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FINAL ASSESSMENT REPORT

PROPOSAL P257

ADVICE ON THE PREPARATION OF CASSAVA AND BAMBOO SHOOTS

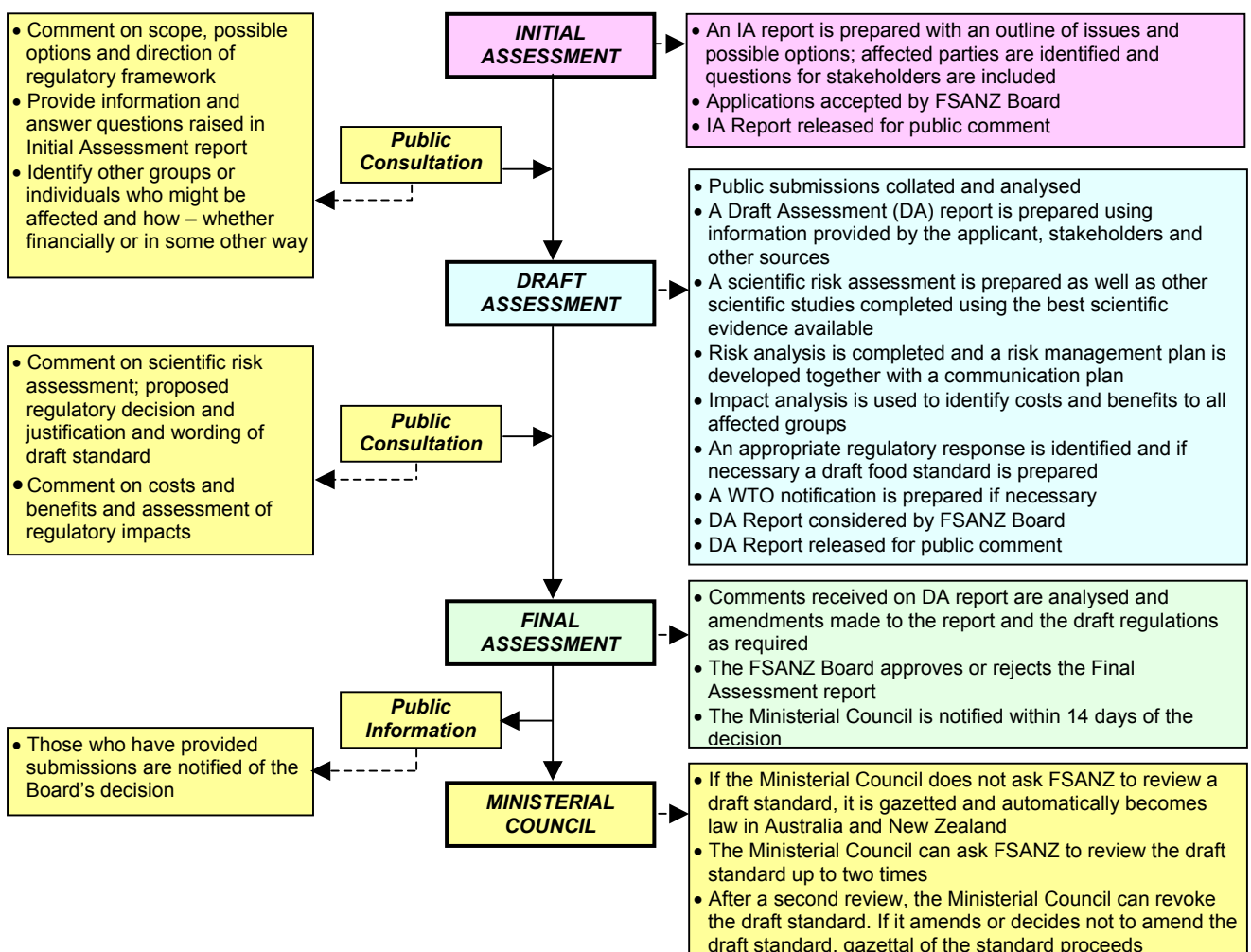
FOOD STANDARDS AUSTRALIA NEW ZEALAND (FSANZ)

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FSANZ is responsible for developing, varying and reviewing standards and for developing codes of conduct with industry for food available in Australia and New Zealand covering labelling, composition and contaminants. In Australia, FSANZ also develops food standards for food safety, maximum residue limits, primary production and processing and a range of other functions including the coordination of national food surveillance and recall systems, conducting research and assessing policies about imported food.

The FSANZ Board approves new standards or variations to food standards in accordance with policy guidelines set by the Australia and New Zealand Food Regulation Ministerial Council (Ministerial Council) made up of Commonwealth, State and Territory and New Zealand Health Ministers as lead Ministers, with representation from other portfolios. Approved standards are then notified to the Ministerial Council. The Ministerial Council may then request that FSANZ review a proposed or existing standard. If the Ministerial Council does not request that FSANZ review the draft standard, or amends a draft standard, the standard is adopted by reference under the food laws of the Commonwealth, States, Territories and New Zealand. The Ministerial Council can, independently of a notification from FSANZ, request that FSANZ review a standard.

The process for amending the *Australia New Zealand Food Standards Code* is prescribed in the *Food Standards Australia New Zealand Act 1991* (FSANZ Act). The diagram below represents the different stages in the process including when periods of public consultation occur. This process varies for matters that are urgent or minor in significance or complexity.



Final Assessment Stage

FSANZ has now completed two stages of the assessment process and held two rounds of public consultation as part of its assessment of this Proposal. This Final Assessment Report and its recommendations have been approved by the FSANZ Board and notified to the Ministerial Council.

If the Ministerial Council does not request FSANZ to review the draft amendments to the Code, an amendment to the Code is published in the *Commonwealth Gazette* and the *New Zealand Gazette* and adopted by reference and without amendment under Australian State and Territory food law.

In New Zealand, the New Zealand Minister of Health gazettes the food standard under the New Zealand Food Act. Following gazettal, the standard takes effect 28 days later.

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Executive Summary and Statement of Reasons

Cassava and bamboo shoots contain potentially toxic compounds called cyanogenic glycosides, which break down upon disruption of the plant cells, to form hydrogen cyanide. The potential toxicity due to the presence of cyanogenic glycosides can be reduced by appropriate preparation of the plant material prior to consumption as food, including peeling, slicing and cooking (e.g. boiling or baking) to encourage break down the cyanogenic glycosides, and subsequent removal of the liberated hydrogen cyanide.

There are a number of varieties of cassava which range from low cyanide content (referred to as ‘sweet cassava’) to higher cyanide content (referred to as ‘bitter cassava’). Bitter cassava requires more extensive processing (sometimes more than one day) to remove the cyanogenic potential than sweet cassava, however, bitter cassava is not traded commercially and the only varieties available in Australia and New Zealand are the sweet varieties. There are many species of bamboo, of which only a small number are viable as food and currently only low cyanide varieties are available in Australia and New Zealand.

The symptoms of acute cyanide intoxication from inadequately prepared cassava or bamboo shoots can include rapid respiration, drop in blood pressure, rapid pulse, dizziness, headache, stomach pains, vomiting, mental confusion, twitching and convulsions. Ingested cyanide is detoxified in humans by conversion to thiocyanate and excretion in urine. The detoxification requires sulphur compounds which are provided by dietary sulphur amino acids and so, the ability of humans to detoxify cyanide will be compromised by an inadequate dietary protein intake.

The objective of this Proposal is to examine the potential public health and safety risk associated with consumption of inadequately prepared cassava and/or bamboo shoots in the Australian and New Zealand populations and to determine whether any risk management measures are necessary.

The dietary exposure to cassava and bamboo shoots in the general population in Australia and New Zealand is low overall – cassava being consumed mainly by people of Pacific Island descent and bamboo shoots being consumed commonly in Asian cuisine. The availability of cassava and bamboo shoots in Australia and New Zealand is also low, although it could reasonably be assumed that the popularity of bamboo shoots is growing in tandem with the popularity of Asian cuisine. As such, the likelihood of an acute cyanide intoxication event occurring is assessed as low, but not insignificant given that the general population has a low level of knowledge about the appropriate preparation required for the safe consumption of these products.

FSANZ has considered both regulatory and non-regulatory options, including a non-regulatory option of encouraging the industry to provide voluntary preparation instructions, which some industry sectors are already doing. However, FSANZ considers that it is necessary to ensure all consumers are provided with appropriate information to enable the safe consumption of cassava and bamboo shoots, given that the consequences of cyanide intoxication can be severe. Therefore, the preferred option is a regulatory option of requiring directions for use for the raw produce to be provided.

Statement of Reasons

It is agreed that directions should be required to accompany the sale of cassava and bamboo shoots, in Standard 1.2.6 – Directions for Use and Storage – of the *Australia New Zealand Food Standards Code* (the Code). It is agreed that required directions should be: a statement indicating that cassava should be peeled and fully cooked before being consumed; and a statement indicating that bamboo shoots should be fully cooked before being consumed. It is agreed that cassava be limited to sweet varieties of cassava through Standard 1.4.4 – Prohibited and Restricted Plants and Fungi and sweet cassava be defined as those varieties of cassava that contain less than 50 mg/kg hydrogen cyanide (fresh weight basis) in Standard 1.1.2 – Supplementary Definitions for Foods. The proposed amendments to the Code, including additional Code variations in Standard 1.2.1 – Application of Labelling and Other Information Requirements, which give effect to the proposed amendments in Standard 1.2.6, are at Attachment 1.

The above amendments to the Code are agreed for the following reasons:

- There is the potential for cassava and bamboo shoots to cause a public health and safety risk if the food is not prepared properly.
- There is insufficient knowledge in the general community of preparation techniques sufficient to enable safe use.
- The definition of sweet varieties of cassava and the requirement to have directions for preparation are consistent with the Codex standard for sweet cassava.
- There is likely to be minimal cost to either the cassava or bamboo industry given that some sectors of the industry have voluntarily developed and provided preparation instructions to accompany the sale of the fresh produce, and the text required to be provided will not be prescribed by the Code.

1. Introduction

This Proposal was prepared initially in order to consider the potential safety risks associated with consumption of cassava, which contains potentially toxic cyanogenic glycosides, and appropriate risk management strategies. The scope of this Proposal has since been expanded to assess the potential safety risk associated with consumption of bamboo shoots, which also contain cyanogenic glycosides.

The safety of cassava and other similar produce as food was raised initially during the development of the Novel Foods Standard (Standard 1.5.1) as an example of a possible non-traditional food for which there is insufficient knowledge in the broad community to enable safe use. Following consultations with the Senior Food Officers from New Zealand and from each of the States and Territories of Australia, it was agreed that, given the history of use of cassava it could not be considered a non-traditional food or a novel food. However, it was agreed that FSANZ (then the Australia New Zealand Food Authority) should consider the need for additional consumer information regarding the safe preparation and use of cassava. The concerns regarding bamboo shoots were raised on a later occasion and incorporated into the Proposal.

The potential toxicity of cyanogenic glycosides in cassava and bamboo shoots can be reduced by adequate preparation prior to consumption. For cassava, peeling and slicing disrupts the cell structure of the plant, with the subsequent liberation of hydrogen cyanide. The hydrogen cyanide can be removed by further processing such as cooking (baking, boiling, or roasting) or fermentation followed by cooking. For bamboo shoots, slicing liberates hydrogen cyanide, which is removed by boiling. Raw produce with higher levels of cyanogenic glycosides will require more extensive processing to liberate and remove hydrogen cyanide.

2. Regulatory Problem

Cassava is an important tropical root crop in Pacific Island countries, Latin America, Africa and parts of Asia. Although not widely used in Australia and New Zealand, certain ethnic groups, especially those from the Pacific islands, consume it. Bamboo shoots are used in Asian cuisine and are becoming more popular in Australia and New Zealand. The public health concern in relation to the consumption of cassava and bamboo shoots in Australia and New Zealand is the presence of cyanogenic glycosides, which can lead to hydrogen cyanide exposure and its related toxicity.

Currently, cassava and bamboo shoots may be sold without any statements or advice to consumers to alert them to the potential risks related to the use of these raw or improperly prepared foods.

This Proposal has been raised by FSANZ under section 12AA of the *Food Standards Australia New Zealand Act 1991* (FSANZ Act).

2.1 Inclusion of bamboo shoots in the scope of Proposal P257

Canned bamboo shoots are widely available in supermarkets in Australia and New Zealand, and present little or no risk to public health and safety since processing liberates and removes hydrogen cyanide.

Fresh bamboo shoots, on the other hand, have not undergone any processing to remove the hydrogen cyanide (although levels are reported to drop following harvesting), and thus present some potential public health and safety risk. The popularity of using fresh bamboo shoots rather than canned, in cooking in Australia and New Zealand, has risen in recent years in tandem with the increase in popularity of Asian dishes.

2.2 Current regulations

While raw cassava and bamboo shoots can currently be sold without any mandatory statements or advice to consumers to alert them to the potential risks related to the use of these raw foods, there are several existing standards which could be used to manage the risk to public safety, subject to the risk assessment discussed in section 5 of this Report. These standards are described below.

2.2.1 *Standard 1.2.6 – Directions for Use and Storage*

Standard 1.2.6 requires either directions for use and/or storage of food, to be included on the label of food, where for public health and safety reasons, the consumer should be informed of specific use or storage requirements. Standard 1.2.6 applies only to packaged food and neither raw bamboo shoots nor raw (including frozen) cassava are subject to this requirement.

2.2.2 *Standard 1.4.4 – Prohibited and Restricted Plants and Fungi*

Standard 1.4.4 lists the species of plants and fungi that must not be added to food or offered for sale as food. It also lists the species of plants and fungi, or a part or derivative of a plant or fungus, or any substance derived therefrom, that may only be added to or be present in a food if it complies with the requirements for natural toxicants from the addition of a flavouring substance. In the context of this Proposal, a broad prohibition on either cassava or bamboo shoots is not appropriate, however, this Standard can be used to address sale of certain varieties for which there are safety concerns.

