FOREWORD

Given the food safety issues surrounding cassava, its trade and their impact to the small and micro-producers, this standard is therefore developed to ensure that cassava produced in the Philippines are microbiologically and chemically safe and compliant with regulatory requirements. The Bureau, in collaboration with the experts of the Technical Working Group (TWG), developed a Code of Good Agricultural Practices (GAP) for Cassava.

Special Order No.188 series 2014 established the TWG tasked to conduct field validation studies; sample products for the purposes of various analyses; and draft and finalize the GAP. The members of the TWG include identified experts from the various government agencies such as Bureau of Plant Industry (BPI), Philippine Center for Postharvest Development and Mechanization (PhilMech); and academic institutions particularly the University of the Philippines Los Banos (UPLB) and Visayas State University (VSU).

This Code provides general recommendations to allow flexible and uniform adoption even when production practices and environmental conditions are diverse. Therefore, this Code is also applicable to micro and small-scale cassava producers.

INTRODUCTION

Cassava, popularly known as ‘balinghoy’, ‘balanghoy’ or ‘kamoteng kahoy’ is mainly used as food and/or as feed ingredient. The Philippine Statistics Authority (PSA) – Bureau of Agricultural Statistics (BAS) reported that cassava production grew by 3.8 percent from 688.80 thousand metric tons (mt) level in 2013 to 714.99 thousand mt in 2014. According to the Food and Agriculture Organization (FAO), more or less a billion people depend on cassava as food staple in 105 countries and it is considered as the fourth most important crop in developing countries.

Although consumed in different forms, cassava is also a substitute for rice among marginal farmers in the uplands. Studies have shown that cassava roots once harvested deteriorate rapidly within 40-48 hrs and this is mainly caused by physiological and mechanical damage during harvesting, transportation and handling (Ashaye, et. al., 2005).

One of the food safety concerns in the consumption of cassava is the cyanide content found in the roots and leaves. According to FAO, the roots and leaves contain varying amounts of cyanide, which is toxic to humans and animals. Processing (e.g. fermentation, drying), however, can significantly reduce the cyanide content.
This GAP addresses the essential principles of food safety applicable to primary production through postharvest processing of cassava. It encompasses Good Hygienic Practices (GHP) and Good Manufacturing Practices (GMP) that will help minimize microbiological, chemical and physical hazards associated with all stages of production to postharvest processing.

SECTION 1 - OBJECTIVE

This Code addresses Good Agricultural Practices (GAPs) that will assist in the control of microbial, chemical and physical hazards associated with all stages of the primary production and postharvest processing of cassava meant for human consumption and for the production of feed ingredients.

SECTION 2 - SCOPE, USE AND DEFINITIONS

2.1 Scope

This standard covers the general hygienic practices for the primary production and postharvest processing of cassava meant for human consumption and for the production of feed ingredients. This Code does not provide recommendations for handling practices to maintain the safety of cassava at wholesale, retail, and food services or in the home.

2.2 Use

This Code follows the format of the Codex Code of Hygienic Practice for Fresh Fruits and Vegetables (CAC/RCP 53-2003) and takes into consideration the relevant practices in the Philippine National Standard (PNS) Code of Good Agricultural Practices for Fresh Fruits and Vegetables (PNS/BAFS 49:2011). As such, it should be read in conjunction with these standards and the Codex Recommended International Code of Practice-General Principles of Food Hygiene (CAC/RCP 1-1969, Rev 4:2003) and other applicable codes.

