Imported food risk statement
Ready-to-eat cassava chips and hydrocyanic acid

Commodity: Ready-to-eat (RTE) cassava chips. These are defined as product containing sweet cassava that is represented as ready for immediate consumption with no further preparation required including crisps, crackers or 'vege' crackers.

Cassava is also known as manioc, mandioca, tapioca, aipim and yuca.

Analyte: Hydrocyanic acid (HCN)

Recommendation and rationale
Is hydrocyanic acid in ready-to-eat (RTE) cassava chips a medium or high risk to public health: ☑ *Yes* ☐ *No* ☐ *Uncertain, further scientific assessment required* **Rationale:** • Cassava (*Manihot esculenta*) may contain cyanogenic glycosides which can release hydrogen cyanide (hydrocyanic acid or HCN) and result in cyanide poisoning • There have been four food recalls in Australia of RTE cassava chips due to the presence of cyanogenic glycosides • A number of surveillance activities have been undertaken in Australia in relation to hydrocyanic acid levels in RTE cassava chips with levels of total hydrocyanic acid ranging from undetectable to a maximum of 165 mg of HCN equivalents per kg in cassava chips

General description
Nature of the analyte: *Synonyms:* hydrogen cyanide, prussic acid Cassava is a traditional, staple food crop grown in a number of tropical countries. The cassava tubers (root) normally require a post-harvest treatment to reduce the concentration of toxic cyanogenic glycosides before safe consumption is possible. Unprocessed cassava tubers are classified as either bitter or sweet, based on the concentration of hydrocyanic acid which can be released from the cyanogenic glycosides. Sweet cassava tubers must contain less than 50 mg hydrogen cyanide/kg on a fresh weight basis in accordance with Standard 1.1.2 of the Australia New Zealand Food Standards Code (the Code). Ready-to-eat cassava chips are made either from sliced sweet cassava tuber or the dough prepared using cassava/tapioca flour. In the latter case, the dough is steamed, cut into thin slices to resemble chips and then dried. This produces a partially finished cassava crackers or chip pellet, which may be imported into Australia and subsequently deep fried or baked and seasoned accordingly by an Australian manufacturer (Miles et al. 2011; NSWFA 2012). Sliced cassava is usually deep fried. Cassava chips which require further processing are not considered RTE in accordance with Standard 3.2.2 and Schedule 19 of the Code.

Adverse health effects:

Rapid onset of clinical signs as a result of cyanide poisoning may occur depending on the amount consumed and can include headache, dizziness, mental confusion and stupor in addition to cyanosis, twitching and convulsions. In severe poisoning cases fatal coma may result.

Consumption patterns:

FSANZ's understanding of current typical Australian consumption patterns for cassava and cassava-based products is limited, however from available national dietary records most are consumed infrequently at a population level.

In the 2007 Australian National Children's Nutrition and Physical Activity Survey, <1% of children aged 2 – 16 years consumed cooked cassava (excluding boiled cassava) (DOHA 2008). In the 2011 – 2012 Nutrition and Physical Activity survey (part of the 2011 – 2013 Australian Health Survey), <1% of children aged 2 – 16 years and <1% of adults aged 17 – 69 years reported consumption of cassava. Adults aged 70 years and above did not report consumption of cooked cassava. These data included peeled, fresh or frozen cassava that had been cooked (boiled, microwaved or steamed) and drained (Australian Bureau of Statistics 2011-12).

For both the 2007 and the 2011 – 2012 surveys, mixed foods that contained cassava chips were excluded from the analysis. The 2007 survey derived data from two days of dietary recall data for each respondent (a respondent is counted as a consumer if the food was consumed on either day one or day two, or both days), compared with only one day of dietary recall data for the 2011 – 2012 survey. Using two days of data will result in a higher proportion of consumers compared to a single day only, meaning the results are not directly comparable.

While the typical Australian consumption patterns for cassava and cassava-based products are limited, RTE cassava chips are present in the Australian marketplace and are promoted to consumers with gluten intolerances as an alternative snack food to crisps.