2.2.3 *Standard 1.4.1 – Contaminants and Natural Toxicants*

The maximum levels for natural toxicants in foods are specified in Standard 1.4.1 – Contaminants and Natural Toxicants. At present, there is no maximum level of hydrogen cyanide specified for either processed cassava products, including cassava flour and cassava chips or processed (i.e. canned) bamboo shoots.

Standard 1.4.1 also regulates the maximum levels for natural toxicants from the addition of flavouring substances to food. There is a limit on total hydrocyanic acid in confectionery, stone fruit juices, marzipan and alcoholic beverages.

2.2.4 *Standard 1.2.3 – Mandatory Warning and Advisory Statements and Declarations*

This standard sets out mandatory advisory statements and declarations which must be made in relation to certain food or foods containing certain substances. **Warning statements** are required where the risk to public health and safety is high (potentially life threatening) and awareness of the potential risk is low.

Advisory statements are required when the general population or a sub-group of the population are exposed to a health or safety risk but the risk to public health and safety is not life threatening, or when guidance about a food is needed to maintain public health and safety. **Mandatory declarations** are required when individuals are aware of risks (e.g. individuals susceptible to allergic reactions) and need only to identify those risks to manage them.

2.2.5 *Standard 1.1.2 – Supplementary Definitions for Foods*

Standard 1.1.2 sets out definitions for foods which do not have specific compositional requirements elsewhere in the Code. At present neither cassava nor bamboo shoots are defined in the Code. Providing a definition for cassava and/or bamboo shoots could provide clarity since there are a number of plant varieties.

2.2.6 *Standard 1.2.1 - Application of Labelling and Other Information Requirements*

Standard 1.2.1 sets out the application of general labelling and other information requirements contained in Part 1.2 of the Code and labelling and information requirements specific to certain foods in Chapter 2 of the Code. Amendments to Standard 1.2.1 may be necessary to give effect to amendments elsewhere in the Code (e.g. to Standard 1.2.6).

2.3 **International regulations**

There are Codex standards for sweet cassava and for edible cassava flour. The Codex standard for sweet¹ cassava applies to the commercial sweet varieties of cassava roots to be supplied to the consumer after preparation and packaging. A statement indicating that cassava should be peeled and fully cooked before being consumed is required in the provisions concerning marking or labelling in the standard. The standard for edible cassava flour sets a maximum level for hydrocyanogenic acid content of 10 mg/kg. There is a draft Codex standard for canned bamboo shoots which has not been finalised.

3. **Objectives**

The three primary objectives of this Proposal are:

1. To examine the public health and safety risk associated with consuming raw or inadequately prepared cassava. To determine whether any risk management measures are necessary in Australia and New Zealand.
2. To examine the public health and safety risk associated with consuming raw or inadequately prepared bamboo shoots. To determine whether any risk management measures are necessary in Australia and New Zealand.
3. To examine the public health and safety risk associated with consuming commercially available processed cassava and bamboo products.

¹ Sweet varieties of cassava are those that contain less than 50 mg/kg hydrogen cyanide (fresh weight basis). In any case, cassava must be peeled and fully cooked before being consumed.

In developing or varying a food standard, FSANZ is required by its legislation to meet three primary objectives which are set out in section 10 of the FSANZ Act. These are:

- the protection of public health and safety;
- the provision of adequate information relating to food to enable consumers to make informed choices; and
- the prevention of misleading or deceptive conduct.

In developing and varying standards, FSANZ must also have regard to:

- the need for standards to be based on risk analysis using the best available scientific evidence;
- the promotion of consistency between domestic and international food standards;
- the desirability of an efficient and internationally competitive food industry;
- the promotion of fair trading in food; and
- any written policy guidelines formulated by the Ministerial Council.

4. Background

The populations of Australia or New Zealand have consumed neither cassava nor fresh bamboo shoots to any great extent, although tapioca pudding (a processed product of cassava) has been consumed traditionally in both Australia and New Zealand. Both cassava and fresh bamboo shoots are consumed extensively in other countries. Cassava is consumed as a staple food in many African nations and is preferred because it is a hardy crop and resistant to drought.

4.1 Traditional use of cassava

Cassava is grown for its enlarged starch-filled roots, which contain about 30% starch and very little protein. Cassava grows well in a tropical climate and is eaten primarily in Africa, Pacific Island Countries, South America and regions of Asia including Indonesia. Cassava is consumed in a number of forms: flour used for cooking; root slices; root chips; baked grated root; steamed grated root; pan fried grated root; steamed whole root; and tapioca pearls made as a pudding. Cassava leaves are also eaten in some countries after extensive boiling.

Cassava flour can be produced by either sun drying or heap fermentation. Sun drying involves peeling the roots, followed by drying the whole roots or large pieces cut longitudinally in the sun. The brittle dry material is then pounded in a wooden mortar and pestle and sieved to remove fibrous material, which produces white flour. Heap fermentation involves peeling and cutting the roots and leaving them in a small heap for 3-5 days during which some fermentation takes place with liberation of hydrogen cyanide. The roots are then sun dried, pounded and sieved to produce white flour. Cassava flour produced by heap fermentation has lower cyanide content than cassava flour produced by sun drying.

4.2 Traditional use of bamboo shoots

Bamboo shoots are a traditional component of Asian cuisine. Fresh bamboo shoots are cut, the outer leaves are peeled away and any fibrous tissue at the base is trimmed, the bamboo shoot is sliced and then boiled for 8-10 minutes.

In Thailand and Vietnam, some shoots are finely grated and used in salads. In Japan, shoots are sometimes boiled whole for in excess of 2 hours. The most common preparation involves boiling the shoots in stocks, soups or salted water for use in assorted dishes.

5. Issues

5.1 Safety assessment

The following summary is derived from the safety assessment report at Attachment 2.

5.1.1 Characterisation of cyanogenic potential of cassava and bamboo shoots

Cassava and bamboo shoots contain potentially toxic cyanogenic glycosides, linamarin and taxiphillin respectively, which break down to produce hydrogen cyanide. This potential toxicity can be significantly reduced by adequate processing to break down the cyanogenic glycoside and remove the resulting hydrogen cyanide.

There is a range of varieties of cassava with varying cyanide contents. Values from 15 to 400 mg/kg fresh weight of hydrogen cyanide in cassava roots have been reported in literature. Sweet varieties of cassava (which are the varieties traded commercially) will typically contain approximately 15 to 50 mg/kg hydrogen cyanide on a fresh weight basis.

There are approximately 1200 species of bamboo, although only a limited number of these are viable as food. Bamboo shoots may contain as much as 1000 mg/kg hydrogen cyanide, significantly higher than the amounts detected in cassava tubers, however, the cyanide content is reported to decrease substantially following harvesting.

Sweet varieties of cassava (low cyanide content) are adequately processed by peeling and then fully cooking (e.g. roasting, baking or boiling). Bitter varieties of cassava (high cyanide content) will require further processing, involving techniques such as heap fermentation taking more than one day. Currently the commercial trade is only in sweet cassava. The varieties of bamboo shoots sold commercially for food are adequately processed by boiling before adding to dishes. If either cassava or bamboo shoots are eaten raw or processed inadequately, their consumption may be potentially toxic.

5.1.2 Toxicological summary

The potential toxicity of a food produced from a cyanogenic plant depends on the likelihood that its consumption will produce a concentration of hydrogen cyanide (HCN) that is toxic to exposed humans. The factors important in this toxicity are:

- If the plant is not sufficiently detoxified during processing or preparation, preformed HCN is released.
- If the plant is consumed raw or not sufficiently processed prior to consumption, part of the potential HCN is released in the body, until the low pH of the stomach deactivates the β -glucosidase enzyme.
- The β -glucosidase enzyme may be reactivated in the alkaline environment of the gut, resulting in further release of HCN.

Cyanide ingested by release from a plant containing cyanogenic glycosides, either prior to or following consumption, follows the known cyanide metabolic pathway and toxicokinetics for animals and humans. Cyanide is detoxified by the enzyme rhodanese, forming thiocyanate, which is excreted in the urine. This detoxification requires sulphur donors, which by different metabolic pathways are provided from dietary sulphur amino acids. There are several factors influencing hydrolysis of cyanogenic glycosides including the confounding influence of nutritional status, with respect to, for example, riboflavin, vitamin B12, sodium and methionine).

Hydrogen cyanide inactivates the enzyme cytochrome oxidase in the mitochondria of cells by binding to the $\text{Fe}^{3+}/\text{Fe}^{2+}$ contained in the enzyme. This causes a decrease in the utilization of oxygen in the tissues. Cyanide causes an increase in blood glucose and lactic acid levels and a decrease in the ATP/ADP ratio indicating a shift from aerobic to anaerobic metabolism. Cyanide activates glycogenolysis and shunts glucose to the pentose phosphate pathway decreasing the rate of glycolysis and inhibiting the tricarboxylic acid cycle. Hydrogen cyanide will reduce the energy availability in all cells, but its effect will be most immediate on the respiratory system and heart.

5.1.2.1 Toxicological studies in animals

The lethal doses of HCN in mg/kg bw are generally reported to be between 0.66 to 10-15 for various species. Chronic sub-lethal dietary cyanide has reportedly caused: some reproductive effects including lower birth rates and increased number of neonatal deaths; impaired thyroid function; and behavioural effects including increasing ambivalence and slower response time.

5.1.2.2 Observations in humans

The symptoms of acute cyanide intoxication include: rapid respiration, drop in blood pressure, rapid pulse, dizziness, headache, stomach pains, vomiting, diarrhoea, mental confusion, twitching and convulsions. If the cyanide limit exceeds the limit an individual is able to detoxify, death due to cyanide poisoning may occur. The likelihood of cyanide intoxication from consumption of cassava or bamboo shoots occurring in Australia or New Zealand is low due to the low dietary exposure, however, the lethal dose is dependent on body weight and it is possible that a child or person of smaller body weight would not be able to detoxify the cyanide resultant from a meal of inadequately prepared cassava or bamboo shoots. The acute lethal dose of hydrogen cyanide for human beings is reported to be 0.5-3.5 mg/kg bw. Approximately 50-60 mg of free cyanide from cassava and its processed products constitutes a lethal dose for an adult man.

Other diseases related to dietary cyanide intake have been observed and are described as follows:

- Konzo is an upper motor neuron disease characterised by irreversible but non-progressive symmetric spastic paraparesis with an abrupt onset. In severe cases, patients are not able to walk, and speech and arms may also be affected. It affects primarily children and women of child-bearing age. Konzo is associated with high and sustained intake of cyanogens at sub-lethal concentrations from cassava or cassava flour in combination with a low intake of protein.

- Tropical ataxic neuropathy (TAN) is used to describe several neurological syndromes which differ in clinical presentation. The main clinical features include: optical atrophy; angular stomatitis; sensory gait ataxia; and neurosensory deafness. The onset of TAN is usually slow, over months or years and affects males and females equally, but mostly in older age groups. The cause is attributed to cyanide exposure from the chronic consumption of foods derived from cassava.
- Goitre and cretinism due to iodine deficiency can be considerably aggravated by a continuous dietary cyanide exposure from insufficiently processed cassava. The effect is caused by thiocyanate, which is similar in size to the iodine molecule and interferes with uptake of iodine into the thyroid gland, but only occurs when iodine intake is inadequate.

These diseases occur in countries where there is chronic consumption of cassava as a staple food, food insecurity is prevalent and dietary intake of protein and/or iodine are inadequate. Therefore, in Australia and New Zealand where neither cassava nor bamboo shoots are staple foods and the background diet of the population is good, these cyanide related diseases are not considered a concern.

5.2 Dietary exposure

The extent of consumption of both cassava and bamboo shoots in Australia and New Zealand is assessed to be relatively small although there are few recent and reliable statistics available. Most of the information available is specific to cassava.

5.2.1 National Nutrition Survey information

Of the respondents in the Australian National Nutrition Survey 1995 there were two consumers of cassava. In the New Zealand National Nutrition Survey 1997 there were nine consumers of cassava. In these surveys cassava was described as ‘cooked’, ‘boiled’ or ‘baked’. No cassava flour or cassava chips were recorded as eaten. The Australian National Nutrition Survey recorded 36 consumers of bamboo shoots (either ‘cooked’/‘canned’ or ‘raw’) and the New Zealand National Nutrition Survey recorded one consumer of cooked bamboo shoots. The dietary consumption data for cassava and bamboo shoots in Australia and New Zealand is summarised in tables 1 and 2.

Table 1: Dietary consumption of cassava and bamboo shoots for Australia and New Zealand from National Nutrition Survey data

Food	Number of Consumers	Consumers as a % of total respondents (#)	Mean Consumption g/day
Cassava Boiled (New Zealand)	8	2.6	287.85
Cassava, Baked (New Zealand)	1	0.3	145.15
Cassava, Cooked (Australia)	2	0.01	114.96

Bamboo Shoots, Cooked or Canned (Australia)	31	0.2	35.10
Bamboo Shoots, Raw (Australia)	5	0.04	31.27
Bamboo, Cooked (New Zealand)	1	0.02	70.00

Total number of respondents for Australia whole population aged 2 – 100 years = 13 858, Total number of respondents for New Zealand 15 years and above = 4 636 and total number of respondents for New Zealand Pacific Islanders 15 years and above = 307.

