

For Safe and Healthy Eating

“What we can do at home to reduce acrylamide in foods”



Introduction

Foods contain nutrients, such as protein, fat and carbohydrate. We take sufficient amounts of essential nutrients from various kinds of foods for healthy life.

Various compounds in foods and food ingredients may react with other compounds during the heating process to form new compounds. A number of new compounds work favorably for nice and appetizing quality of foods, such as the color of baked bread crust and aroma of roasted coffee beans. Heating foods will sterilize microorganisms on or in foods and generally improve absorption of nutrients.

However, heating may produce certain compounds which would affect the human health when taken more than certain amounts. Acrylamide is one of such compounds.

Acrylamide is known to form during heating at temperatures at or above 120°C, including baking and frying. A wide range of commercially available foods and home-cooked foods made with baking or frying process contain acrylamide. Foods made with steaming or boiling process rarely contain detectable acrylamide. Taking acrylamide from foods continuously for a long time may possibly affect human health inadvertently.

The Ministry of Agriculture, Forestry and Fisheries (MAFF) and food manufacturers are striving to reduce acrylamide in processed foods for supplying consumers with safer foods.

MAFF has developed this booklet to explain what is “acrylamide” in foods and how to reduce an intake of acrylamide from foods.

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1. What are in our foods?

➤ Nutrients

Three major nutrients and micronutrients (vitamins and minerals)

< Three major nutrients >

Nutrient	Function	Digested in the body to:	Rich in:
Proteins	Build the body	Amino acids and short peptides. “Essential amino acids” need to be taken from foods because they are not synthesized in the body (e.g., Tryptophan)	Meat, fish, egg, soybean products 
Fats	Provide energy	Glycerol and fatty acids. “Essential fatty acids” must be obtained from foods because they are not synthesized in the body (e.g., Linoleic acid)	Butter, margarine, vegetable oils 
Carbohydrates	Provide energy	Saccharides and short polysaccharides. (e.g., Glucose) Those not digested in the body are called dietary fiber	Rice, breads, noodles, potatoes. sugar 

➤ Other major components

- Water

➤ Another components

- Naturally present in food/ingredients (Alkaloids, mycotoxins and toxins in puffer fish, etc.)
- Naturally present in the environment which contaminate foods (Cadmium, lead, etc.)
- Formed during manufacturing/processing (Acrylamide, trans fatty acids, etc.)
- Intentionally used during production and manufacturing (Food additives, agricultural chemicals, veterinary drugs, etc.)

❑ **Not all natural components in foods are good for health (e.g., natural toxins, such as toxin in puffer fish)**

❑ **Components essential for health and life may show adverse health effects if taken too much (Salt, vitamin A, etc.)**

Nutritionally well-balanced diets are essential for health. Eat a variety of foods at appropriate amount and do not continue to eat only one type of food even if that food is known to have food health effect.

2. What happens to foods when we cook them?

Humans have eaten a variety of cooked foods after becoming capable of using fire.

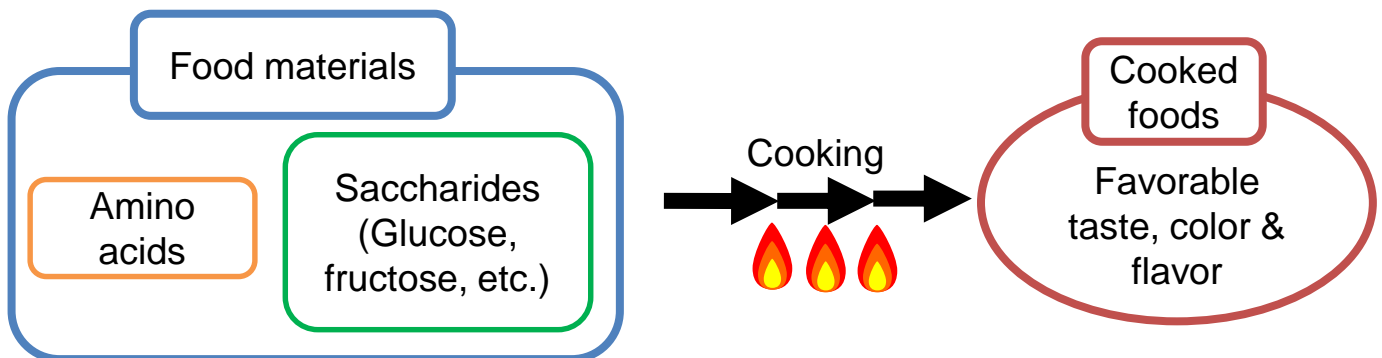
The known advantages of cooking foods are as follows:

- Making foods softer and easier to eat and facilitating the digestion and absorption of nutrients in the body; and
- Killing harmful microorganism on or in foods.

