

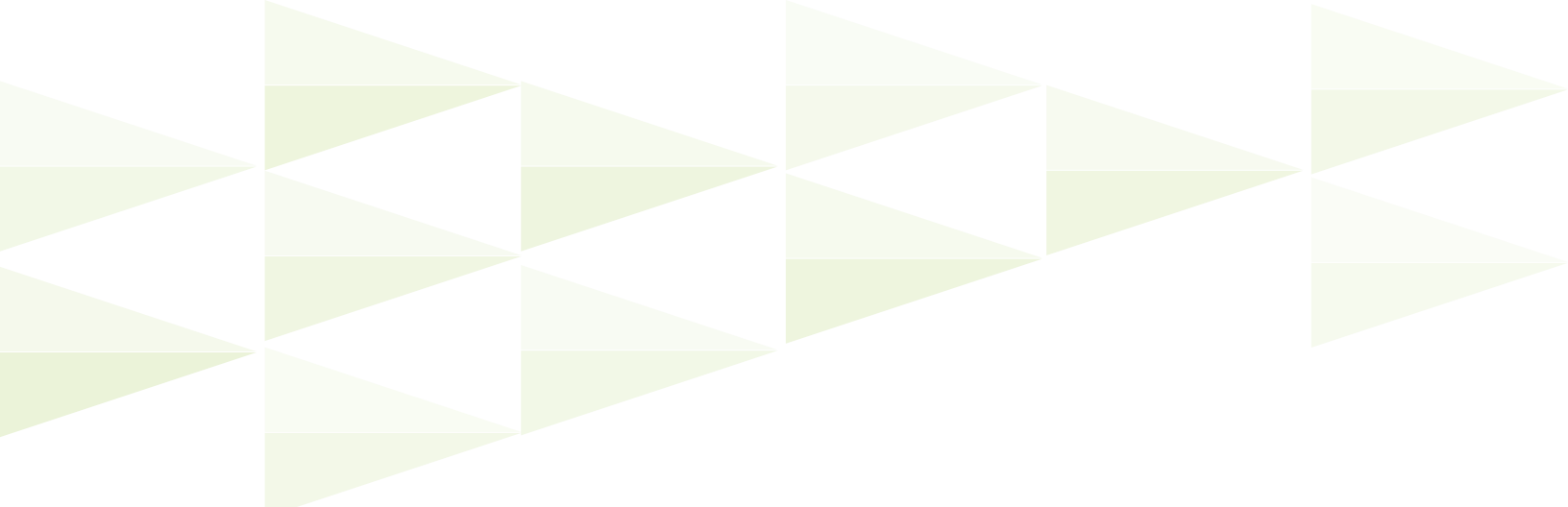


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PROCEDURES FOR SAMPLING AND SAMPLE PREPARATION of sweetpotato roots and potato tubers for mineral analysis



PROCEDURES FOR SAMPLING AND SAMPLE PREPARATION of **sweetpotato** roots and **potato** tubers for mineral analysis

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International Potato Center (CIP)
Global Program Genetics and Crop Improvement