- All New Zealand consumers of cassava were Pacific Islanders aged between 48 – 80 years, 8 female and 1 male consumer.
- All Australian consumers of cassava were aged between 6 (female) – 44 (male) years.
- Australian consumers of Bamboo shoot included 21 females and 10 males. The youngest consumer of bamboo shoots was a 3 year old female. Table 2 gives a more detailed breakdown of the consumer groups who recorded eating bamboo shoots in the Australian National Nutrition Survey 1995.

Table 2: Dietary consumption data for bamboo shoots in Australia

Food	Consumer group	Number of Consumers	Mean Consumption g/day
Bamboo Shoot, Raw	2-12 yrs	1(3yrs)	42.33
	25 – 64 yrs	4	28.51
Bamboo Shoot, Cooked or Canned	2-12 yrs	2	68.24
	13-24 yrs	5	32.74
	25-64 yrs	22	36.31
	65+ yrs	2	5.67

5.2.2 Availability of cassava in New Zealand

Information on the availability of cassava in New Zealand has been obtained from the South Pacific Trade Commission, New Zealand². Cassava is the second major root crop imported into New Zealand, behind taro and ahead of yam. The New Zealand market for tropical root crops is largely confined to the Polynesian population situated in south and west Auckland and in the Wellington suburb of Porirua. There is also a growing market among the Asian population. In 1999, 1400 tonnes of cassava were imported into New Zealand. The fresh imports came mainly from Fiji (approximately 2/3) and Tonga (approximately 1/3). The varieties of cassava grown in the Pacific Island countries have low cyanide contents. About 55% of the tropical root crops imported are sold to specialist fruit and vegetable retailers and large supermarkets.

² Exporting Fruit and Vegetables to New Zealand, A guide for Pacific Island Producers (revised 2000). South Pacific Trade Commission, Auckland, New Zealand.

Cassava is usually available all year round. Some frozen cassava identified in retail outlets in New Zealand included preparation instructions (personal communication from Tanja Briski, July 2003).

5.2.3 *Availability of cassava in Australia*

The availability of cassava in Australia is limited and is mostly sold through greengrocers. The majority of cassava imported into Australia comes from Pacific Island countries (personal communication from Dr Howard Bradbury, Australian National University, June 2003). Cassava chips (e.g. 'Vegechips') made from cassava and/or cassava flour are available from supermarkets, service stations and other retail outlets in Australia, however, this is a processed product and there would be little, if any cyanide present. Tapioca pearls, derived from cassava and consumed as tapioca pudding, is available in supermarkets in both Australia and New Zealand. Like cassava chips, tapioca pearls are a processed product which has a long history of safe consumption in both Australia and New Zealand.

5.2.4 *Availability of bamboo shoots in Australia*

The Australian Commercial Bamboo Corporation Ltd (ACBC) sold fresh bamboo shoots for the first time on the Australian domestic market during 2001. The total sale of bamboo shoots through the Sydney and Melbourne markets was 21,850 kg, and of that, 16,630 kg was produce of the ACBC (personal communication from ACBC, August 2002). Other bamboo shoots sold originate from small operators or plantation owners. The ACBC stated at the time of this communication that the bamboo shoots they sold would contain directions for the consumer on how to prepare them.

5.3 **Nutritional assessment**

5.3.1 *Nutritional composition*

The cassava tuber has a high carbohydrate content, but is not a good source of protein. It contains vitamin C, potassium and dietary fibre. Cassava leaves have a higher protein content, contain vitamin C and vitamin A and provide some dietary fibre (Leaflet No. 5 – Cassava, South Pacific Commission).

Bamboo shoots are a good source of thiamine, vitamin B6 and potassium. However, the process of canning greatly reduces the vitamin content. One cup of cooked bamboo shoots provides approximately 14 calories, 0.3 g fat, 1.2 g fibre, 1.8 g of protein and 640 mg potassium³.

5.3.2 *Role of sulphur-containing amino acids in cyanide detoxification*

Dietary cyanide exposure from cyanogenic glycosides in insufficiently processed cassava has been implicated as a contributing factor in growth retardation. In the human body, cyanide is detoxified mainly by enzymatic conversion to the much less toxic thiocyanate (SCN). This detoxification requires sulphur donors, which are provided from sulphur-containing dietary amino acids, cysteine and methionine (Bradbury and Holloway, 1988⁴; Rosling, 1994⁵).

³ Sourced from http://www.wholehealthmd.com/print/view/1,1560,FO_233,00.html

⁴ Bradbury, H. and Holloway, W. Antinutritional factors in root crops. In: Chemistry of Tropical Root Crops: Significance for Nutrition and Agriculture in the Pacific. Canberra: ACIAR, 1988; 201

In subjects who have an adequate protein component of their diet, excess cysteine and methionine are not required for protein synthesis and are degraded to inorganic sulphate and excreted. Where dietary intake of protein is inadequate, the preferential use of metabolically available sulphur-containing amino acids for cyanide detoxification is also believed to hamper protein synthesis and hence contribute to growth retardation in children exposed to dietary cyanide from cassava.

A deficit in height-for-age index, otherwise referred to as 'stunting' was associated with children who consumed inadequately processed cassava, however, weight-for-height and weight-for-age indices were not significantly different from children who consumed cassava which was adequately processed (Banea-Mayambu et al., 2000⁶). This indicates that because of the preferential use of sulphur amino acids for cyanide detoxification in the human body, dietary cyanide exposure may be a factor aggravating growth retardation.

5.3.3 Iodine deficiency diseases

Iodine deficiency diseases, which include goitre (enlargement of the thyroid gland) and, in its most severe form, cretinism (shortness of stature and severe mental impairment) and are due to a low dietary intake of iodine, are exacerbated by intake of cyanogenic plants such as cassava (Ermans et al., 1983⁷; Simons et al., 1980⁸). Ingested cyanide from cyanogenic plants is converted in the body to thiocyanate, which is removed in the urine. The thiocyanate inhibits the uptake of iodine by the thyroid gland.

5.4 Risk assessment

Cassava and bamboo shoots contain potentially toxic cyanogenic glycosides which break down to produce hydrogen cyanide. By adequate processing, both the cyanogenic glycosides and hydrogen cyanide can be removed prior to consumption, thus significantly reducing the potential toxicity.

The symptoms of acute cyanide intoxication include: rapid respiration, drop in blood pressure, rapid pulse, dizziness, headache, stomach pains, vomiting, diarrhoea, mental confusion, twitching and convulsions. If the cyanide ingested exceeds the limit an individual is able to detoxify, death due to cyanide poisoning may occur.

⁵ Rosling, H. (1994) **Measuring effects in humans of dietary cyanide exposure from cassava**. *Acta Horticulturae*, 375, pp 271-283.

⁶ Banea-Mayambu, J-P., Tylleskar, T., Tylleskar, K., Gebre-Medhin, M. and Rosling, H. (2000) **Dietary cyanide from insufficiently processed cassava and growth retardation in children in the Democratic Republic of Congo (formerly Zaire)**. *Annals of Tropical Paediatrics*, 20, pp 34-40

⁷ Ermans, A.M., Bourdoux, P., Kintheart, J., Lagasse, R., Luvivila, K., Mafuata, M., Thilly, C.M. and Delange, F. (1983). Role of cassava in the etiology of endemic goitre and cretinism. In F. Delange, R. Ahluwalia (Eds.), *Cassava toxicity and thyroid: Research and public health issues*, pp 9-16. Ottawa: International Development Research Centre

⁸ Simons, E., Bourdoux, G.P., Hanson, A., Mafuta, M., Lagasse, R., Ramioul, L. and Delange, F. Foods consumed and endemic goitre in the Ubangi, in Ermans, A.M., Mbulamoko, N.M., Delange, F. and Ahluwalia, R. (Eds.) *Role of cassava in the Etiology of Endemic Goitre and Cretinism*, I.D.R.C.-136c, Ottawa, Canada, 1980, pp 69-80

The extent of consumption of both cassava and bamboo shoots in Australia and New Zealand is assessed as being relatively small. According to the National Nutrition Surveys in Australia and New Zealand, cassava is eaten primarily by individuals of Pacific Island descent and there were more consumers in New Zealand than Australia, while fresh bamboo shoots were more commonly eaten in Australia than New Zealand. Bamboo shoots are used commonly in Asian cuisine and their popularity is growing with the popularity of Asian cuisine. Because of the limited availability of either raw cassava or raw bamboo shoots and the low dietary exposure, the likelihood of cyanide intoxication from consumption of cassava or bamboo shoots occurring in Australia or New Zealand is low, but due care in preparation remains necessary.

Other diseases related to dietary cyanide intake and nutrition have been observed (konzo, tropical ataxic neuropathy, goitre and cretinism). However, these occur in countries where there is chronic consumption of cassava as a staple food, food insecurity is prevalent and dietary intake of protein and/or iodine are inadequate. Therefore, in Australia and New Zealand where neither cassava nor bamboo shoots are staple foods and the background diet of the population is adequate, these cyanide related diseases are unlikely to be a concern.

5.5 Risk management

Under the current food regulations labelling information is required when a food poses a demonstrated risk to public health and safety, either to the general population or to a specific sub-group of the population. The type of labelling information required depends on the level of risk.

FSANZ has undertaken a risk assessment (considering safety factors, dietary exposure assessment and nutritional implications) to characterise the extent to which the inadequate preparation of cassava or bamboo shoots poses a demonstrated risk to the public safety of the population. FSANZ has identified specific sub-groups of the population that are potentially at increased risk.

5.5.1 Category of public safety risk

The likelihood of cyanide poisoning or acute intoxication from ingestion of cassava or bamboo shoots in Australia or New Zealand is small for the following reasons:

- a low availability of cassava and fresh bamboo shoots;
- most cassava sold in Australia and New Zealand is a sweet variety which has lower levels of hydrogen cyanide;
- limited dietary exposure of the general population to both cassava and bamboo shoots;
- the variety of dietary components eaten;
- general adequacy of protein in the diet; and
- the voluntary provision of preparation information by some suppliers.

However, even though the potential for cyanide poisoning or acute intoxication is low from the consumption of cassava and bamboo shoots, the consequences are quite severe. A single meal of cassava with sufficiently high levels of hydrogen cyanide can result in death by cyanide poisoning if the individual is not able to detoxify the ingested cyanide. Smaller, non-fatal amounts of hydrogen cyanide may cause acute intoxication with symptoms of: rapid respiration, drop in blood pressure, rapid pulse, dizziness, headache, stomach pains, vomiting, and diarrhoea.

Other cyanide diseases such as konzo (an upper motor neuron disease) and tropical ataxic neuropathy have only been observed in African countries in which cassava is a staple food and the diet is deficient in protein. These diseases primarily affect children and women of child bearing age and are not life-threatening. These are not considered to pose a risk to the populations of Australia or New Zealand because the variety of our diet means cassava would not be consumed as a staple food, and the background diet of the population and the protein consumption is generally good. As such, the risk is assessed as low.

5.5.2 Level of public awareness of potential safety risk

People in Australia and New Zealand currently consuming either cassava or fresh bamboo shoots, particularly individuals of Pacific Island descent consuming cassava or those of Asian descent consuming fresh bamboo shoots, are likely to be aware of the risk to public safety. However, the general populations of Australia and New Zealand have very little knowledge of what cassava is, the potential risk to public safety or appropriate preparation methods.

5.5.3 Risk management approach

Standard 1.2.6 – Directions for Use and Storage requires directions for use of food, to be included on the label of food, where for public health and safety reasons, the consumer should be informed of specific use. However, at present this requirement applies to packaged food only. It is an appropriate extension for Standard 1.2.6 to require directions for use for unpackaged food for public health and safety reasons. As such, it is proposed that directions will be required to accompany the sale of cassava and bamboo shoots, in Standard 1.2.6 of the Code. It is proposed to limit cassava to sweet varieties of cassava through Standard 1.4.4 – Prohibited and Restricted Plants and Fungi and define sweet cassava as those varieties of cassava that contain less than 50 mg/kg hydrogen cyanide (fresh weight basis) in Standard 1.1.2 – Supplementary Definitions for Foods. This risk management approach is consistent with the Codex standard for sweet cassava. Required directions will be: a statement indicating that cassava should be peeled and fully cooked before being consumed; and a statement indicating that bamboo shoots should be fully cooked before being consumed.

5.6 Issues raised in submissions

A full summary of submissions in response to the both the Initial Assessment Report and the Draft Assessment Report are available at Attachment 3.

5.6.1 Submissions received in response to the Initial Assessment Report

The Initial Assessment Report discussed only the public safety risk associated with the consumption of inappropriately or inadequately prepared cassava. The risk associated with the consumption of inappropriately or inadequately prepared bamboo shoots was not discussed in the Initial Assessment Report and was only included in the scope of this proposal at Draft Assessment. Hence, the following comments relate only to cassava.

5.6.1.1 Insufficient information on which to base preferred regulatory option

Some submitters indicated that the Initial Assessment Report did not supply sufficient information to assess the level of risk to the population posed by cassava. As such, some submitters felt that they did not have sufficient information to indicate a preferred regulatory option.

FSANZ consideration

A detailed safety assessment and information on dietary exposure and availability was provided in the Draft Assessment Report and is also included in this Report. While there is very limited information on dietary exposure available, the information provided was considered sufficient for submitters to indicate a preferred regulatory option based on the risk assessment.

5.6.1.2 General community awareness of the risks associated with cassava

Some submitters noted that the current consumers of cassava are probably familiar with the required preparation but the general community, including potential new consumers of cassava, would not necessarily be familiar with the adequate preparation techniques required.

FSANZ consideration

While FSANZ does not have any data to indicate that the general population is generally unaware of the risks associated with the consumption of inadequately prepared cassava, based on the low availability of cassava and dietary exposure information, FSANZ agrees with these comments made by submitters that it is unlikely the wider population has much knowledge about cassava. This was taken into account in assessing the likelihood of the risk (section 5.4) and the risk management options (section 5.5).

