sieve. Duplicate analyses were carried out. Food samples (1·0 g) were homogenized for 10 min with 40 ml of distilled water at 70°C for 10 min. The filtered extracts were made up to 100 ml with water. L-glutamic acid was measured in the extracts by the Boehringer Mannheim enzymic method described by Beutler & Michal (1974). The principle of this method was that L-glutamic acid was oxidatively deaminated to α-keto-glutarate by nicotinamide-adenine dinucleotide and in the presence of diaphorase, the resulting NADH reduced iodonitrotetrazolium chloride to a formazan, whose absorbance was measured at 492 nm.

The determination of enzymic inhibitors in the foods was also carried out by blanks where standards with and without sample were analysed for L-glutamic acid. The interference of reducing substances such as ascorbic acid in meat samples was eliminated by prelimary treatment of the samples with hydrogen peroxide and dilute sulphuric acid. The extracts from the initial homogenization were mixed with 0·5 ml of KOH (2 mol/litre) and 0·1 ml 30% (w/v) hydrogen peroxide. The solution was incubated for 10 min at 70°C as above but neutralized after incubation with sulphuric acid (1 mol/litre).

RESULTS AND DISCUSSION

There was a large variation in the concentrations of L-glutamic acid in both fresh and processed foods, with a range of 6·7 to 658 mg/100 g in fresh foods and 0·05 to 6827 mg/100 g in processed foods with the highest concentration occurring in beef stock cubes (Table 1). The mean concentration of L-glutamic acid in fresh foods was 114 mg/100 g compared to processed foods of 433 mg/100 g but the standard deviation for processed foods was 1162 compared to 141 for fresh foods (Table 1). The variation in L-glutamic acid content can also be seen within the same food in that the concentration increases from 50·3 to 292 mg/100 g during ripening of tomatoes. These results were for the same variety but it appears that there are differences in varieties in that the concentrations in canned tomatoes and tomato juice were found to be 202 and 109 mg/100 g, respectively (Table 1). Giacometti (1979) reported that the L-glutamic acid content of fresh tomatoes was 140 mg/100 g.

MSG may be added to food as a flavour enhancer and it appears that chicken soup, beef soup, canned mushrooms, beef stock cube, Chinese meal, Suimin (beef) and tomato sauce all contain added MSG. The high levels of L-glutamic acid found in Cheddar and Parmesan cheeses, soysauce and Vegemite are derived from the bacterial or yeast fermentations used in their product (Furia, 1981).

TABLE 1
L-Glutamic Acid and MSG Equivalent (in Parentheses) Content of Foods

Fresh food	L-*glutamate* (*mg/100 g*)	*Processed food*	L-*glutamate* (*mg/100 g*)
Almond	39·8 (45·8)	Asparagus (canned)	23·0 (26·5)
Apple	11·7 (13·5)	Baked beans (canned)	78·2 (89·9)
Avocado	84·7 (97·4)	Beer (draught)	16·9 (19·4)
Broccoli	115 (133)	Bread (white)	22·4 (25·8)
Capsicum (green)	30·7 (35·3)	Cheese (Camembert)	40·4 (46·5)
Carrot	47·1 (54·2)	Cheese (cottage)	0·05 (0·06)
Corn	123 (142)	Cheese (Cheddar)	154 (177)
Egg	27·9 (32·1)	Cheese (Parmesan)	516 (594)
Garlic	112 (128)	Chicken (barbecued)	143 (165)
Mushroom	192 (221)	Corn (canned)	49·6 (57·0)
Onion	102 (118)	Cows milk (pasteurized)	15·1 (17·4)
Pea	69·4 (79·8)	Flour (wheat)	23·5 (27·0)
Peanut	105 (121)	Hamburger (meat)	60·7 (69·8)
Potato	180 (208)	Mushrooms (canned)	34·0 (39·1)
Soybean	63·2 (72·7)	Mushrooms (canned)	
Spinach	20·0 (23·0)	(MSG added)	146 (168)
Strawberry	22·4 (23·8)	Olives (bottled)	21·4 (24·6)
Sultana	22·4 (25·8)	Orange juice	27·3 (31·4)
Tomato (green)	50·3 (57·9)	Peanut butter	79·4 (91·3)
Tomato (yellow)	253 (291)	Pizza	94·4 (109)
Tomato (red)	292 (336)	Potato crisps	198 (227)
Walnut	658 (757)	Rice (white)	6·2 (7·1)
Zucchini	6·7 (7·7)	Chinese meal (packaged)	1 243 (1 429)
		Salmon (canned)	36·3 (41·8)
		Sardines (canned)	22·3 (25·7)
		Soup, chicken (canned)	205 (236)
		Soup, beef (packaged)	2 482 (2 854)
		Soy sauce	1 090 (1 253)
		Steak sauce	111 (127)
		Stock cube (beef)	6 827 (7 851)
		Suimin (beef)	362 (416)
		Sauce (tartare)	30·5 (35·1)
		Sauce (tomato)	440 (506)
		Tomato (canned)	202 (232)
		Tomato juice (canned)	109 (125)
		Tomato paste (canned)	556 (640)
		Vegemite	1 431 (1 646)
		Wine (Claret)	12·2 (14·0)
		Wine (Moselle)	21·5 (24·7)
		Wine (Reisling)	7·8 (9·0)

The concentrations of L-glutamic acid found in some of the foods in the present study were greater than the concentrations in food of 250 mg/100 g that have been reported to cause Chinese restaurant syndrome and MSG induced asthma (Olney, 1979; Allen & Baker, 1981). The 'Acceptable Daily Intake' of MSG of 10·5 g (FAO/WHO, 1979) appears to be very high when a challenge dose of MSG of only 2 g can induce asthma in patients (Allen & Baker, 1981). Schaumberg *et al.* (1969) found that there were large variations in the oral threshold doses among individuals. Taking these studies into account and the fact that many countries do not regulate the amount of L-glutamic acid added to foods during cooking or processing (Scientific Status Summary, 1980), it would be difficult for susceptible individuals to avoid certain foods or prepared meals.

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