It covers general hygienic practices that are specific to the primary production; including specific guidance on how to minimize microbiological, chemical and physical hazards during primary processing of cassava meant for human consumption and for the production of feed ingredients. This Code supplements the Philippine Code of Good Agricultural Practices for Fruits and Vegetables (GAP-FV) Farming (PNS/BAFPS 49:2011).
2.3 Definitions

Agricultural inputs
Any incoming material such as seed pieces, organic and inorganic fertilizers, water, and agricultural chemicals used for the primary production of cassava

Agricultural worker
Any person that undertakes one or more of the following activity such as cultivation, harvesting and postharvest practices

Biological control
The use of competing biologicals such as insects, microorganisms and/or microbial metabolites for the control of mites, pests, plant pathogens and spoilage organisms

Cleaning
The removal of soil, dirt, grease or other foreign matter from the harvest

Composting
A managed process where organic materials are subjected to moisture, heat and microorganisms for a specified period of time to produce a product known as compost

Contamination
Food safety context:
The introduction or transfer of a food safety hazard to produce or to the inputs that contact produce, such as soil, water, chemicals, equipment and people

Environmental context:
The introduction or occurrence of a hazard into the environment

Cropping pattern
The proportion of area under various crops at any given point of time in a unit area

Domestic animals
Animals that are raised as family pets or as a source of food for the family

Farm
Any premise or establishment in which cassava is grown and harvested and the surroundings under the control of the same management
**Fertilizer**
Includes any solid or liquid substance either organic or inorganic nutrient elements – singly or in combination with other materials, applied directly to the soil, foliage or plant for the purpose of promoting plant growth, increasing crop yield or improving product quality

**Field packing**
Produce is placed inside woven sacks, jute sacks or any appropriate container during harvesting

**Food safety hazard**
Any chemical, biological or physical substance or property that can cause cassava to become an unacceptable health risk to consumers

**Grower**
The person responsible for the management of the primary production of cassava

**Hazard**
A biological, chemical or physical agent in, or condition of, food with the potential to cause an adverse health and environmental effect/s

**Manure**
Animal excrement which may be mixed with litter or other material, and which may be fermented or otherwise treated

**Packing**
The action of putting fresh cassava tubers, chips and granules in a package which may take place in a field or in the establishment

**Pest**
An unwanted animal or plant that affects the production, quality and safety of fruit and vegetables – for example, insects, diseases, weeds, rodents and birds

**Pesticide**
Any substance or product, or mixture thereof, including active ingredients, adjuvants and pesticide formulations, intended to control, prevent, destroy, repel or mitigate directly or indirectly, any pest. The term shall be understood to include insecticide, fungicide, bactericide, nematicide, herbicide, molluscicide, avicide, rodenticide, plant regulator, defoliant, desiccant and the like.
Primary production
Refers to the growing and harvesting of cassava including land preparation, planting, weeding, irrigation, application of fertilizers and agricultural chemicals, and harvesting

Primary processing
Those steps involved in the processing of cassava granules, cassava starch and cassava grates such as washing, peeling, chipping, granulating, grating, drying, milling / pulverizing, packing and storing

Risk
Refers to the likelihood of an adverse health effect and the severity of this effect following exposure to a hazard

Site
A defined area on the property – for example, a production site

SECTION 3 - PRIMARY PRODUCTION

In each primary production area, it is necessary to consider particular agricultural practices that ensure the safe production of cassava meant to be used as food, raw material for starch production and dried granulated cassava. Various conditions are taken into consideration like those that are specific to the production area and various methods of production. Procedures associated with primary production should be conducted under good hygienic conditions and should minimize potential hazards to health due to the contamination of cassava.

3.1 Environmental Hygiene

One of the key features of sustainable farming is the continuous integration of site-specific knowledge and practical experiences into future management planning and practices. This section is intended to ensure that the land, buildings and other facilities, which constitute the layout of the farm, are properly managed to ensure the safe production and protection of the environment.

3.1.1 Location of Production Site

Where possible, potential sources of contamination from the environment should be identified. In particular, primary production should not be carried out in areas where the presence of potentially harmful substances would lead to an unacceptable level of such substances in or on cassava after harvest.
In evaluating the location of production site for potential sources of contamination, the following
are to be considered:

- Previous land use and cropping pattern;
- Slope and potential for run-off from nearby fields;
- Proximity to high risk production sites; potential microbial hazards including fecal
  contamination and contamination by organic waste and potential environmental hazards
  that could be carried to the growing site; the access of domestic and wild animals to the
  site and to water sources used in primary production. Considering this potential source of
  contamination, efforts should be made to protect cassava-growing areas from animals

If previous uses cannot be identified, or the examination of the growing or adjoining sites leads
to the conclusion that potential hazards exist, the sites should be analyzed for contaminants of
concern. If the contaminants are at excessive levels and corrective or preventive actions have not
been taken to minimize potential hazards, the sites should not be used until correction/control
measures are applied.