5.6.1.3 Low cyanide varieties of cassava

Submissions noted that research is being undertaken to develop cassava with low or zero levels of cyanide, and that currently, only low cyanide cassava varieties are grown and consumed in, and exported from Pacific Island countries. Low cyanide varieties require less extensive processing to remove a large proportion of the cyanogenic glycosides prior to consumption, thus the risk to consumers is less than for higher cyanide varieties. Three submitters suggested that restricting sale of cassava to low cyanide varieties is a possible regulatory option.

FSANZ consideration

It is encouraging that varieties of cassava available in Australia and New Zealand are likely to be low cyanide varieties and thereby pose a lower risk to public safety than higher cyanide varieties. However, there is currently no regulation that prohibits higher cyanide content varieties being sold in Australia or New Zealand. The Codex Standard on sweet cassava applies to varieties that contain less than 50 mg/kg hydrogen cyanide (fresh weight basis). FSANZ is proposing to adopt this level of hydrogen cyanide set in the Codex Standard.

5.6.1.4 Assessing the likelihood of risk

One submitter suggested that the objective of the proposal should be (rather than the objective stated in the Initial Assessment Report) to examine the risk that consumers of cassava will eat it raw or improperly prepared and to consider whether the severity of the risk warrants further action.

FSANZ consideration

While the objective stated in the Initial Assessment Report was less specific than the above suggested objective, it was always FSANZ's intention to assess, to the extent that information is available, the general knowledge of appropriate cassava preparation in the broad community and the likelihood that it will be prepared inadequately and hence pose a risk to public safety. The specific objectives of this proposal were refined in the Draft Assessment Report and are outlined in section 3 of this Report.

5.6.1.5 Cassava trade

Cassava is an important domestic and export crop in the Pacific Islands Countries, both economically and culturally. Submitters want to ensure that regulation does not impede initiatives to promote cassava to the broader community.

FSANZ consideration

FSANZ must have regard to, among others, fair trading and international regulations as discussed in section 3 of this Report. The economic impact of any required risk management labelling strategy on Pacific Island Countries has been discussed in the impact analysis (section 7). FSANZ has taken into account patterns of use and regulations in other countries in assessing the risk and developing risk management strategies.

5.6.2 Submissions received in response to the Draft Assessment Report

In contrast to the Initial Assessment Report, the Draft Assessment Report discussed the potential public health and safety risk associated with consumption of the inappropriate or inadequate preparation of bamboo shoots in addition to cassava. No direct comments were made, in the submissions received, about the appropriateness of addressing the potential public health and safety risk associated with bamboo shoots within the scope of this Proposal, which was originally intended to consider only cassava.

In response to the Initial Assessment Report some submitters believed that there was insufficient information available to recommend a preferred option, either regulatory or non-regulatory. Most submitters to the Draft Assessment Report indicated a preferred option and, of those that recommended a preferred option, all supported one of the regulatory options rather than one of the non-regulatory options.

5.6.2.1 Clarification of options – both regulatory and non-regulatory

One submitter suggested that the options, as stated in the Draft Assessment Report, require further clarification. Specifically, Options 3 and 4 (regulatory options) referred to 'unpackaged fresh cassava and bamboo shoots' whereas Options 1 and 2 simply referred to cassava and bamboo shoots without mentioning 'unpackaged' or 'fresh'. This inconsistency in wording of the options resulted in difficulty for submitters in making a direct comparison between all of the options.

FSANZ consideration

The regulatory and non-regulatory options have been rewritten in this Report to more accurately and unambiguously present the intent of each option. Section 6 of this Report states the regulatory and non-regulatory options for this Proposal.

5.6.2.2 Clarification of draft variation to Standard 1.2.6

One submitter was concerned that, even though it is clear that FSANZ is concerned about the potential public health and safety risks for fresh cassava and bamboo shoots that require processing by the consumer, the drafting included in the Draft Assessment Report may pick up processed products.

FSANZ consideration

FSANZ has amended the proposed drafting to include further text in the editorial note immediately following the table to clause 3 of Standard 1.2.6. This editorial note describes the products that are intended to be captured by the entries in the table to clause 3 and those which are not.

5.6.2.3 Practical application of the proposed amendments

One submitter indicated that regulatory agencies would need to apply resources for enforcement as well as the possible testing of cassava samples and this should be weighed against the potential benefits for the population. This submitter also requested that the following questions related to the practical application of the proposed amendments be addressed in this Report:

- Will the format and wording of the labelling requirements be set out in Standard 1.2.6? That is, will the text be prescribed?
- A significant proportion of consumers of cassava and/or bamboo shoots are likely to be of non-English speaking background. Will there be any requirement for translation of the labelling requirements into other languages, and if so, who would be responsible?

FSANZ consideration

FSANZ acknowledges that there will potentially be resource implications for enforcement agencies. Government enforcement agencies are identified as potentially affected by the regulatory options in section 7.1 of this Report and the impacts have been assessed for government enforcement agencies in section 7.3 of this Report. In terms of the questions posed, the text and format for the labelling requirements will not be prescribed beyond what is indicated in Standard 1.2.6, table to clause 3. There is no requirement for any labelling provisions in the Code to be translated into other languages however, Standard 1.2.9 – Legibility Requirements – of the Code applies.

Standard 1.2.9 makes specific reference to general requirements where a language other than English is used in addition to the English language, that is, where a language other than English is used in addition to the English language on a label on a package of food or in association with a display of food the information in that language must not negate or contradict the information on the label in the English language.

In addition to these comments, the practical implications of the draft variations proposed in this Report are discussed in section 5.7 of this Report.

5.6.2.4 Adoption of Codex definition for ‘sweet cassava’

The Ministry of Agriculture, Sugar and Land Resettlement, Fiji does not support the adoption of the definition for sweet cassava, with a hydrogen cyanide value of 50 mg/kg or less, from the Codex Standard for sweet cassava. This value of 50 mg/kg hydrogen cyanide is used to distinguish the commercial trade in cassava from the ‘bitter varieties’ that are not traded commercially. The value of 50 mg/kg hydrogen cyanide does not represent a safety level. This submitter also did not support the prohibition of cassava varieties other than sweet cassava. They also suggest that the level of 50 mg/kg hydrogen cyanide is too low and it will impede trade.

FSANZ consideration

FSANZ is aware that the level of hydrogen cyanide specified in the Codex Standard for sweet cassava (50 mg/kg) is for the purpose of providing a definition for sweet cassava and distinguishing the commercial trade in cassava from the bitter cassava that is primarily for domestic use. FSANZ is also aware that the Joint FAO/WHO Expert Committee on Food Additives (JECFA) was not able to estimate a safe level for intake of cyanogenic glycosides.

Based on the assessments of dietary intake and safety, FSANZ concluded that:

- there is the potential for cassava to cause a public health and safety risk if the food is not prepared properly; and
- there is insufficient knowledge in the general community of preparation techniques sufficient to enable safe use.

Subsequently, FSANZ recommended that a statement indicating that cassava should be peeled and fully cooked before being consumed should be required to accompany the sale of cassava, in Standard 1.2.6 of the Code. FSANZ also identified that these directions are appropriate for varieties of cassava that contain lower levels of hydrogen cyanide, however, these directions may not be sufficient for safe use of bitter cassava with higher levels of hydrogen cyanide. Therefore, the 50 mg/kg is in effect, an indication of the hydrogen cyanide level in cassava, for which the proposed directions for use effectively manage the potential public health and safety risk. Essentially, FSANZ is proposing to use 50 mg/kg hydrogen cyanide as a defining level of sweet cassava, and identifying risk management strategies required for safe use of sweet cassava, rather than as a safety level.

With respect to the comment that the level of 50 mg/kg hydrogen cyanide is too low and, if adopted, will impede trade, FSANZ proposes to retain this level of hydrogen cyanide in the definition. FSANZ is adopting a definition used by Codex and FSANZ does not have any evidence to support using either no level or a different level of hydrogen cyanide in the definition.

5.7 Practical application of proposed recommendations

The proposed required directions to accompany the sale of sweet cassava and bamboo shoots are intended to capture only raw cassava, i.e. cassava that has not been processed including frozen cassava and frozen peeled cassava, and raw bamboo shoots. It is not intended that the following are captured by the proposed required directions: canned bamboo shoots; cassava flour/tapioca flour; tapioca pearls; tapioca pudding; cassava chips (including chips that are made from tapioca or cassava flour) or any other fully processed product that contains or uses cassava or bamboo shoots. A description of those products that are intended to be included or excluded from the proposed required directions has been added to the editorial note immediately following the table to clause 3 of Standard 1.2.6 in the proposed drafting.

The proposed required directions for raw sweet cassava and raw bamboo shoots may either be attached to the products or accompany the sale of the products. The proposed required directions will not be prescribed text.

6. Regulatory Options

Four regulatory options were posed in the Initial Assessment Report and these were expanded in the Draft Assessment Report to consider:

- regulating the maximum amount of hydrogen cyanide in processed products derived from cassava and bamboo shoots; and
- appropriate Standards in the Code through which to implement risk management strategies.

The possible regulatory and non-regulatory options have been further clarified since Draft Assessment and they are:

6.1 Non-regulatory options

Option 1: Maintain the status quo and allow raw cassava and raw bamboo shoots to be sold with or without provision of consumer information in relation to appropriate preparation techniques.

Option 2: Encourage voluntary consumer information provision about the appropriate preparation of raw cassava and raw bamboo shoots through industry self-regulation.

6.2 Regulatory options

Option 3: Require mandatory information, through Standard 1.2.6 to accompany the sale of raw cassava and raw bamboo shoots to allow its safe consumption. The required directions would be: a statement indicating that cassava should be peeled and fully cooked before being consumed; and a statement indicating that bamboo shoots should be fully cooked before being consumed.

Option 4: Require mandatory information, through Standard 1.2.6, to accompany the sale of raw cassava and raw bamboo shoots to allow their safe consumption. Limit cassava to sweet varieties of cassava through Standard 1.4.4 and define sweet cassava as those varieties of cassava that contain less than 50 mg/kg hydrogen cyanide (fresh weight basis) in Standard 1.1.2. The proposed amendments to the Code would include an additional variation to Standard 1.2.1 which will give effect to the proposed amendments in Standard 1.2.6. In this case the required directions would be: a statement indicating that sweet cassava be peeled and fully cooked before being consumed; and a statement indicating that bamboo shoots be fully cooked before being consumed.

The Codex Standard for sweet cassava defines ‘sweet cassava’ by way of numerical value for hydrogen cyanide content even though this is technically not a safety value, but a value to distinguish ‘sweet’ cassava that is traded commercially from ‘bitter’ cassava which is generally only used in situations of food shortage. It is worth noting the following difficulties in establishing a maximum level for hydrogen cyanide in cassava and/or bamboo shoots that would have otherwise been encountered in the absence of a Codex definition for sweet cassava:

- There are a large number of different varieties of both cassava and bamboo shoots. Varieties that are higher in cyanogenic glycosides require more extensive processing prior to consuming, however, it is possible to consume these varieties safely with adequate processing.
- The cyanogenic glycoside content varies extensively even within the same species because of growing and weather conditions. For example, in times of drought, the cyanogenic glycoside content of all varieties increases.

The industry has indicated that varieties of cassava and bamboo shoots known to be generally lower in cyanogenic glycoside content are used in Australia and New Zealand. Most of the cassava in Australia and New Zealand is imported from Pacific Island countries, which are varieties that are generally low in cyanogenic glycosides.

7. Impact Analysis

7.1 Affected Parties

Affected parties identified by the regulatory options outlined in section 6 include:

- Consumers of cassava or bamboo shoots including both:
 - a. current consumers of cassava or bamboo shoots who are aware of appropriate preparation techniques, including people of Pacific Island or Asian descent living in Australia or New Zealand; and
 - b. potential consumers of cassava or bamboo shoots who are not aware of appropriate preparation techniques.
- Government enforcement agencies that may need to accommodate enforcement of labelling in relation to preparation of raw produce and/or maximum levels of hydrogen cyanide in processed products, depending on the preferred regulatory option.

- Industry including:
 - a. those wishing to grow, import and/or sell cassava or bamboo shoots in Australia and/or New Zealand; and
 - b. growers and/or exporters of cassava and/or bamboo shoots in other countries, mainly Pacific Island countries and Asian countries.
- Health professionals including general practitioners or staff at hospitals who would treat potential cases of cyanide poisoning or cyanide diseases associated with consumption of inappropriately prepared cassava or bamboo shoots.

7.2 Data Collection

The safety issues related to the consumption of inadequately prepared cassava or bamboo shoots (Attachment 2) are used to inform the impact analysis of various regulatory and non-regulatory options.

Dietary exposure data used to assess the likelihood of inadequately prepared cassava or bamboo shoots being consumed by the Australian and New Zealand populations or any sub-groups thereof was obtained from the 1995 Australian National Nutrition Survey and the 1997 New Zealand National Nutrition Survey as discussed in section 5.3 of this Report. Additional information was obtained from South Pacific Trade Commission, New Zealand⁹ and through personal communications with researchers in the field.

The aforementioned document produced by the South Pacific Trade Commission, New Zealand, was also used to estimate the impacts of various regulatory and non-regulatory options on the industry involved in growing, importing, exporting and selling cassava.

7.3 Impact Analysis

7.3.1 Option 1

Maintain the status quo and allow raw cassava and raw bamboo shoots to be sold with or without provision of consumer information in relation to appropriate preparation techniques.

7.3.1.1 Consumers

There will be no impact on those already consuming cassava and/or bamboo shoots in Australia and New Zealand who are aware of necessary preparation prior to consumption. The potential risk to the public safety of new consumers of cassava and/or bamboo shoots who are unaware of the risks associated with inadequate preparation or necessary preparation techniques represents a potential cost to the broader community.