New compounds may be formed from naturally occurring compounds in foods during cooking.

What happens to foods when we cook them?

- Favorable taste, color and flavor are formed during cooking. (e.g., favorable color and flavor of baked bread crusts and cookies, and flavor of roasted or grilled meat)



- Some new compounds formed in foods during cooking may affect our health inadvertently when ingested from such foods in certain amounts. Acrylamide is one of these compounds.

If we stop eating cooked foods or reduce eating cooked foods, what will be the result?

- It may not be possible to take all the essential nutrients in the required amounts to keep ourselves healthy.
- The probability of food poisoning may increase and digestibility of foods may become lower. Foods labelled to be intended for cooking (such as meat and meat products, fish and fishery products) shall be heated at the appropriate temperature for sufficient time.

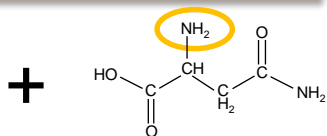
3. What is acrylamide occurring during cooking?

How acrylamide occurs during cooking?

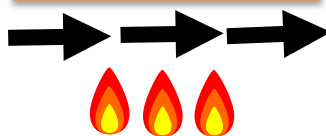
Acrylamide is formed from naturally occurring compounds in foods during a cooking process at temperatures above 120°C)

A type of amino acid
(but different from aspartic acid)

Asparagine

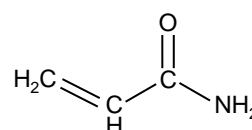


Cooking at
≥ 120°C



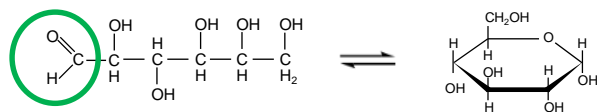
Occurs after the
moisture content
gets low

Acrylamide



Reducing sugar

A type of sugar (e.g., Glucose)



Acrylamide is

- Formed during frying (deep-, stir-), baking, etc.
- Contained in processed foods or foods home-cooked using the above methods
- Rarely formed during cooking using sufficient amount of water (e.g., simmering, steaming, boiling, etc.)

What health effect acrylamide in foods show?

- Acrylamide given to mice in drinking water showed:
 - Adverse effect on the nervous system; and
 - Higher probability of carcinogenicity



- International food safety risk assessment body noted:

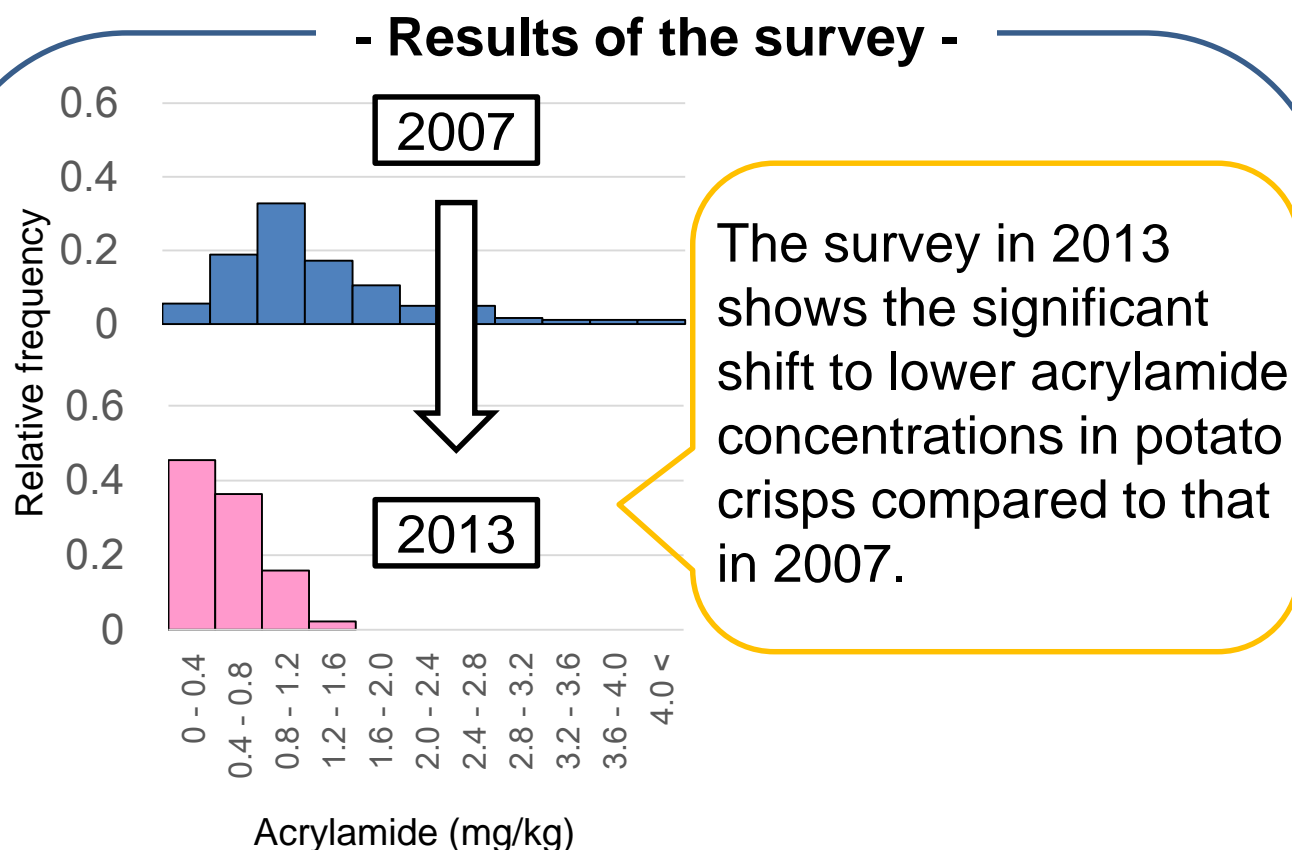
“While adverse neurological effects are unlikely at the estimated average exposure, morphological changes in nerves cannot be excluded for individuals with a high dietary exposure to acrylamide.”

4. What has MAFF been doing for reducing acrylamide in foods?



The MAFF, in collaboration with the food manufactures:

- developed a “Code of practice for reduction of acrylamide in foods” and promoted the implementation of mitigation measures.
- collected information on effective mitigation measures and commissioned research on feasible mitigation measures.



The survey in 2013 shows the significant shift to lower acrylamide concentrations in potato crisps compared to that in 2007.

* "relative frequency" is the ratio of the number of samples with concentrations in a specific range and the total number of samples.

**"1 mg/kg" means 1 milligram of acrylamide in 1 kilogram of foods (1 milligram = 1/1000 gram) .

5. What should the consumer do at home?

i. What should the consumer do in daily life to reduce an intake of acrylamide from foods?

A well-balanced diet is the key!

- To take the required amount of essential nutrients to keep healthy
- To prevent cancer or other diseases caused by the life-style by taking sufficient amounts of fruits and vegetables and less salty foods
- To keep low intakes of compounds which may pose health risk to consumer

Do not stop or reduce eating cooked foods!

- It will become difficult to take the required amounts of essential nutrients to keep healthy
- Possibility of food poisoning or indigestion may increase
- You must cook appropriately foods labelled to be intended for cooking (such as meats and meat products, and fish and fishery products)



ii. What should the consumer do to reduce formation of acrylamide during home cooking?

Consumers who tend to eat stir-fried or deep-fried foods often should try to balance their diet by also eating non-fried foods. They should change cooking methods at home to decrease the intake of acrylamide.

Consumers who rarely stir-fry or deep-fry foods at home but rather frequently simmer or steam foods do not need to change their cooking methods.