Other considerations are on site selection, which may affect the cultural management later.

- Topography – flat or undulating (not more than 15%). If the slope area is very steep,
  water and soil conservation techniques are recommended (example: Sloping Agricultural
  Land Technology or SALT specifically the establishment of contour hedgerows);
- Soil – all types of soil but ideally sandy loam to clay loam;
- Soil pH – optimum pH is at 5.5 - 6.5;
- Rainfall – enough rainfall or water sources that can support the growth of cassava plants;
- Soil drainage – well-drained area is recommended to avoid waterlogging

3.1.2 Production Site Preparation

During land preparation, potential sources of microbiological and chemical contaminations from
conduct of various operations should be identified and avoided. In particular, farm machineries
should be checked for possible leakage of oil and fuel. Organic fertilizers, when applied, should
be fully decomposed.

The land is thoroughly plowed and harrowed using a tractor or animal. These operations are
usually done when there is enough soil moisture. The field should be plowed at least 15-25 cm
(6-10 inches) deep. If planting in ridges, a height of 15-20 cm and planting distance of 75 to 100
cm between ridges is recommended.
Appropriate cultural practices such as proper land preparation, proper use of chemical inputs, off-barring and hilling-up should be practiced to control the weeds.

3.1.3 Field Sanitation

Growers or agricultural workers should regularly conduct field sanitation in the production area. Clean field generally minimize the spread of pests and diseases. Diseased plants should be regularly removed, buried or burned as these may harbor pests and diseases. However, growers or agricultural workers should preserve naturally occurring beneficial organisms whenever possible.

3.2 Hygienic Production of Cassava

3.2.1 Variety selection

All varieties may be used for feed while only those varieties with low HCN are recommended for food and certified by the National Seed Industry Council. Refer to Annex A Table 1.

3.2.2 Planting material requirements

Stem, as the planting material, should be physiologically mature, fresh and healthy. To ensure maximum yield and quality, it is recommended that seed pieces be used at up to a maximum of six (6) times as planting material. A stem is mature if the diameter of the pith or cork is not more than half the diameter of the cortex. A stem is healthy if it is free from insects, pests and diseases and its diameter is not less than 1.5 cm. A stem is fresh if the latex or sap comes out within 3 seconds after cutting. If the planting material(s) are sourced from outside the farm, a record of purchase should be kept.

3.2.3 Agricultural input requirements

Agricultural inputs (seed pieces, water, fertilizers, agricultural chemicals and the like) should not contain microbial or chemical contaminants as defined under the General Principles of Food Hygiene (CAC/RCP 1-1969) and at levels that may adversely affect the safety of cassava. All agricultural chemicals should be duly approved by the Fertilizer and Pesticide Authority (FPA).

3.2.3.1 Water for primary production

Usually, cassava is not irrigated. To support the growth of cassava plants throughout the year, there should be enough rainfall or water source. Cassava plants produce low yield and deformed
roots when subjected to drought stress especially during the first three (3) months after planting. However, there should be no waterlogging since young cassava plants (1-3 months old) will have stunted growth while mature cassava plants will have rotten roots.

3.2.1.1.1 Water for fertilizers, pest control and other agricultural chemicals

Water used for the application of water-soluble fertilizers and agricultural chemicals in the field and during post-harvest handling should not contain microbial contaminants at levels that may adversely affect the safety of cassava.

3.2.3.2 Fertilizer application

The use of organic and inorganic fertilizers in cassava production should be managed to limit the potential for microbial and chemical contamination. If found to be contaminated with heavy metals or other chemicals at levels that may affect safety, these inputs should not be used.