7.3.1.2 Government

There will be no impact on government enforcement agencies.

⁹ Exporting Fruit and Vegetables to New Zealand, A guide for Pacific Island Producers (revised 2000). South Pacific Trade Commission, Auckland, New Zealand.

7.3.1.3 Industry

There will be no impact on growers, importers/exporters or sellers of cassava or bamboo shoots. The industry can continue to take a pro-active approach to informing the public by voluntarily labelling if they wish.

7.3.1.4 Health professionals

There is currently little impact on health professionals since cases of dietary cyanide poisoning from cassava or bamboo shoots are unlikely given the current low levels of intake in the Australian and New Zealand communities. This Option may present a potential cost to health professionals if new consumers of cassava or bamboo shoots are not informed of appropriate preparation requirements and eat inadequately prepared or raw produce.

7.3.2 Option 2

Encourage voluntary consumer information provision about the appropriate preparation of raw cassava and raw bamboo shoots through industry self-regulation.

7.3.2.1 Consumers

There will be no impact on those already consuming cassava and/or bamboo shoots in Australia and New Zealand who are aware of necessary preparation prior to consumption. There is a potential benefit to new consumers of cassava and/or bamboo shoots that are unaware of appropriate preparation techniques. However, this potential benefit of appropriate information may not necessarily be distributed evenly throughout the community since the decision to provide information to the consumer would be at the discretion of the industry. Although it is likely that industry will choose to provide information to consumers of their product, voluntary inclusion of preparation directions will not be enforceable and may not adequately assure public safety of all consumers.

7.3.2.2 Government

There would be no impact on government enforcement officers since the information provided by industry would be voluntary.

7.3.2.3 Industry

There may be a potential cost to industry to pay for the provision of additional information in conjunction with the product, if industry chooses to provide this information. However, this potential cost is likely to be balanced, if not outweighed, by the consumer trust in the credibility of the industry and the increased awareness of the consumers.

7.3.2.4 Health professionals

There is currently little impact on health professionals since cases of dietary cyanide poisoning from cassava or bamboo shoots are unlikely given the current low levels of intake in the Australian and New Zealand communities.

Encouraging the voluntary provision of information in conjunction with the produce may, depending on the extent to which it is taken up by industry, reduce the potential cost of the risk to public safety of new consumers without knowledge about appropriate preparation.

7.3.3 Option 3

Require mandatory information, through Standard 1.2.6 to accompany the sale of raw cassava and raw bamboo shoots to allow its safe consumption. The required directions would be: a statement indicating that cassava should be peeled and fully cooked before being consumed; and a statement indicating that bamboo shoots should be fully cooked before being consumed.

7.3.3.1 Consumers

There would be little impact on current consumers who are aware of appropriate preparation. The safety of potential consumers would be assured by the requirement for industry to provide information to enable the safe use of the food, representing a benefit to the broader community.

7.3.3.2 Government

There would be a cost to government enforcement agencies who would need to ensure that required information on appropriate preparation be supplied in conjunction with the food.

7.3.3.3 Industry

There would be a cost to industry of providing required information on appropriate preparation techniques in conjunction with the food. As with Option 2, the benefit of increased credibility and public awareness in the market may, in part, outweigh this cost.

7.3.3.4 Health professionals

There is a potential benefit to health professionals of increased awareness of the consumers and potential consumers and this is likely to translate in reducing any potential for inappropriate consumption of cassava or bamboo shoots by new consumers.

7.3.4 Option 4

Require mandatory information, through Standard 1.2.6, to accompany the sale of raw cassava and raw bamboo shoots to allow its safe consumption. Limit cassava to sweet varieties of cassava through Standard 1.4.4 – Prohibited and Restricted Plants and Fungi and define sweet cassava as those varieties of cassava that contain less than 50 mg/kg hydrogen cyanide (fresh weight basis) in Standard 1.2.1 – Supplementary Definitions for Foods. The proposed amendments to the Code would include an additional variation to Standard 1.2.1 – Application of Labelling and Other Information Requirements, which will give effect to the proposed amendments in Standard 1.2.6. In this case the required directions would be: a statement indicating that sweet cassava be peeled and fully cooked before being consumed; and a statement indicating that bamboo shoots be fully cooked before being consumed.

7.3.4.1 Consumers

There would be little impact on current consumers who are aware of appropriate preparation. The safety of potential consumers would be assured by the requirement for industry to provide information to enable the safe use of the food, representing a benefit to the broader community. There would be an additional benefit to all consumers of cassava as only low cyanide varieties of cassava (i.e. sweet cassava) will be available.

7.3.4.2 Government

There would be a cost to government enforcement agencies who would need to ensure that required information on appropriate preparation be supplied in conjunction with the food. There would be an additional cost associated with this Option of testing raw produce for hydrogen cyanide content and/or processed products derived from cassava and bamboo shoots.

7.3.4.3 Industry

There would be a cost to industry of providing required information on appropriate preparation techniques in conjunction with the food. As with Option 2, the benefit of increased credibility and public awareness in the market may, in part, outweigh this cost. This Option represents a further cost to industry in that they would need to be aware of the variety of cassava and its hydrogen cyanide content. This cost of ensuring an appropriate level of hydrogen cyanide in raw produce may impact on a different industry sector.

7.3.4.4 Health professionals

There is a potential benefit to health professionals of increased awareness of the consumers and potential consumers as per Option 3. There is a further benefit that all cassava consumed would be low cyanide varieties (i.e. sweet cassava), further reducing any potential for inappropriate consumption of cassava by new consumers.

7.3.5 Summary

Option 4 provides a benefit to consumers and health professionals in protecting public safety by ensuring the provision of preparation directions to enable safe use. There is further protection of the public safety of consumers in providing a maximum level of hydrogen cyanide for cassava (by adopting the level set in the Codex standard for sweet cassava), although it is not currently feasible to develop such a level for fresh bamboo shoots. Implementation of Option 4 is likely to result in some cost to enforcement agencies and to some industry sectors, however, some producers and/or importers have already initiated providing preparation directions. This cost is outweighed by our obligation to protect public safety by ensuring consumers have adequate information to safely prepare and eat cassava and/or bamboo shoots. Option 4 is the preferred regulatory option.

8. Consultation

Although FSANZ did not form a formal external advisory group, a number of interested parties were consulted with during the course of the draft assessment including: the Australian Commercial Bamboo Corporation; Dr Howard Bradbury of the Australian National University who has undertaken extensive research on cassava and developed simple kits to determine the total cyanide content of cassava; and Ms Tanja Briski, a technical specialist in toxicology at Auckland hospital undertaking a masters project on cassava.

8.1 Submissions in response to the Initial Assessment Report

A total of eight submissions were received in response to the Initial Assessment Report, which was released for public comment in August 2002. These submissions are summarised at Attachment 3. Five of these submissions were from Australia, two from New Zealand and one from the Secretariat of the Pacific Community. Only three of the eight submitters stated a preference for a regulatory option. Of these three submitters, one favoured Option 2, and the other two favoured Option 3 in combination with Option 4. A fourth submitter suggested implementing any risk management option through Standard 1.2.6 – Directions for use and storage, if necessary. The remainder of submitters felt that there was insufficient information on the level of risk provided in the Initial Assessment Report to enable them to support any one regulatory option over the others posed.

8.2 Submissions in response to the Draft Assessment Report

A total of seven submissions were received in response to the Draft Assessment Report (DAR), which was released for public comment in September 2003. Five of these were from Australia, one from New Zealand and one from Fiji. The majority of submitters (six out of the seven) supported the intent of the recommendations, either Option 3 or Option 4 presented in DAR.

8.3 World Trade Organization (WTO)

As members of the World Trade Organization (WTO), Australia and New Zealand are obligated to notify WTO member nations where proposed mandatory regulatory measures are inconsistent with any existing or imminent international standards and the proposed measure may have a significant effect on trade.

A Codex standard for cassava has been adopted and the proposed changes to regulation in this Report with respect to cassava are consistent with the Codex standard. The commercial trade in both bamboo shoots and cassava is relatively small and these proposed regulatory changes are likely to have a minimal impact on trade. However, most of cassava available in Australia and New Zealand is imported from neighbouring Pacific Island countries and the proposed requirement to provide directions for preparation may have an impact on growers and/or exporters of cassava in these countries.

Notification was made to the agencies responsible in accordance with Australia and New Zealand's obligations under the WTO Sanitary and Phytosanitary Measure (SPS) agreement. This enabled other WTO member countries to comment on proposed changes to standards where they may have a significant impact on them.

One submission was received in response to this notification from the General Director, Central Laboratory for Food and Feed, Agriculture Research Centre, Ministry of Agriculture, Egypt, which was supportive of the recommendations of the Draft Assessment Report.

9. Conclusion and Recommendation

It is agreed that directions should be required to accompany the sale of cassava and bamboo shoots, in Standard 1.2.6 – Directions for Use and Storage – of the Code. It is agreed that required directions should be: a statement indicating that cassava should be peeled and fully cooked before being consumed; and a statement indicating that bamboo shoots should be fully cooked before being consumed. It is agreed that cassava be limited to sweet varieties of cassava through Standard 1.4.4 – Prohibited and Restricted Plants and Fungi and sweet cassava be defined as those varieties of cassava that contain less than 50 mg/kg hydrogen cyanide (fresh weight basis) in Standard 1.1.2 – Supplementary Definitions for Foods. The proposed amendments to the Code, including additional Code variations in Standard 1.2.1 – Application of Labelling and Other Information Requirements, which give effect to the proposed amendments in Standard 1.2.6, are at Attachment 1.

The above amendments to the Code are agreed for the following reasons:

- There is the potential for cassava and bamboo shoots to pose a public health and safety risk if the food is not prepared properly.
- There is insufficient knowledge in the general community of preparation techniques sufficient to enable safe use.
- The definition of sweet varieties of cassava and the requirement to have directions for preparation are consistent with the Codex standard for sweet cassava.
- There is likely to be minimal cost to either the cassava or bamboo industry given that some sectors of the industry have voluntarily developed and provided preparation instructions to accompany the sale of the fresh produce, and the text required to be provided will not be prescribed by the Code.

10. Implementation and review

The amendments to the Code with respect to Standard 1.2.6 – Directions for use and storage, Standard 1.4.4 – Prohibited and Restricted Plants and Fungi, Standard 1.1.2 – Supplementary Definitions for Food, and Standard 1.2.1 – Application of Labelling and Other Information Requirements, would come into effect upon gazettal, subject to any request from the Ministerial Council for a review.

ATTACHMENTS

1. Draft variations to the *Australia New Zealand Food Standards Code*
2. Safety assessment report
3. Summary of submissions to the Initial and Draft Assessment Reports

Draft Variations to the *Australia New Zealand Food Standards Code*

To commence: On gazettal

[1] **Standard 1.1.2** of the *Australia New Zealand Food Standards Code* is varied by –

[1.1] *inserting in clause 1*

sweet cassava means those varieties of cassava roots grown from *Manihot esculenta* Crantz of the *Euphorbiaceae* family that contain less than 50 mg per kg of hydrogen cyanide (fresh weight basis)

[1.2] *inserting after clause 1*

Editorial note:

Sweet cassava may also be known by other common names including manioc, mandioca, tapioca, aipim and yucca.

[2] **Standard 1.2.1** of the *Australia New Zealand Food Standards Code* is varied by –

[2.1] *omitting paragraphs 2(2)(a) to 2(2)(o) substituting –*

- (a) subclause 2(2) of Standard 1.2.3; and
- (b) subclause 3(2) of Standard 1.2.3; and
- (c) subclause 4(2) of Standard 1.2.3; and
- (d) subclause 5(2) of Standard 1.2.3; and
- (e) clause 2 of Standard 1.2.6; and
- (f) subclause 4(2) of Standard 1.2.8; and
- (g) subclause 4(3) of Standard 1.2.8; and
- (h) subclause 4(3) of Standard 1.5.2
- (i) clause 6 of Standard 1.5.3; and
- (j) subclause 2(3) of Standard 1.2.10; and
- (k) subclause 4(3) of Standard 2.2.1; and
- (l) clauses 5, 6, and 10 of Standard 2.2.1; and
- (m) clause 3 of Standard 2.2.3; and
- (n) subclause 3(2) of Standard 2.6.3; and
- (o) subclause 3(3) of Standard 2.6.4; and
- (p) subclause 3(4) of Standard 2.6.4.

[3] **Standard 1.2.6** of the *Australia New Zealand Food Standards Code* is varied by –

[3.1] *omitting clause 2 substituting –*

2. Circumstances where food must be labelled with, or accompanied by directions

(1) The label on a package of food must include directions for the use or storage of the food, where the food is of a nature as to warrant such directions for reasons of health or safety; or

(2) Where the food is unpackaged, the food must be either labelled with or accompanied by directions for the use or storage of the food, where the food is of a nature as to warrant such directions for reasons of health or safety.

[3.2] *inserting after clause 2*

3. Circumstances applying to specific foods

Notwithstanding the provisions of clause 2, any food listed in Column 1 of the Table to this clause must be labelled with or accompanied by the directions for use or storage specified in Column 2:

Table to clause 3

Column 1	Column 2
Food	Directions required to be supplied
Bamboo Shoots (raw)	A statement indicating that bamboo shoots should be fully cooked prior to being consumed
Sweet Cassava (raw)	A statement indicating that sweet cassava should be peeled and fully cooked before being consumed

[3.3] *omitting the Editorial note substituting –*

Editorial note:

Clause 2 of this Standard operates in addition to clause 6 of Standard 1.2.5 which requires the label on a packet of food to include a statement of the conditions of storage where this is necessary to ensure the food will keep for the specified period indicated by the use-by date or best-before date.