Tips for lowering acrylamide formation during cooking

The basic concept for lowering acrylamide formation is as follows:

a. Tips for preparation for cooking

Before stir- or deep-frying, treat raw materials in such a way that will not increase acrylamide during cooking

b. Tips for cooking

Stir- or deep-fry in such a way that acrylamide formation will be as low as possible



Tips for preparation for cooking

“Treat raw materials in such a way that will not increase acrylamide during cooking”

Potatoes should be stored at room temperature before stir- or deep-frying

Storing potatoes at low temperatures will increase reducing sugar in them and consequently acrylamide in stir- or deep-fried potatoes. Potatoes in a refrigerator should be moved to room temperature one week before frying to lower reducing sugar in raw potatoes.

< Experimental Results >

- Acrylamide levels in stir-fried potatoes from potatoes stored at room temperature were less than half of those from using potatoes stored in a refrigerator.
- Potatoes stored in refrigerator were more easily scorched when fried.

Stir-fried potatoes* from potatoes stored for a month:

At 4°C



At room temperature



* The cut potatoes (*Solanum Tuberosum*, var Danshaku) were fried at 200°C for 10 minutes.

Potatoes and vegetables should be soaked in water immediately after cutting

Acrylamide forming substances (e.g., asparagine and reducing sugars) should be washed away from the surface of the potatoes and vegetables after they are cut by soaking them in water. Soaking them in water will reduce formation of acrylamide during frying.

< Experimental Results >

- Acrylamide levels in fried lotus roots soaked in water were half of the levels in those not soaked in water.

Stir-fried lotus roots from those:

Not soaked in water



Soaked in water for 10 min.



The sliced lotus roots were not soaked or soaked in water for 10 minutes, and then fried for 6 minutes at 200°C.

The lotus roots are generally soaked in water to remove bitter tastes.

Tips for cooking

“Stir- or deep-fry in such a way that acrylamide formation will be as low as possible”

Avoid scorching as much as possible during frying

The higher the temperature of stir-or deep-frying and the longer the cooking time, the higher the concentration of acrylamide. Avoid scorching of potatoes and vegetables as much as possible when frying. Stop toasting slices of bread when the color of bread is still golden yellow.

< Experimental Results >

- The longer the cooking time (more scorching), the higher the concentration of acrylamide.

Stir-fried asparagus for:

2 min



5 min

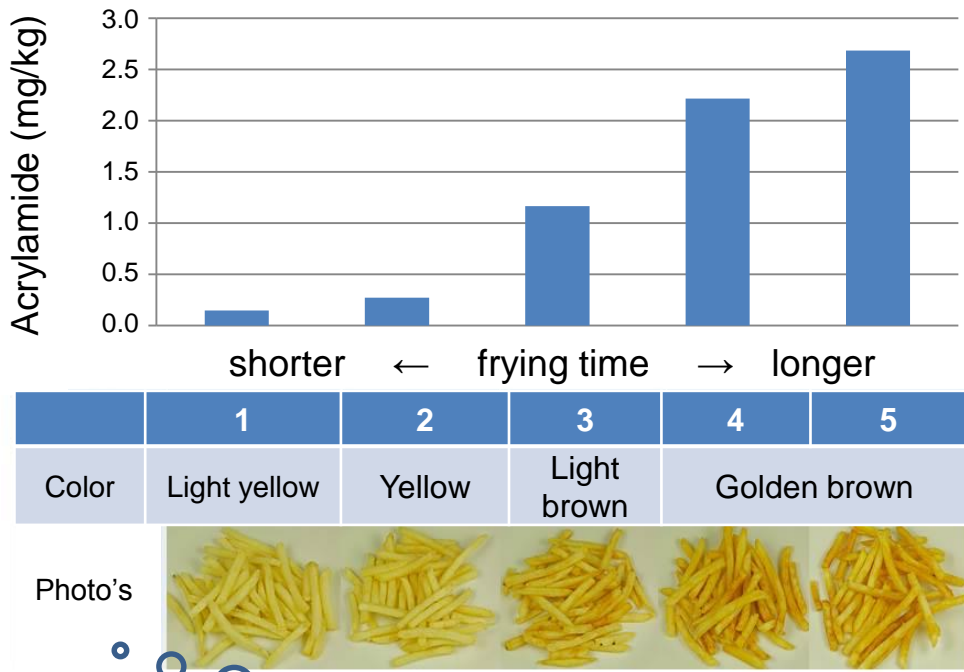


8 min



Asparagus stalks were stir-fried at 200°C.