Key risk factors:

There are a number of risk factors related to RTE cassava chips. These include:

- Variety of cassava
- Processing procedure
- Cassava names

Risk mitigation:

- Section 19–6 of Schedule 19 of the Code currently permits a maximum level (ML) of 10 mg/kg of total hydrocyanic acid in RTE cassava chips.
- The use of sweet cassava only (≤ 50 mg/kg hydrocyanic acid fresh weight) in the production of RTE cassava chips will potentially reduce the amount of available substrates used to form hydrocyanic acid. This is supported in Standard 1.1.2 and Schedule 23 of the Code, where sweet cassava is permitted but bitter cassava (≥ 50mg/kg hydrocyanic acid) is listed as a prohibited botanical.
- Adequate processing and/or preparation of sweet cassava which supports the release of hydrogen cyanide gas from raw cassava will reduce the exposure to hydrocyanic acid from the consumption of RTE cassava chips.
- Monitor the quality assurance systems used by importers and manufacturers to manage hydrocyanic acid levels in RTE cassava chips or ready-to-fry cassava pellets.
- Increased awareness of the differences in the nomenclature of cassava (*Manihot esculenta Crantz*) in various regions and countries. FSANZ is currently addressing this through Proposal P1025 – Code Revision which includes relevant changes in relation to RTE cassava chips. It is proposed that a reference to the definition of Cassava and its alternative names is included directly after the definition of sweet cassava. This will be in Standard 1.1.2 Definitions used throughout the Code (FSANZ 2014a).

Compliance history:

The majority of cassava available in Australia for manufacturing is imported from overseas countries. For example, in 2011, approximately 1600 tonnes of dried cassava was imported into Australia. There were no reported exports of cassava from Australia (FAO 2013).

The imported food compliance data sourced from the Imported Food Inspection Scheme of the Australian Department of Agriculture and Water Resources for September 2009 – May 2013 showed that of the 134 samples tested for hydrocyanic acid applied to RTE cassava chips there were 46 fails, a 34% failure rate. The failed samples were from India, Indonesia, Malaysia, Singapore, Sri Lanka and United Kingdom.

There were no notifications on the European Commission's Rapid Alert System for Food and Feed (RASFF) for hydrocyanic acid, hydrogen cyanide or prussic acid in RTE cassava chips from September 2009 – May 2013 (EC 2014).

There have been four food recalls in Australia of imported RTE cassava chips and one food recall of domestically manufactured RTE cassava chips due to the presence of cyanogenic glycosides from 2008 – October 2014. The majority of these products were labelled with one of the alternative synonyms for cassava.

The food recalls in Australia due to high hydrocyanic acid concentrations in cassava chips for this period include:

- Recall of Piranha Vege Crackers due to unusually high levels of naturally occurring cyanogenic glycosides (January 2008) (NSWFA 2008a; NSWFA 2008b). This product was manufactured in Australia from imported ingredients
- Recall of Lotus Brand tapioca chips due to high level of naturally occurring cyanide (November 2011) (FSANZ 2011a)
- Recall of Grandma's tapioca chips & Manjilas tapioca chips spicy due to high levels of naturally occurring cyanide (December 2011) (FSANZ 2011b)
- Recall of Manjilas tapioca chips spicy due to high levels of naturally occurring cyanide (October 2014)(FSANZ 2014b)

Surveillance information:

Cyanide poisoning from the consumption of RTE cassava chips is not a notifiable condition in Australia, however cases of foodborne illness in two or more related cases is notifiable in some jurisdictions (DOH 2014).

Illness associated with consumption of RTE cassava chips with high levels of hydrocyanic acid

A literature-based search did not identify any outbreaks in Australia associated with hydrocyanic acid and the consumption of RTE cassava chips. This is anticipated as severe cases of cyanide poisoning are rare in countries where foods containing high levels of cyanogenic glycosides are not readily part of a typical daily diet (Geller et al. 2006; FSANZ 2008).

There are some reported outbreaks in relation to cassava consumption more generally, however this is mainly associated with countries who consume cassava on a frequent basis and often occur in population groups whose diets are deficient in specific amino acids required for cyanide detoxification (FAO and UNEP 1984; Akinpelu et al. 2011). A number of cases have been reported, particularly for children in tropical countries where such foods are considered an important part of the diet. The vulnerability of children to cyanogenic glycoside poisoning is mainly attributed to the lower body mass of children and their consequent higher food consumption amounts per kilogram bodyweight (Geller et al. 2006; FSANZ 2008).

Data on the prevalence of hydrocyanic acid in RTE cassava chips

In January 2008, Japan rejected a shipment of RTE cassava chips from Australia due to unacceptably high level of hydrocyanic acid (59 mg of HCN eq/kg). The product had been manufactured in New South Wales, using dried, semi-finished cassava chip pellets (derived from a combination of tapioca flour and fresh cassava) imported from Indonesia (NSWFA 2008a; NSWFA 2008b; Miles et al. 2011).

