

SURVEY REPORT



Government of South Australia

Department of Health

Acrylamide

A survey of acrylamide in non-carbohydrate based foods

FOOD POLICY AND PROGRAMS BRANCH, PUBLIC HEALTH

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Acrylamide

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Background

Acrylamide is a chemical used to make polyacrylamide materials. Polyacrylamide is widely used in the treatment of drinking water as a flocculant to assist in the removal of particles and other impurities. Polyacrylamide is also used in the manufacture of glues, paper and cosmetics. Polyacrylamide materials contain very small amounts of acrylamide. Acrylamide is known to cause cancer in animals and previous concerns have been focused on use of acrylamide in occupational environments and also associated with cigarette smoking.

In April 2002 researchers in Sweden discovered unexpectedly large amounts of the chemical acrylamide in foods rich in starch that had undergone high temperature cooking or processing. A Food Standards Australia New Zealand (FSANZ) Acrylamide Task Force began examining available data shortly after receiving advice of the Swedish discovery. An update published by FSANZ in January 2003¹ included advice on the formation of acrylamide by the Maillard reaction;

“In October 2002, articles in the journal *Nature* confirmed earlier observations that acrylamide may be formed in foods during baking and frying, but has not been found in raw food, or food cooked at the lower temperatures reached during boiling.

The authors showed that acrylamide is formed during the Maillard reaction. Products of the Maillard reaction are responsible for much of the flavour and colour associated with fried, roasted and baked foods. This reaction requires sugars, proteins (or free amino acid) and high temperatures to proceed. Model systems used by the authors showed that heating the amino acid asparagine with glucose at 185°C results in most of the asparagine reacting to form acrylamide.”

Since the initial discovery of acrylamide in food by the Swedish Food Authority in 2002, research on the formation of acrylamide in food and surveys to determine the levels present in a wide range of foods and their potential implications for health has continued internationally.

International research²

In February 2005, the Joint (*Food and Agriculture Organisation (FAO) & World Health Organisation (WHO)*) Expert Committee on Food Additives (JECFA) examined data from 24 countries of levels of acrylamide in a total of 6,752 food samples.

The range for the international mean intakes was estimated to be 3.0 µg/kg bw per day up to 4.3 µg/kg bw per day, assuming a body weight of 60kg. Potato fries and potato crisps were identified as a significant contributor to exposure with a mean concentration of 477 µg/kg.

Australian survey of acrylamide in carbohydrate based foods³

In 2003, following research by FSANZ a survey of a wide range of carbohydrate based foods was undertaken by the Research and Development Section of the Australian Government Analytical Laboratory (AGAL - now known as the National Measurement Institute) to assess levels of acrylamide in foods widely available in Australia. 112 composite samples were analysed from a total of 547 products. The survey enabled preparation of preliminary dietary exposure estimates of Australians to acrylamide in the food groups examined.

Mean dietary exposure to acrylamide was estimated at between 1.4 µg/kg bw per day and 1.5 µg/kg bw per day for 95th percentile consumers, based on a body weight of 67kg. When adjusted to the lower body weight of 60kg applied to international mean intakes the estimated Australian exposure to acrylamide from food is marginally lower than international estimates. The mean concentration of acrylamide found in hot potato chips in the Australian survey was 501 µg/kg which is consistent with levels found internationally.

Survey of acrylamide in non-carbohydrate based foods

In June 2005 the SA Department of Health undertook a limited survey to examine concentrations of acrylamide in non-carbohydrate based foods to add to the knowledge of dietary exposure established by the AGAL survey. FSANZ provided a recommended list of foods for inclusion in the survey. A total of 75 samples were submitted for analysis. Samples as recommended by FSANZ included coffee, cereal beverage, chocolate, prune juice, nuts, commercial soups, olives, canned beans, meat pies, fried rice, frozen pizza, hash browns, fish, chicken and beef.

Analysis method

Samples were prepared as per manufacturers instructions prior to despatch to the laboratory or supplied as purchased ready-to-eat. LC/MS/MS analysis, quantification and confirmation methods were as employed for the previous Australian carbohydrate-based foods survey.

Results

The highest level of acrylamide found was 440µg/kg in a hash brown (fried potato), which is consistent with a mean level of 501µg/kg found in hot potato chips examined as part of the carbohydrate based foods survey. Full results are below in Table 1.