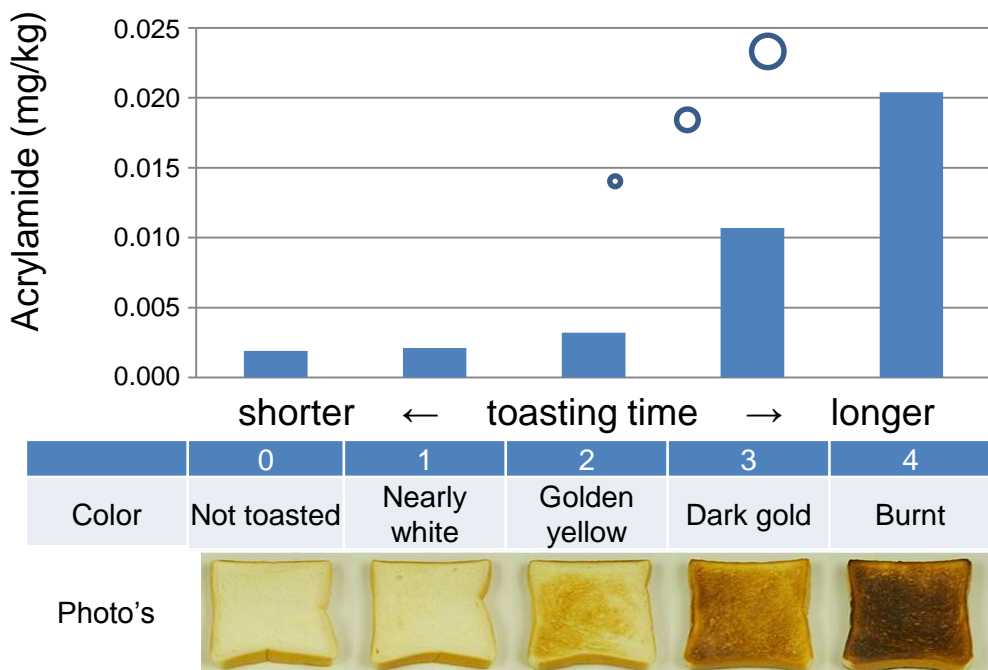
Fried potatoes



The Color of fried potatoes correlates with the acrylamide concentrations

Golden yellow is recommended.

Toasted bread



Stir-fry using low heat

Stir-frying at lower heat produced less acrylamide than at higher heat because generally the temperature is lower at low heat.

Stir frequently during stir-frying

Stirring frequently during stir frying reduced acrylamide formation because of uniform heating.

< Experimental Results >

For bean sprouts, burdock roots and lotus roots:

- The lower the heat, the lower the acrylamide concentrations.
- The more stirring frequently, the less the acrylamide concentrations.
- The color of stir-fried vegetables were not so different.

Effects of heating:

Low
(1 kW)



High
(5 kW)



* Stir-fried until the weight of foods became 85% of the original.

Effects of stirring:

Quick
(60 rpm)



Slow
(15 rpm)



* Stir fried at 190 °C until the weight of foods became 80% of the original.

Shorten stir-frying time by partially substituting frying by steaming

Cooking with water (such as simmering, steaming and boiling) will not reach a temperature above 120°C and acrylamide is not formed during these cooking methods.

Using microwave oven will also reduce acrylamide formation.

<Experimental results>

15 volunteers cooked “Kimpira gobo (shredded burdock roots and carrot, stir-fried and seasoned with soy sauce and sugar)”.

The acrylamide concentrations in kimpira gobo cooked with steaming are much lower than those without steaming.

Protocols

1. Cooking as usual
2. Cooking with lower heat than the usual, stirring more frequently and frying as short as possible. Add soy sauce and water and heat for 15 minutes with the lid on. Stir-frying with middle heat without lid until no liquid is observed.



The Taste and flavor of kimpira dishes are not so different from these two protocols.