Since then, a number of surveillance activities have been undertaken in Australia in relation to total hydrocyanic glycoside levels in RTE cassava chips with levels of total hydrocyanic acid ranging from undetectable to a maximum of 165 mg of HCN equivalents per kg (eq/kg) in cassava chips, 237mg of HCN eq/kg in raw semifinished cassava pellets and 27 mg of HCN eq/kg in dried semifinished cassava pellets (Miles et al. 2011; NSWFA 2012). Australia and New Zealand analytical surveys of hydrocyanic acid concentration in RTE cassava chips and more broadly, in other foods are listed below:

- NSWFA initial survey of total hydrocyanic acid in RTE cassava chips (2008)(Miles et al. 2011)
- Department of Health WA analysed cassava containing foods for hydrocyanic acid levels in January 2008 (FSANZ 2009)
- NSWFA follow up survey of cyanogenic glycosides in RTE cassava chips (2011-2012)(NSWFA 2012)
- New Zealand survey of total hydrocyanic acid level in a sample of RTE cassava chips available in NZ (2011) (NZFSA 2011)
- New Zealand conducted a follow up survey on a further 65 samples of RTE cassava chips in mid-2011 (unpublished data).
- FSANZ/NZ collaborative survey of cyanogenic glycosides in other plant based foods (NZ foods only)(FSANZ 2014c)
- FSANZ/NZ collaborative survey - follow up on total hydrocyanic acid in apple juice (FSANZ 2014c)
- FSANZ/NZ survey of total hydrocyanic acid levels in apricot kernels (FSANZ 2014c)

Other relevant standards or guidelines

Codex has a number of regulatory limits for the maximum level of hydrocyanic acid in Cassava (*Manihot esculenta* Crantz) and cassava derived products which are listed below.

Codex Maximum Levels for cassava
• Codex standard for sweet cassava which is defined as being grown from *Manihot esculenta* Crantz (also known as manioc, tapioca, aipim, yuca). Sweet cassava are those that contain less than 50 mg/kg hydrogen cyanide on a fresh weight basis (Codex 2005).
• Codex standard for bitter cassava, which are those that contain more than 50 mg/kg of hydrogen cyanide on a fresh weight basis (Codex 2010).
Codex Maximum Levels for cassava derived products
• Gari is a type of flour of various granule size made from cassava tubers. A total hydrocyanic acid content of ≤2 mg/kg, determined as free hydrocyanic acid is permitted (Codex 1989a)
• Edible cassava flour is derived from dried cassava, chips or paste. It can be made from bitter cassava (*Manihot Utilisima* Pohl) which must be soaked for several days prior to drying. A total hydrocyanic acid content of ≤ 10 mg/kg is permitted (Codex 1989b).
Other relevant Codes of practice or Standards
• Code of practice for the reduction of hydrocyanic acid in cassava and cassava products (Codex 2013a).
• Codex general standard for contaminants and toxins in foods (Codex 1995).

Approach by overseas countries

Similar measures have been implemented in other countries to regulate the level of hydrocyanic acid in cassava and cassava derived products. Examples are listed below:

- In Brazil, multimistura, which is comprised of 5% cassava leaves, bran of wheat and rice, corn wheat flours and other ingredients, is permitted with a maximum hydrocyanic acid concentration of 5 mg/kg(Codex 2013b).
- In Indonesia, mocaf, a modified cassava flour, has a maximum hydocyanic acid concentration of 10 mg/kg. In contrast, in Indonesia, cassava flour has a maximum concentration of 40 mg/kg (Codex 2013b).

- In the Philippines, dried cassava chips and granules have a maximum total hydrocyanic acid concentration of 10 mg/kg on a dry weight basis. Sweet cassava must have <50 mg/kg hydrogen cyanide per kg of cassava root (fresh weight)(Codex 2013b).
- There are a number of East African Standards for cassava based products which stipulate a maximum level of total hydrocyanic acid content of 10 mg/kg. The products include:
    - Dried cassava chips (EAS 2010a)
    - Cassava flour (EAS 2010b)
    - Cassava wheat composite flour (EAS 2010c)
    - Food grade cassava starch (EAS 2010d)
    - Cassava crisps (EAS 2010e)

It is unclear whether the major exporters of cassava for Australia have appropriate HACCP plans in place. However, the Codex Code of practice recommends Good Manufacturing Practice even for small scale producers of cassava, to reduce the cyanogens in cassava and cassava based products (Codex 2013a).

To inform consumers of the risks associated with exposure to hydrocyanic acid through the consumption of RTE cassava chips, advisory statements were released by other countries. Statements have included:

- Advisory from the Centre for Food Safety in Hong Kong in response to the incident in Australian (January 2008) (CFS 2008).
- US consumers advised of the recall of Piranha Vege Crackers due to high levels of cyanide (January 2008) (Paton 2008).
- Canadian Food Inspection Agency advised consumers of the fruit and vegetables that produce cyanide (2012)(CFIA 2012).

Other considerations
Biosecurity requirements apply to certain products under this commodity. Refer to the BICON database.

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