Growers or agricultural workers should not use untreated solid nor liquid manure because foodborne pathogens can persist in soils for long periods of time. In cases when the farm produces its own organic inputs, proper treatment procedures should be adopted to reduce or eliminate the pathogens present in the raw material and to minimize the probability of contaminating the produce. The composting site should also consider the slope and proximity to production areas in order to prevent cross contamination from runoff or leaching.

Organic fertilizer should be broadcast or applied on or before the final harrowing of the field.

The following factors may be useful in deciding the appropriate kind of fertilizer or the needed amount to be applied: crop demand and available nutrients from the soil, farm manure and other crop residues.

The rate of application of inorganic fertilizer should be based on soil analysis. In the absence of soil analysis, the general recommendation is eight (8) bags complete fertilizer: four (4) bags are applied as basal at planting and another four (4) bags are applied as side dress two (2) months after. In order to minimize loss and contamination of the produce, correct application and proper storage procedures should be followed. If organic inputs are procured from outside sources, documents should be kept.

3.2.3.3 Agricultural chemicals

Growers should use only agricultural chemicals, which are authorized by FPA for the cultivation
of cassava and should use them according to the manufacturer’s instructions for the intended purpose. Residues should not exceed levels as established by the Codex Alimentarius Commission or the ASEAN or by the Philippine National Standard (PNS).

Growers should refer to the Sections 7.2-7.5 of the PNS Code of Good Agricultural Practices for Fresh Fruits and Vegetables (PNS/BAFPS 49:2011) regarding practices pertaining to pesticide management.

3.2.3.4 Biological control

In order to control biological organisms and/or their metabolites applied for the control of pests, growers should use only biological controls, which are authorized for the cultivation of cassava and should use them according to the manufacturer’s instructions / crop protection specialist for the intended purpose.

Registration of biological control agents is based on existing regional and national standards on the Regulation, Use and Trade of Biological Control Agents (BCA).

3.2.4 Personnel Health, Hygiene and Sanitary Facilities

All agricultural workers including contractors or visitors should act in accordance with the appropriate sections of the Recommended International Code of Practice – General Principles of Food Hygiene (CAC/RCP 1 – 1969) to maintain an appropriate degree of personal cleanliness; operate in an appropriate manner and to ensure that those who come directly in contact with cassava during processing are not likely to contaminate them.

In particular, attention should be given to availability of hand-washing facilities equipped with soap and clean water during processing of food products.

Workers involved in postharvest processing should undergo training on hygiene instructions. Evidence on the conduct of training should be kept. Moreover, the farm should keep track of evidence that hygiene instructions are followed.

For cassava food products, regular environmental and personnel hygiene assessment as well as sanitary inspection of facilities should be conducted to serve as basis for corrective and preventive actions.
3.2.5 Harvesting

Harvesting operations and methods should be conducted with consideration on the possible sources of contamination. Cassava is ready for harvest eight (8) to 12 months after planting. Harvesting cassava roots is usually done manually. However, mechanical digger/harvester can be used to ease and facilitate harvesting operations. Care should be taken so as not to break the roots as this will lead to losses from the soil and to contamination that may evolve into spoilage. Harvested cassava roots/tubers should be placed in appropriate and sanitary harvesting container.

During harvesting, a responsible person should be present to supervise the activity at all times and to assure that harvesters observe hygienic practices

3.2.5.1 Equipment Associated with Growing and Harvesting

Harvesting tools, implements and equipment that have direct contact with the produce should be cleaned, disinfected and maintained in good order regularly.

Equipment and containers used for harvesting should be made from non-toxic materials. They should be designed and constructed to ensure that, when necessary, they can be cleaned, disinfected and maintained to avoid the contamination. When using reusable harvesting containers and tools a cleaning and disinfection schedule is in place to prevent contamination. A record of cleaning should be available. Containers that are damaged and can no longer be kept in a hygienic condition should be discarded.

As far as practicable, produce containers should only be used to contain harvested produce. If these are used for other purposes – except as container of agricultural chemicals, these must be cleaned and disinfected as necessary prior to use.