Food Product Standards in Chapter 2 of this Code may contain directions for use and/or storage specific to that individual commodity.

The Table to clause 3 is for those foods where there is potential for the food to cause an acute public safety risk if the food is not prepared properly, and where there is insufficient knowledge in the general community of preparation techniques sufficient to enable safe use of the food.

It is not intended that the following be captured: canned bamboo shoots; cassava flour/tapioca flour; tapioca pearls; tapioca pudding; cassava chips (including chips that are made from tapioca or cassava flour) or any other fully processed product that contains cassava, cassava flour, tapioca flour, tapioca pearls or bamboo shoots.

[4] **Standard 1.4.4** of the Australia New Zealand Food Standards Code is varied by –

[4.1] *inserting in Column 1 and Column 2 respectively of Schedule 1 immediately before the entry for Melia azedarach –*

Manihot esculenta Crantz (other than Sweet Cassava)

Cassava

[4.2] *inserting as the second paragraph in the Editorial note at the end of Schedule 1 –*

Sweet cassava is defined in Standard 1.1.2 and the requirements for it are contained in clause 2 of 1.2.1 and clause 3 of Standard 1.2.6
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Safety Assessment Report

CYANOGENIC GLYCOSIDES IN CASSAVA AND BAMBOO SHOOTS

1 Characterisation of the cyanogenic potential of cassava and bamboo shoots

1.1 Cyanogenic glycosides in plants

The cyanogenic glycosides (CG) may be defined chemically as glycosides of the α -hydroxynitriles and belong to the secondary metabolites of plants. They are amino acid-derived plant constituents. The biosynthetic precursors of the CGs are different L-amino acids, which are hydroxylated, then the *N*-hydroxylamino acids are converted to aldoximes and these are converted into nitriles and hydroxylated to α -hydroxynitriles and then glycosylated to CGs (Vetter, 2000). All known CGs are β -linked, mostly with D-glucose.

There are at least 2650 species of plants that produce CGs and usually also a corresponding hydrolytic enzyme (beta-glycosidase), which are brought together when the cell structure of the plant is disrupted by a predator, with subsequent breakdown to sugar and a cyanohydrin, that rapidly decomposes to hydrogen cyanide (HCN) and an aldehyde or a ketone (Hosel, 1981; Moller and Seigler, 1999). The glycosides, cyanohydrins and hydrogen cyanide are collectively known as cyanogens. This combination of cyanogenic and hydrolytic enzyme is the means by which cyanogenic plants are protected against predators (Jones, 1998; Moller and Seigler, 1999).

There are approximately 25 CGs known with the major CGs found in the edible parts of plants being: amygdalin (almonds); dhurrin (sorghum); linamarin (cassava, lima beans); lotaustralin (cassava, lima beans); prunasin (stone fruit); and taxiphyllin (bamboo shoots).

The potential toxicity of a cyanogenic plant depends primarily on the potential that its consumption will produce a concentration of hydrogen cyanide that is toxic to exposed humans. If the cyanogenic plant is inadequately detoxified during processing or preparation of the food, the hydrogen cyanide can be toxic. If the cyanogenic plant is consumed directly, the beta-glycoside can be released and is then active until the low pH of the stomach deactivates the enzyme, releasing at least part of the potential hydrogen cyanide. It is possible that part of the enzyme fraction can be reactivated in the alkaline environment of the gut (WHO, 1993). The toxicity of cyanide and cyanogenic glycosides is discussed in section 2 of this report.

1.1.1 Cassava

In cassava, the major cyanogenic glycoside is linamarin, while a small amount of lotaustralin (methyl linamarin) is also present, as well as an enzyme linamarinase. Catalyzed by linamarinase, linamarin is rapidly hydrolysed to glucose and acetone cyanohydrin and lotaustralin hydrolysed to a related cyanohydrin and glucose. Under neutral conditions,

acetone cyanohydrin decomposes to acetone and hydrogen cyanide. This reaction for linamarin is shown below in Figure 1.

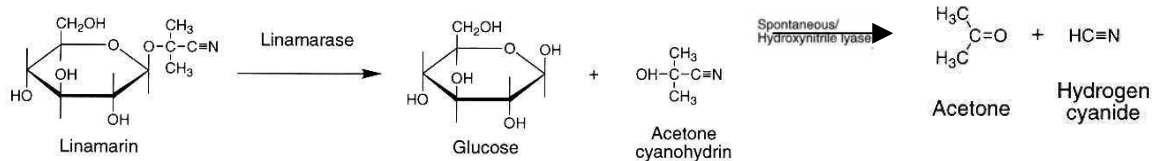


Figure 1: Reaction of linamarin with linamarinase in cassava

If the cassava plant is not adequately detoxified during the processing or preparation of the food, it is potentially toxic because of the release of this preformed hydrogen cyanide. The hydrogen cyanide is readily removed during processing of cassava, however, the presence of residual linamarin and its acetone cyanohydrin in cassava-based food products has the potential to cause adverse health effects.

1.1.2 Bamboo shoots

Bamboo shoots contain the cyanogenic glycoside taxiphyllin, which is a p-hydroxylated mandelonitrile tiglochlinin. Taxiphyllin is hydrolysed to glucose and hydroxybenzaldehyde cyanohydrin. Benzaldehyde cyanohydrin then decomposes to hydroxybenzaldehyde and hydrogen cyanide.

1.2 Botanical names for cassava and bamboo shoots and their characteristics

1.2.1 Cassava

The botanical name for cassava is *Manihot esculanta* Crantz and it is a member of the Euphorbiaceae (Surge) family. Cassava is also known by the other common names: manioc, manihot, and yucca. Cassava originates in Latin America and was later introduced into Asia and Africa.

Cassava is a perennial woody shrub that grows 1-3 m tall. It grows well between 30 degrees north and 30 degree south of the equator, from sea level to an altitude of 2,000 m. Deep soil and regular rains are needed and the ideal growing temperature is about 20 degrees. Cassava is propagated by 20-30 cm long cuttings of the woody stem and plants are usually spaced at 1 to 1.5 m. Cassava is often planted with other crops such as beans or maize.

The plant parts used are the storage root and leaves. The starchy tuber is most commonly consumed and very large tubers may reach the size of 0.5 m long and 10 cm diameter.

There are a number of varieties of cassava which range from low cyanide content (referred to as 'sweet cassava') to higher cyanide content (referred to as 'bitter cassava'). Bitter cassava requires more extensive processing (sometimes more than one day) to remove the cyanogenic potential than sweet cassava.

1.2.2 Bamboo shoots

There are approximately 1200 species of Bamboo. Bamboo species can be categorised into two groups: the clumping types with short rhizomes (underground stems) botanically referred to as sympodial; and the running types with long rhizomes, referred to as monopodial.

In general, the clumping types are adapted to sub-tropical and tropical climates and produce shoots after mid-summer, while the runners are adapted to cooler climates and produce shoots in spring. Clumping types have larger shoots (up to 5 kg each) than those of running types (usually not greater than 1.5 kg each) and are harvested when shoots are above ground, in contrast to shoots of running types which are mainly below soil surface at harvest (Midmore, 1988).

While there are approximately 1200 species of bamboo, only a few have been used as human food in Asia and Australia (personal communication from Australian Commercial Bamboo Corporation Ltd.). Those currently used in Australia that FSANZ is aware of include:

- *Dendrocalamus asper*;
- *Dendrocalamus latiflorus*;
- *Bambusa oldhamii*; and
- *Phyllostachys pubescens*.

Dendrocalamus asper is the most important species in for shoot production in Thailand (Fu et al., 1987), while *Dendrocalamus latiflorus* and *Bambusa oldhamii* are the most important in Taiwan (Tai, 1985). The different bamboo species also have different levels of cyanide. The characteristics of the above varieties are described by Midmore (1998) below:

Dendrocalamus latiflorus: Mature plantations give shoots up to 60 cm in length and weigh 3-5 kg.

Dendrocalamus asper: Shoots can reach 30 cm in diameter, 30 cm in length and weigh 4-7 kg.

Bambusa oldhamii: Small diameter shoots (approximately 10 cm) weighing approximately 0.5 kg. This variety has good eating quality.

Phyllostachys pubescens: Shoots range from 7.5 to 15 cm in diameter and weigh on average 1.5 kg.

A period of three to seven years is required between establishing a bamboo plantation and the harvesting of commercial-sized shoots. In Australia, the season for availability of fresh bamboo is from September until April (Midmore, 1988).

1.3 Cyanide concentrations in cassava and bamboo shoots

The actual levels of CGs of a cyanogenic plant is influenced by various factors, both developmental (endogenous) and ecological (exogenous). The whole development cycle of the cyanogenic plants show characteristic changes in their CG (and HCN) contents (Vetter, 2000).

1.3.1 Cassava

There are many varieties of cassava and the cyanide content differs as well as the suitability for different growing and consumption conditions. Usually higher cyanide content is correlated with higher yields. During periods of drought the cyanide content of both sweet and bitter cassava varieties increases (Bokanga et al., 1994). Bitter cassava varieties are more drought resistant and thus more readily available and cheaper. However, owing to food

shortage in times of drought, less time is available for the additional processing required (Akintonwa and Tunwashe, 1992).

Values from 15 to 400 mg/kg of fresh weight of hydrocyanic acid in cassava roots have been mentioned in the literature. Sweet varieties of cassava will typically contain approximately 15 to 50 mg/kg hydrogen cyanide on fresh weight basis. Cassava leaves contain approximately 10% more linamarin than cassava roots.

1.3.2 *Bamboo shoots*

A WHO report (1993) states that the concentration of cyanide in the immature shoot tip of bamboo is 8000 mg HCN/kg, whereas Ferreira et al. (1990) report that bamboo shoots contain as much as 1000 mg/kg HCN in the apical part. A sample of *Dendrocalamus giganteus* contained, on average, 894 mg/kg HNC (Ferreira et al., 1995). The discrepancy between the two reported levels likely reflects the large number of varieties and their varying cyanide contents. It is likely that the varieties normally eaten contain, on average, closer to 1000 mg/kg HCN. This total amount of cyanide appears quite high in comparison with the concentrations of cyanide in cassava however, the cyanide content in bamboo shoots decreases substantially following harvesting.

1.4 **Traditional preparation of cassava and bamboo shoots**

1.4.1 *Cassava*

Cassava roots are highly perishable and deteriorate in air at ambient temperature in 3-4 days. In subsistence agriculture the plants are left in the ground until needed for food processing.

Cassava is consumed in a number of forms: flour used for cooking; root slices; root chips; baked grated root; steamed grated root; pan fried grated root; steamed whole root; and tapioca pearls made as a pudding. There are many traditional methods for the preparation of cassava used around the world and some of these are discussed below.

In East Africa either sun drying or heap fermentation are used. Sun drying involves peeling the roots, followed by drying the whole roots or large pieces cut longitudinally in the sun. The brittle dry material is then pounded in a wooden mortar and pestle and sieved to remove fibrous material, which produces white flour. Heap fermentation is more work intensive and time consuming. It involves peeling and cutting the roots and leaving them in a small heap for 3-5 days during which some fermentation takes place with liberation of hydrogen cyanide. The roots are then sun dried, pounded and sieved to produce white flour. Flour produced by heap fermentation is slightly dark coloured and contains only about one half of total cyanide content of the white flour produced by sun drying (Cardoso et al., 1998). In times of drought when the total cyanide content of roots is high, heap fermentation is preferred over sun drying (Ernesto et al., 2002).

In Western Africa a roasted product called 'gari' is made where the ground cassava is stored in a bag for 2-3 days, the excess water then squeezed out in a press, the damp product dried and the hydrogen cyanide removed by roasting in a metal dish over a wood fire.

Cassava leaves are also an important part of the diet in countries such as Sierra Leone, Guinea, the Democratic Republic of Congo and the Central African Republic where they are consumed as a basic vegetable. For example, Mpondu is prepared by grinding young cassava leaves, usually after blanching, and boiling them extensively (Simons et al., 1980).

In the South Pacific including Papua New Guinea and Fiji, the introduced cassava varieties are virtually all sweet and the roots after peeling may be safely boiled and eaten. In some parts of the Pacific, cassava roots are placed in shallow pits surrounded by damp sawdust and the pit is then covered with soil, preserving the roots for several months (Cassava Leaflet No. 5, South Pacific Commission, 1995).

In Indonesia, a product called gaplek is used which is the peeled dried cassava tuber (Djazuli and Bradbury, 1999).

1.4.2 *Bamboo shoots*

The following steps are typically taken in the preparation of bamboo shoots:

- Fresh bamboo shoots are cut in half lengthwise.
- The outer leaves are peeled away and any fibrous tissue at the base is trimmed.
- The bamboo shoot is thinly sliced into strips.
- The shoots are boiled in lightly salted water for 8-10 minutes.

In Thailand and Vietnam some shoots are finely grated and used in salads. In Japan, shoots are sometimes boiled whole for in excess of 2 hours. The most common preparation involves boiling the shoots in stocks, soups or salted water for use in assorted dishes.

1.5 **Cyanogen content of processed products**

1.5.1 *Cassava flour and other products*

The safe level of cyanogens in cassava flour has been set by the WHO as 10 ppm (FAO/WHO, 1991), while the acceptable level in Indonesia is 40 ppm (Damardjati et al., 1993).

The total cyanogen content of cassava flour has been determined in African countries including different providences of Mozambique, Tanzania, and the Central African Republic. Djazuli and Bradbury (1999) also surveyed the total cyanogen content of cassava roots, cassava flour, cassava chips and gaplek in various cassava growing provinces of Indonesia. These results are summarised in Table 1 below.