TABLE 1: Acrylamide concentration in 75 food samples

Beverage Products	Acrylamide concentration (µg/L)
Coffee - Instant - Decaffeinated	<3
Coffee - Instant - Decaffeinated	<3
Coffee - Instant	<3
Coffee - Instant	Trace
Coffee - Instant	<3
Coffee - Instant	<3
Coffee - Instant	Trace
Coffee - Brewed - Decaffeinated	<10
Coffee - Brewed - Decaffeinated	15
Coffee - Brewed - Decaffeinated	13
Coffee - Brewed - Dark Roast	<10
Coffee - Brewed - Dark Roast	<10
Coffee - Brewed - Dark Roast	<10
Coffee - Brewed - Dark Roast	14
Coffee - Brewed - Light Roast	23
Coffee - Brewed - Light Roast	18
Coffee - Brewed - Light Roast	<10

Coffee - Brewed - Light Roast	9
Coffee Bags	<10
Coffee Bags	7
Instant Cereal Beverage	Trace
Chocolate Milk	<25
Chocolate Milk	<25
Cocoa Powder – Method 1 – prepared with water	Trace
Cocoa Powder – Method 2 – Analysis of dry powder	<100 µg/kg
Cocoa Powder	<100
Prune Juice – 100% Natural	93
Solid Food Products	Acrylamide concentration (µg/kg)
Chocolate confectionery bar	<25 µg/kg
Chocolate confectionery bar	<25 µg/kg
Chocolate – plain block	<25
Chocolate – plain block	<30
Nuts – Cashew	Trace
Nuts – Mixed, salted	Trace
Nuts – Peanuts, dry roasted	<25
Peanut Butter – smooth	Trace
Peanut Butter – smooth	Trace
Soup – Canned – Pea & Ham	<25
Soup – Canned – Vegetable & Barley	50
Soup Mix – Roast Chicken	<25
Soup Mix – Cream of Chicken & Mushroom	<25
Baked Beans - Canned in Tomato Sauce	<25
Baked Beans - Canned in Tomato Sauce	<25
Four Bean Mix - Canned	<25
Four Bean Mix - Canned	<25
Olives - Spanish Black	345
Olives - Spanish Green	<25
Meat Pie	<25
Meat Pie	<25
Meat Pie	<25
Meat Pie	Trace
Fried Rice	<25
Fried Rice	<25
Fried Rice	<25
Pizza Frozen - Oven Baked	<25
Pizza Frozen - Microwave 5 min	<25

Pizza Frozen - Oven Baked	<25
Pizza Frozen - Oven Baked	<25
Fish – Battered & Fried	<25
Fish – Battered & Fried	<25
Fish – Crumbed & Fried	<25
Fish – Crumbed & Fried	<25
Fish – Dory, Crumbed – Oven Baked	52
Chicken Nuggets - Fried	50
Chicken Nuggets - Fried	Trace
Chicken Nuggets - Fried	<25
Chicken Nuggets - Oven Baked	<25
Chicken Schnitzel - Fried	<25
Chicken Schnitzel - Fried	Trace
Chicken Schnitzel - Oven Baked	<25
Chicken Fillets - Crumbed Oven Baked	<25
Hash Brown – Fried	440
Hash Brown – Oven Baked	320
Hash Brown – Oven Baked	200
Beef Schnitzel - Fried	<25
Beef Schnitzel - Oven Baked	<25
Beef Schnitzel - Oven Baked	<25
Beef Schnitzel - Oven Baked	Trace

Conclusion

The concentrations of acrylamide found in this survey and the previous 2003 Australian survey are consistent with levels found in similar foods internationally. Dietary exposure to acrylamide in Australia is also comparable to international exposures documented by JECFA.

JECFA is continuing its review of research of acrylamide formation in food, dietary exposure and toxicity. A working group led by the UK and the USA has prepared a discussion paper and work has commenced on a draft “Code of Practice for the reduction of acrylamide in food”. The Code of Practice is expected to be finalised by 2009.⁴ An internet site has been established by the WHO / FAO as an international network on acrylamide in food, inviting all interested parties to share relevant data as well as ongoing investigations.

<http://www.acrylamide-food.org/index.htm>

While international efforts are continuing with research on acrylamide, the intake of acrylamide can be minimised by avoiding food that is cooked excessively, moderate consumption of fried and fatty foods, and eating a balanced and varied diet.

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