SECTION 4 - HANDLING, STORAGE AND TRANSPORT

4.1 Preventing Cross Contamination

Harvested cassava is susceptible to damage, wounds and cuts during harvesting and post-harvest handling due to the nature of the operations. Mechanical damage is unavoidable; cutting the root off the plant creates a wound; and digging utensils may scrape the roots. Wounds and bruises are points of entry for microorganisms leading to cassava root/tuber spoilage.

During packing of produce, care must be taken in the field to avoid contaminating containers or bins by exposure to manure or animal feces and other contaminants.
Growers/agricultural workers should continually reinforce the importance of good hygienic practices since poor hygienic practices can significantly increase the risk of contaminating harvested cassava.

4.2 Field packing, storage and transport

Cassava that will be sold as whole / fresh or for further processing (i.e. food or feed) should ensure that field packing operations are conducted with consideration in removal of dirt from harvested tubers.

Growers/ agricultural workers during this operation should ensure that clean pallets and containers are used and efforts towards ensuring that these containers do not come in contact with other sources of contaminants are done.

With suitable handling and storage, freshly harvested cassava should be sorted and damaged roots should be segregated. It should be stored and contained under conditions that will minimize the potential for microbial, chemical or physical contamination.

Prior to transportation, produce are packed in the field in such a way that it can withstand rough handling during loading and unloading, compression from the weight of other containers, impact and vibration during transport and high humidity during transit. When not in use, cleaned harvest containers and transport trailers should be covered and kept in a protected location. Damaged containers or transport trailers are replaced as necessary.

Freshly harvested cassava should be transported using clean and disinfected vehicles or other appropriate mode of transportation.

Transport vehicles should not be used for the transport of hazardous substances unless they are adequately cleaned, and where necessary disinfected, to avoid cross-contamination.

Cold storages are used for fresh tubers and cassava grates. While, well -ventilated storages can be used for starch. Ordinary sheds can be used to store dried granulated cassava.

Storage facilities and vehicles for transporting the harvested crops should be built in a manner to minimize damage to cassava and to avoid access by pests. They should be made of non-toxic materials that permit easy and thorough cleaning. They should be constructed in a manner to reduce the opportunity for potential contamination from physical objects such as glass, wood, plastic, etc.
SECTION 5 – ESTABLISHMENT: DESIGN AND FACILITIES

Refer to the General Principles of Food Hygiene (CAC/RCP 1-1969, Rev 4 2003).

This section applies hygienic recommendations for the primary processing of cassava intended as feed ingredient. It provides recommendations on the application of relevant Good Manufacturing Practices (GMP) principles for all stages of production of cassava for food and for feed, which involves pre-drying, chipping and drying.

5.1 Premises and Lay out

5.1.1 For cassava food products

Packing and minimal processing of cassava is a year-round operation. The design of the processing and packing areas should allow thorough cleaning and disinfection of food contact surfaces, including drying pavements, to ensure that foodborne pathogens do not grow in the facility or on the equipment.

Where feasible, raw material handling areas should be separated from processing/packing areas.

Within each of these areas, cleaning operations should be conducted separately to avoid cross-contamination between tools and utensils in each operation.

Water drums being used to preserve the tuber should be made of a material that will not contribute a hazard to health and that will allow thorough cleaning.

5.1.2 For animal feeds and industrial uses

The design of the processing and packing areas should allow thorough cleaning and disinfection to ensure that pathogens do not grow in the facility or on the equipment.

5.2 Drainage and waste disposal

In the preparation of fresh cassava tubers, the processing of products covered by this standard generates large quantity of waste that can serve as food and shelter for pests. Therefore, it is important for the processor to have an effective waste disposal system. This should always be maintained in good condition so it does not become a source of product contamination.
SECTION 6 - POSTHARVEST OPERATIONS

6.1 Control of Food Hazards

It should be recognized that while processing may reduce the level of contamination initially present on the raw materials, it will not be able to guarantee elimination of such contamination.

Consequently, the processor should ensure that steps are taken by their suppliers (growers, harvesters, packers and distributors) to minimize contamination of the raw materials during primary production. Processors should ensure that their suppliers adopt principles outlined in the main text of the standard.