Table 1: Total cyanogens content of cassava flour

Source of flour	Year obtained	Number of samples surveyed	Author(s)	Total cyanogens content (ppm)
Mujocojo (Nampula, Mozambique)	1996	32	Cardoso et al., 1998	49(±29)
Mujocojo (Nampula, Mozambique)	1997	30	Ernesto et al., 2000	26(±23)
Terrene A (Nampula, Mozambique)	1996	22	Cardoso et al., 1998	43(±30)
Terrene A (Nampula, Mozambique)	1997	30	Ernesto et al., 2000	13(±19)
Acordos de Lusaka	1997	30	Cardoso et al., 1998	67(±39)

Indonesia (East Java, Central Java, West Java and Lampung in Sumatra)	1996	59	Djazuli and Bradbury, 1999	22 samples of starch and 8 other products: 5(±4) 14 samples of cassava flour, 9 samples of cassava chips and six samples of gaplek: 54(±51)
Tanzania	-	-	Mlingli et al., 1992	131(±71)
Central African Republic	-	-	Tylleskar et al., 1992	32

A document obtained from the internet entitled ‘Cassava based foods: A step towards safer consumption’¹⁰ provides the cyanogenic potential of a number of commercially processed cassava-based products prepared from cassava roots and flour. These values are shown in Table 2 below.

Table 2: Cyanogenic potential of commercially processed cassava-based products prepared from cassava roots and flour

Generic name	Preparation	Cyanogenic potential (ppm)
Chilli tapioca	Root slices	2.8(±0.8)
Tapioca crisps	Root slices	3.2(±1.1)
Tapioca sticks	Root chips	4.5(±0.8)
Tapioca chips	Root slices	6.6(±2.7)
Tapioca crackers	Flour	1.5(±0.7)
Opak sambal	Flour	2.1(±0.5)
Tapioca crisps		4.1(±1.5)
Tapioca chips (BBQ)	Flour	4.6(±1.3)
Tapioca chips (seaweed)	Flour	5.3(±1.2)
Tapioca chips (chilli chicken)	Flour	6.1(±1.4)

1.5.2 Canned bamboo shoots

Ferreira et al. (1995) assessed the optimal cooking conditions for the reduction in the initial HCN levels. Bamboo shoots were cooked (one part bamboo shoots, 4 parts water) for 20, 100 and 180 minutes at 98°C/ambient pressure, 110°C/14.5 x 10⁴ kPa, and 122°C/21.12 x 10⁴ kPa. The shoots were then cooled in water, canned and sterilized. The maximum removal of HCN was about 97% leaving a residue level of about 27 mg/kg HCN in the canned sterilized product. The optimum conditions that resulted in this reduction of HCN were 98-102°C for 148-180 minutes.

2 Toxicological summary

2.1 Introduction

¹⁰ sourced from: <http://staff.science.nus.edu.sg/~dbsyhh/web%20cassava%20food%20safety%20.htm>

The potential toxicity of a food produced from a cyanogenic plant depends on the likelihood that its consumption will produce a concentration of HCN that is toxic to exposed animals or humans. The factors that are important in this toxicity are:

- If the plant is not sufficiently detoxified during processing or preparation, preformed HCN is released.
- If the plant is consumed raw or not sufficiently processed prior to consumption, part of the potential HCN is released, until the low pH of the stomach deactivates the β -glucosidase enzyme.
- The β -glucosidase enzyme may be reactivated in the alkaline environment of the gut, resulting in further release of HCN.

Cyanide ingested by release from a plant containing cyanogenic glycosides, either prior to or following consumption, follows the known cyanide metabolic pathway and toxicokinetics for animals and humans. Cyanide is detoxified by the enzyme rhodanase, forming thiocyanate, which is excreted in the urine. There are several factors influencing hydrolysis of cyanogenic glycosides including the confounding influence of nutritional status, particularly blood levels of riboflavin, vitamin B12, sodium and methionine). Because of this, human cases studies and epidemiological studies of the chronic toxicological effects have shown variable results and are rarely of a quantitative nature.

The following information is largely summarised from a WHO Report (1993), unless referenced otherwise. The WHO Report discusses the toxicity of cyanide and cyanogenic glycosides separately. The toxicity of cyanide is discussed first as a basis for understanding that of cyanogenic glycosides. This Report summarises both cyanide and cyanogenic glycosides together.

2.2 Metabolic pathway and toxicokinetics

Hydrogen cyanide after oral ingestion or administration is readily absorbed and rapidly distributed in the body through the blood. It is known to combine with iron in both methaemoglobin and haemoglobin present in erythrocytes. The cyanide level in different human tissues in a fatal case of HCN poisoning has been reported gastric content, 0.03; blood, 0.5; liver, 0.03; kidney, 0.11; brain, 0.07; and urine, 0.2 (mg/100g).

The major defence of the body to counter the toxic effects of cyanide is its conversion to thiocyanate mediated by the enzyme rhodanase (discovered by Lang, 1933). The enzyme contains an active disulfide group which reacts with the thiosulphate and cyanide. The enzyme is localized in the mitochondria in different tissues and is relatively abundant, but in sites which are not readily accessible to thiosulphate, the limiting factor for the conversion of cyanide is thiosulphate. This detoxification requires sulphur donors, which by different metabolic pathways are provided from dietary sulphur amino acids (Bradbury and Holloway, 1988; Rosling, 1994). If the dietary intake of sulphur amino acids is adequate, the sulphur containing amino acids methionine and cysteine, which are not required for protein synthesis, are degraded to inorganic sulphate and excreted in the urine.

There are also several minor reactions which detoxify ingested cyanide. Firstly, cystine may react directly with the cyanide to form 2-imino-thiazolidine-4-carboxylic acid which is excreted in the saliva and urine. Secondly, a minor amount may be converted into formic acid which may be excreted in urine.

Thirdly, cyanide may combine with hydroxycobalamin (vitamin B12) to form cyanocobalamin which is excreted in the urine and bile (it may be reabsorbed by the intrinsic factor mechanism in the ileum allowing effective recirculation of vitamin B12). Fourthly, Methaemoglobin effectively competes with cytochrome oxidase for cyanide and its formation from haemoglobin, effected by sodium nitrite or amyl nitrite, is exploited in the treatment of cyanide intoxication.

2.2.1 *Studies involving cassava*

A part of ingested linamarin in cassava products has been found to pass through the human body unchanged and it is excreted in the urine within 24 hours in both humans (Brimer and Rosling, 1993; Carlsson et al., 1995; Hernandez et al., 1995) and rodents (Barrett et al., 1977). Remaining cyanohydrins are assumed to break down to cyanide in the alkaline environment of the gut (Tylleskar et al., 1992). Carlsson et al. (1999) investigated the metabolic fate of linamarin in cassava flour when consumed as a stiff porridge, which is the most common staple food in southern Tanzania and found that less than one-half of orally ingested linamarin is converted to cyanide and hence thiocyanate, about one-quarter is excreted unchanged and another quarter is metabolized into an as yet unknown compound.

2.3 **Effects on enzymes and other biochemical parameters**

Hydrogen cyanide inactivates the enzyme cytochrome oxidase in the mitochondria of cells by binding to the $\text{Fe}^{3+}/\text{Fe}^{2+}$ contained in the enzyme. This causes a decrease in the utilization of oxygen in the tissues. Cyanide causes an increase in blood glucose and lactic acid levels and a decrease in the ATP/ADP ration indicating a shift from aerobic to anaerobic metabolism. Cyanide activates glycogenolysis and shunts glucose to the pentose phosphate pathway decreasing the rate of glycolysis and inhibiting the tricarboxylic acid cycle.

Cyanide can inhibit several other metalloenzymes most of which contain iron, copper or molybdenum (e.g. alkaline phosphatase) as well as enzymes containing Schiff base intermediates (e.g. 2-keto-4-hydroxyglutarate aldolase).

Hydrogen cyanide will reduce the energy availability in all cells, but its effect will be most immediate on the respiratory system and heart. The lethal dose for an adult depends on body weight and nutritional status and is somewhere between 30 and 210 mg of hydrogen cyanide. If the hydrogen cyanide exceeds the limit an individual is able to detoxify/tolerate, death may occur due to cyanide poisoning. Smaller, non-fatal amounts of cyanide cause acute intoxication with symptoms of rapid respiration, drop in blood pressure, rapid pulse, dizziness, headache, stomach pains, vomiting and diarrhoea.

2.4 **Toxicological studies in animals**

2.4.1 *Acute toxicity studies*

The lethal doses of HCN in mg/kg bw are generally reported to be between 0.66 (rabbit, i.v.; EPA, 1990) to 10-15 for various species (rat, oral; WHO, 1965), although much larger values have been reported for mouse (oral, 598 and i.v. 484; WHO, 1965). Lethal doses of HCN in

mg/kg bw were reported for mouse, 3.7; dog, 4.0; cat, 2.0; and for cattle and sheep, 2.0 (summarised by Conn, 1979a).

The acute toxicity studies of linamarin (the cyanogenic glycoside present in cassava) are summarised in Table 3.

Table 3: Acute toxicity studies of linamarin

Species	Route	LD ₅₀ (mg/kg bw)	References
Rat	i.v.	20 000 linamarin	Oke, 1979
Rat	oral	450 linamarin	Oke, 1979

The following studies were also described in the WHO Report (1993):

A dose of 25 mg linamarin (250 mg/kg bw) fed to rats (100-120 g bw) caused clinical signs of toxicity, including apnoea, ataxia and paresis. In the absence of methionine supplementation, 50% of these rats died within 4 hours. With adequate methionine supplementation, 10% of rats died and about 40% showed no signs of toxicity (reviewed by Oke, 1980).

In a toxicokinetic study 7 out of 10 rats (100 g bw) died after administration of 50 mg linamarin by stomach tube (Barrett et al., 1977).

Oral doses of 100, 120 and 140 mg linamarin/kg bw given by stomach tube to hamsters produced signs of cyanide intoxication in a large percentage. Two animals dosed with 140 mg/kg bw and one animal does with 120 mg/kg bw died within 2 hours of dosing (Frakes et al., 1985).

2.4.2 *Short-term toxicity studies*

Albino female rats fed a raw cassava diet showed: a decrease in haemoglobin, PCV, total serum protein concentration and T₄ concentration; and an increase in serum thiocyanate levels compared with a control group.

One day old broiler chickens were fed a diet containing 0, 10, 20 or 30% cassava. No changes in haematological parameters due to cassava were seen, however, decreased weight gain, decreased feed efficiency and increased blood serum thiocyanate concentrations were associated with cassava feeding.

2.4.3 *Reproduction studies, embryotoxicity and teratogenicity studies*

A short-term reproductive study in rats (49 day study in adults and 28 day study in pups) was performed to evaluate the cumulative effects of adding 500 mg KCN/kg to cassava root flour-based diet in pregnant rats. High dietary level of cyanide did not have any marked effect on gestation or lactation performance. The high cyanide-containing diet, however, significantly reduced feed consumption and daily growth weight of the offspring when fed during the post-weaning period. Protein efficiency rate was not only reduced by the cyanide diet during post-weaning growth phase but there was an additional carry-over effect from gestation. Serum thiocyanate was significantly increased in lactating rats and their offspring during lactation and in the post-weaning growth phase of the pups.

Pregnant golden hamsters exposed to sodium cyanide (0.126-0.1295 mmol/kg/hour) on days 6-9 of gestation, had a high incidence of resorptions and malformations in offspring, the most commonly observed being neural tube defects.

A study on albino female rats fed a 50% gari diet (Nigerian preparation of cassava), a raw cassava diet, a diet containing added KCN or a control diet investigated effects on reproduction. The offspring of the rats fed the 50% gari diet had significantly lower birth weights and brain weights and never attained the same adult weights as those of the controls. The adult females fed the raw cassava diet had a significant reduction in the frequency of pregnancy, the average number of pups per litter and birth weights among these pups. In addition there was an increased incidence of neonatal deaths among the offspring which also had poor development, reduced brain weights and an increased tendency of aggression towards their litter mates. The female rats who received additional KCN in their diet never became pregnant and survived no more than 3 months.

Reproductive effects were studied for cassava in combination with added cyanide in a 110-day feeding experiment with 18 pregnant pigs (Yorkshire gilts). Cyanide fed during gestation did not affect performance during lactation. Milk thiocyanate and colostrums iodine concentrations were significantly higher in the group fed additional cyanide. No effects of cyanide were reported on indices of reproduction performance (Tewe and Maner, 1981a).

A dose of 120 or 140 mg linamarin/kg bw in pregnant hamsters was associated with an increased incidence of vertebral and rib abnormalities as well as the production of encephaloceles in the offspring. Linamarin feeding had no effect on fetal body weight, ossification of skeletons, embryonic mortality, nor litter size.

The offspring of pregnant hamsters fed cassava meals showed evidence of: fetotoxicity; increased tissue thiocyanate concentrations; reduced fetal body weight; and reduced ossification of sacrocaudal vertebrae, metatarsals and sternebrae. There were an increased number of runts compared to litters of hamsters fed control diets.

2.4.4 *Studies on the thyroid gland*

A group of 10 male rats fed a diet containing potassium cyanide (1500 mg/kg feed) for almost one year. Compared with a control group not receiving cyanide there was depression of body weight, plasma thyroxine and thyroxine secretion rate suggestive of depressed thyroid function. At autopsy, the animals were found to have enlarged thyroids.

In a study cited by Oke (1980), the influence of a 100% cassava diet on the thyroid gland was investigated in a 7-day experiment with rats. A significant decrease in glandular stores of stable iodine, significantly higher thyroid weight and higher thyroidal ¹³¹I uptake were observed. Each effect was attributed to a synthetic block in the conversion of monoiodothyronine to diiodothyronine.

2.4.5 *Genotoxicity*

The genotoxicity studies that have been performed on *Salmonella* and *Bacillus* strains and hamsters cells have been negative with the exception of one marginally positive study (*Salmonella typhimurium* strain TA100).

An *in vivo* mutagenicity study in Chinese hamsters detecting chromosomal aberrations with cyanide with oral administration was carried out. There was no indication of mutagenic properties relative to structural chromatid or chromosome damage (Leuschner et al., 1983b).

2.4.6 *Studies on the nervous system*

A special study on the behavioural effects of chronic sub-lethal dietary cyanide in juvenile swine mimicked the situation of free cyanide intake in Liberia due to eating cassava-based foods. There were two clear behavioural trends: 1) increasing ambivalence and slower response time in reacting to various stimuli; and 2) an energy conservation gradient influencing which specific behaviours would be modified in treated animals.

Neuronal lesions including myelin damage in several animal species have been produced by chronic cyanide. The neuropathological changes include areas of focal necrosis especially around the centrum ovale, corpus striatum, corpus callosum, substantia nigra, anterior horn cells, and patchy demyelination in the periven-tircular region.

2.5 Observations in humans

2.5.1 *Acute effects and studies*

Symptoms of acute cyanide intoxication as discussed in section 2.3 are as follows: rapid respiration, drop in blood pressure, rapid pulse, dizziness, headache, stomach pains, vomiting, diarrhoea, mental confusion, twitching and convulsions. If the hydrogen cyanide exceeds the limit an individual is able to detoxify/tolerate, death may occur due to cyanide poisoning.

The acute oral lethal dose of hydrogen cyanide for human beings is reported to be 0.5-3.5 mg/kg bw. Approximately 50-60 mg of free cyanide from cassava and its processed products constitutes a lethal dose for an adult man. Data on the oral lethal dose of cyanide for man in four cases of suicide, calculated from the amount of hydrogen cyanide absorbed in the body at the time of death, and from the amount of hydrogen cyanide found in the digestive tract, differed considerably and corresponded to doses of 0.58-22 mg/kg bw (WHO, 1965).

2.5.2 *Long-term studies and cyanide diseases*

Konzo

‘Konzo’ is a local Zairean term for a disease first described in 1938 in the Democratic Republic of Congo (formally Zaire) by Trolli (1938), but has also been observed in Mozambique, Tanzania, Central African Republic and Cameroon (Ministry of Health, Mozambique, 1984; Howlett et al., 1990; Tylleskar et al., 1992, 1994; Lantrum et al, 1988; Ernesto et al., 2002). Konzo is an upper motor neuron disease characterised by irreversible but non-progressive symmetric spastic paraparesis which has an abrupt onset. It mostly affects children and women of child-bearing age. Severe cases have a spastic toe-scissor gait or patients will not be able to walk at all and the arms and speech may also be affected. A long term follow-up of konzo patients showed that the neurological signs in konzo patients remained constant, however, functional improvement may occur (Cliff and Nicala, 1997). High urinary thiocyanate concentrations and presence of ankle clonus are also observed.

In all reports of epidemics, konzo has been associated with high and sustained cyanogens intake at sub-lethal concentrations from cassava or cassava flour in combination with a low intake of sulphur amino acids.

Tropical Ataxic Neuropathy (TAN)

TAN is used to describe several neurological syndromes attributed to toxiconutritional causes. The syndromes grouped as TAN can differ widely in clinical presentation, natural history and response to treatment. TAN has occurred mainly in Africa, particularly Nigeria. The main clinical features of some of the syndromes have included: sore tongue, angular stomatitis, skin desquamations, optical atrophy, neurosensory deafness and sensory gait ataxia (in Oluwole et al, 2000). The cause is attributed to dietary cyanide exposure from the chronic monotonous consumption of foods processed from cassava. The onset of TAN is usually slow over months or years and the mean age of people affected by TAN is greater than 40 years. TAN affects males and females in all age groups equally.

Goitre and cretinism

Studies in African countries such as Zaire have established that goitre and cretinism due to iodine deficiency can be considerably aggravated by a continuous dietary cyanide exposure from insufficiently processed cassava. This effect is caused by thiocyanate, which is similar in size to the iodine molecule and interferes with uptake of iodine into the thyroid gland. High thiocyanate levels, which can occur after exposure to cyanide from cassava, can only affect the gland when the iodine intake is below 100 micrograms/day, which is regarded minimal for normal function. Populations with very low iodine intake and high thiocyanate levels from consumption of cassava, show severe endemic goitre, but this decreases with iodine supplementation (reviewed by Rosling, 1987).

3 Conclusions

Cassava and bamboo shoots contain potentially toxic cyanogenic glycosides which break down to produce hydrogen cyanide. By adequate processing, both the cyanogenic glycosides and hydrogen cyanide can be removed prior to consumption, thus significantly reducing the potential toxicity.

Sweet varieties of cassava (low cyanide content) are adequately processed by peeling and then fully cooking (e.g. roasting, baking or boiling). Bitter varieties of cassava (high cyanide content) require further processing, involving techniques such as heap fermentation, taking more than one day. Currently the commercial trade is only in sweet cassava. The varieties of bamboo shoots sold commercially for food are adequately processed by boiling before adding to dishes. If either cassava or bamboo shoots are eaten raw or processed inadequately, their consumption may lead to toxicity.

The symptoms of acute cyanide intoxication include: rapid respiration, drop in blood pressure, rapid pulse, dizziness, headache, stomach pains, vomiting, diarrhoea, mental confusion, twitching and convulsions. If the cyanide limit exceeds the limit an individual is able to detoxify, death due to cyanide poisoning may occur. The likelihood of cyanide intoxication from consumption of cassava or bamboo shoots occurring in Australia or New Zealand is low but due care in preparation remains necessary.

Other diseases related to dietary cyanide intake have been observed (konzo, tropical ataxic neuropathy, goitre and cretinism) however, these occur in countries where there is chronic consumption of cassava as a staple food, food insecurity is prevalent and dietary intake of protein and/or iodine are inadequate. Therefore, in Australia and New Zealand where neither cassava nor bamboo shoots are staple foods and the background diet of the population is adequate, these cyanide related diseases unlikely to be a concern.

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Summary of submissions

Submissions received in response to the Initial Assessment Report

A total of eight submissions were received in response to the Initial Assessment Report (IAR), which was released for public comment in August 2002. Five of these were from Australia, two from New Zealand and one from the Secretariat of the Pacific Community. Some submitters felt that there was insufficient information on the level of risk set out in the IAR to enable them to support any one regulatory option over the others.

Submitter	Preferred regulatory option	Scientific issues/toxicology	Other comments
Food Technology Association of Victoria Inc, (David Gill)	Insufficient information to assess level of risk. No preferred option stated, will await Draft Assessment Report (DAR).		Anticipate that consumers will be familiar with proper preparation however, new consumers may not be aware of necessary preparation.
Department of Health, Government of Western Australia (Dr Virginia McLaughlin)	Recommend consideration of both Option 3 (require mandatory information to accompany the sale of cassava) and Option 4 (restrict the sale of cassava to varieties that have levels of cyanogenic glycosides that do not pose public health and safety concerns).	There is an active program in the South Pacific to develop species of cassava with a low or zero level of cyanogenic glycosides.	
Secretariat of the Pacific Community (Tom Osborne, Fiji)	Support voluntary labelling (Option 2)	SPC has produced leaflets for cassava that include nutritional information, preparation and cooking instructions.	Cassava is an important staple food for much of the developing world. In the Pacific cassava is produced for household consumption, local markets and export. Export market is largely for Pacific Islanders living in Australia, New Zealand or US. A list of references was provided.
National Council of Women Australia (Judith Parker)	Option 4 is preferred. Information about safe preparation should be attached to the food (including the unpackaged food) and this should be mandatory (Option 3).	The majority of Australian consumers would not be familiar with the risks to toxicity of inadequate or inappropriate preparation of cassava.	Some consumers would be familiar with the cooking of tapioca and may realise that this is a product of cassava but this would be the extent of their knowledge.

<p>Dietitians Association of Australia (Dr Peter Williams)</p>	<p>Premature to choose an option based on the information presented in the IAR. More information on toxicology, varieties available in Australia, methods of preparation and average consumption are required.</p>	<p>People of Pacific & South Sea Island descent living in Australia and New Zealand are the most likely the main consumers of cassava and it is presumed that these people would be aware of its preparation.</p>	<p>The sale of apricot kernels, is restricted to varieties that have low levels of cyanogenic glycosides. It would be consistent if cassava was also regulated through restricting to varieties with low levels of cyanogenic glycosides. Health professionals working with Pacific Islanders living in Australia and New Zealand could possibly provide information on the extent of cassava's popularity and adverse reactions to locally sold cassava.</p>
<p>Australian Food and Grocery Council</p>	<p>If cassava were sold in a package, then Standard 1.2.6, clause 2 applies: 'the label on a package of food must include appropriate directions for use or storage of the food, where the food is of a nature as to warrant such directions for reasons of health and safety'. If FSANZ finds that consumers of cassava are likely to eat it raw or improperly prepared and considers the severity of the risk warrants further action, FSANZ should consider a suitable amendment to Standard 1.2.6.</p>		<p>The assessment of the preparation of cassava should be consistent with: the COAG principles; the objectives set out in section 10 of the FSANZ Act; and the approach taken in the new joint Food Standards Code. The objective of P257 should be (rather than as set out in IAR): 'to examine the risk that consumers of cassava will eat it raw or improperly prepared and to consider whether the severity of the risk warrants further action.</p>
<p>Dr Jeremy Burdon, HortResearch, Postharvest Science Group (New Zealand)</p>		<p>Cyanogenic potential of cassava differs among varieties. Toxicity problems are often noted in conjunction with other nutrient deficiencies, e.g. protein, iodine, sulphur amino acids. FAO have a standard for cassava flour of 10 mg HCN/kg.</p>	<p>References describing laboratory and field methods to test cyanogenic potential of cassava roots were provided.</p>

<p>Pacific Islands Trade & Investment Commission (PITIC), New Zealand (Parmesh Trand). Includes correspondence from: Ministry of Agriculture, Sugar and Land Resettlement, Fiji (MASLR); Director, Institute of Applied Sciences, the University of the South Pacific (USP); and Food and Agriculture Organisation for the United Nations, sub-regional office for the Pacific.</p>	<p>Would not like to see regulation impeding on the initiatives to promote cassava to the broader population in NZ. MASLR indicate that proper labelling for consumer education and awareness be required and enforced.</p>	<p>There have been no problems related to improper use of cassava in Fiji. References regarding cyanide content and analysis were provided (MASLR). Article providing the levels of cyanide in fresh and processed Fiji Cassava and attached letter were provided (MASLR). A summary of the potential toxicity of cassava was provided by the FAO sub-regional office for the Pacific.</p>	<p>Cassava is an important domestic and export crop for Pacific Island Countries. In 1999, 1400 tonnes of cassava were imported into NZ. Figures for cassava imports to NZ from 1997-2001 were provided. Cassava consumed predominantly by peoples of Pacific Island or Asian decent in NZ however, its promotion by PITIC to the wider community is encouraged.</p>
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Submissions received in response to the Draft Assessment Report

A total of eight submissions were received in response to the Draft Assessment Report (DAR), which was released for public comment in September 2003. Five of these were from Australia, one from New Zealand, one from Fiji and one from Egypt (received in response to the SPS notification). The majority of submitters (six out of the seven) supported the intent of the recommendations, either Option 3 or Option 4 presented in DAR, although there were some issues raised that require addressing or clarification.

Submitter	Preferred regulatory option	Other comments
Food Technology Association of Victoria Inc, (David Gill)	Option 3	Clarification of regulatory options presented in DAR required.
New Zealand Food Safety Authority (Carole Inkster)	Option 4	No further comments.
Ministry of Agriculture, Sugar & Land Resettlement, Fiji	No preferred option stated, however Option 4 not supported	<ul style="list-style-type: none"> • Does not support using the Codex standard to set a maximum level of hydrogen cyanide and for defining sweet cassava as having lower levels of cyanide. The level used in the Codex standard was used to distinguish commercial trade in sweet cassava from bitter cassava and is not a safety level. • Believe that 50 mg hydrogen cyanide per kg is too low and the level will impede on free trade. • Suggest that some of the levels of hydrogen cyanide reported in the DAR are not representative of actual levels. • Suggest FSANZ reconsider whether there is a need to set a maximum level for cyanide in cassava. • Suggest FSANZ reconsider the definition for 'sweet' cassava.
Queensland Health (Kerry Bell)	Option 3	No further comments.

Dietitians Association of Australia (Sue Cassidy)	Option 4	The DAR has addressed issues raised by DAA in response to the IAR. Information accompanying the sale of unpackaged fresh cassava and bamboo shoots will assist in reducing the risk of cyanide intoxication.
Australian Food and Grocery Council (Tony Downer)	No preferred option stated, however, overall intent of Option 3 supported (only clarification sought).	Drafting should be amended to reflect that only raw/fresh cassava or bamboo shoots should be subject to these regulations and ensure that processed products such as canned bamboo shoots are not subject to the labelling requirements.
Department of Human Services, South Australia (Joanne Cammans)	‘Support the intent of the proposal to regulate the provision of information relating to the preparation of cassava and bamboo shoots with the sale of these raw products’.	Raised issues related to the practical application and enforcement of these regulations and requested that these be addressed in the Final Assessment Report.
Central Laboratory for Food and Feed, Agriculture Research Centre, Ministry of Agriculture, Egypt (Dr. Akila S. Hamza, General Director)	Agree with the recommendations of the Draft Assessment Report.	Stressed the importance of clarification of the hazards associated with using these products unprocessed or partially processed.