6.2 Key Aspects of Control Systems

6.2.1 Specific Process Steps

6.2.1.1 Receipt and inspection of raw materials

During unloading of raw material, the transportation vehicle should be verified for cleanliness and the raw materials for any evidence of contamination and deterioration.

6.2.1.2 Preparation of raw material before processing

Physical hazards (such as presence of animal and plant debris, metal and other foreign material) should be removed through manual sorting. Raw materials showing signs of damage or rot should be removed from the lot.

6.2.1.3 Washing and microbiological decontamination

Refer to section 5.2.2.1 of the Code of Hygienic Practice for Fresh Fruits and Vegetables. In addition:

• Water used for final rinses should be of potable quality.

6.2.1.4 Chipping

Chipping can be done through manual or mechanical chopping of fresh roots before drying where the ideal thickness of chips is \( \frac{1}{2} \) inch. All materials or equipment coming in direct contact with the fresh roots should be maintained clean before and after use.
6.2.1.5 Granulation

Fresh roots can also be chopped into smaller size of about 8-10 mm using a cassava granulator. Materials or equipment coming into direct contact with the fresh roots should be maintained clean before and after use.

6.2.1.6 Drying

Cassava can be dried either through sun drying or mechanical dryer. The common method of drying cassava is sun drying wherein chips or granules can be dried by spreading evenly not more than 3 inches thick in a clean dry pavement or tarpaulin/plastic net for 2-4 days for sun drying. For longer storage, the chips/granules should be dried to 14% moisture content.

The quality of chips or granules is highly dependent on moisture content at harvest. The lower the moisture content, the shorter is the drying time. A short drying time will give a higher starch content and white color cassava chips or granulated cassava. However, it should be noted that cyanogenic potential of cassava decreases with longer drying time.

Entry of stray animals should be avoided as they can be source of harmful pathogens. Regular monitoring of drying areas for presence of wild and domestic animals should be conducted.

When gloves are used in the operation, there should be a proper and documented procedure especially on regular cleaning and sanitation. If gloves are used, these should be discarded when these become torn, soiled, or otherwise contaminated.
References:


Codex Alimentarius Commission. 2013. Code of Practice for the Reduction of Hydrocyanic Acid (HCN) in Cassava and Cassava Products (CAC/RCP 3-2013)


Department of Agriculture. 2012. Technoguide on Cassava Production.
ANNEX A

CASSAVA VARIETIES

Table 1. Recommended cassava varieties for food and feed

<table>
<thead>
<tr>
<th>Variety</th>
<th>Potential Yield (MT/ha)</th>
<th>Starch Content (%)</th>
<th>Dry Matter Content (%)</th>
<th>HCN Content</th>
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<tbody>
<tr>
<td>UPL-Ca1 (Datu 1)</td>
<td>30-40</td>
<td>21.4</td>
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<td>UPL-Ca2 (Lakan 1)</td>
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<td>PSB Cv-13 (CMP 62-15)</td>
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<tr>
<td>NSIC Cv</td>
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<td>NSIC Cv-31 (Rajah 2)</td>
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<tr>
<td>NSIC Cv-32 (CM 9165-17)</td>
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<tr>
<td>NSIC Cv-33 (Sultan 8)</td>
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<td>NSIC Cv-34 (CM 9175-25)</td>
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<td>NSIC Cv-35 (CMR 37-24-1)</td>
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<td>NSIC Cv-36 (CMR 36-62-03)</td>
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<td>NSIC Cv-37 (Sultan 9)</td>
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<td>NSIC Cv-38 (SM 2065-2)</td>
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<td>NSIC Cv-44 (LSU-Cv22)</td>
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</table>

*Source: Bureau of Plant Industry – National Seed Industry Council*
TECHNICAL WORKING GROUP (TWG) FOR THE DEVELOPMENT OF PHILIPPINE NATIONAL STANDARD (PNS) CODE OF GOOD AGRICULTURAL PRACTICES (GAP) FOR CASSAVA

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