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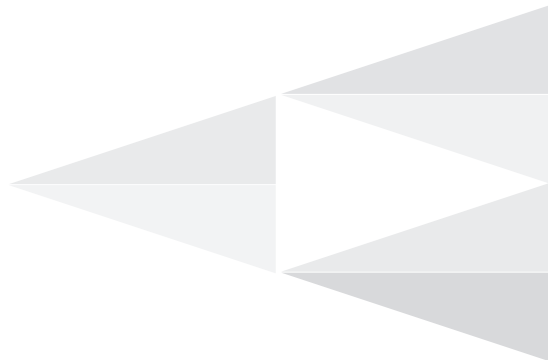
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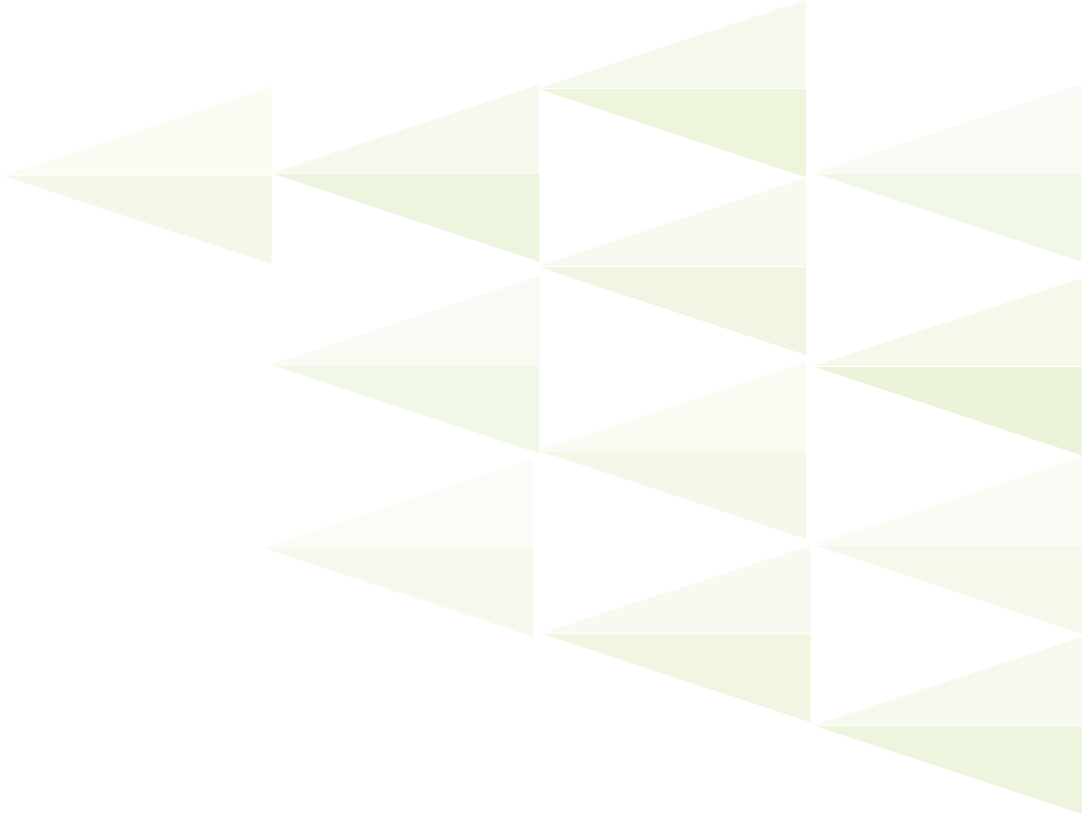
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Sweetpotato

I. Field sampling of sweetpotato roots (Figure 1)

- Make sure the roots are mature and the plants are ready for harvesting.
- Some days before harvesting, identify the plants to be harvested and cut the foliage.
- Harvest the roots carefully with a garden tool (for example a fork), avoiding any root damage.
- Separate marketable and non-marketable roots on the field.
- Select a representative sample. For this purpose, 5 to 10 sweetpotato roots should be collected at random in each replication. The roots should have a representative size for the clone, variety or genotype.
- Avoid selecting damaged roots, roots with extreme sizes, and roots from plants that grew in the borders.
- Put the collected roots inside a paper bag previously labeled with the corresponding identification code of the field plot.
- Place the paper bags with the sweetpotato roots in a box and store them in proper conditions (dark, ventilated and fresh room, protected from dust, etc.) until sample preparation. The sweetpotato samples should be processed for nutrient analysis as soon as they arrive at the laboratory (maximum 1 week after harvest)

II. Sample preparation of sweetpotato roots (Figures 2A and 2B)

- Wash the 5 to 10 roots with abundant tap water (trying to remove all soil residue), rinse with distilled water and dry the roots with paper towel.
- Put the washed roots in a clean and labeled paper bag and store them under proper conditions (dark, ventilated and fresh room, protected from dust, etc).
- Place the samples in white plastic trays, sorting in a correct order.
- Peel the roots with a high-grade stainless steel or ceramic peeler, wash them again with distilled water, dry using paper towel and cut each root longitudinally in 4 sections with a high-grade stainless steel or ceramic knife. Peeling should be done carefully, with minimum removal of the flesh.
- Obtain 3 – 4 slices of each of two opposite sections of each root to obtain a 50 g weighed sample. Use a high-grade stainless steel or ceramic slicer.

Option 1. Using a freeze drier (Figure 2A)

- Put the sweetpotato slices in polyethylene bags and take note of the exact weight.
- Store the samples in a freezer at -20 °C and freeze-dry them until the residual moisture is less than 3%. (At CIP's Quality and Nutrition Laboratory, 72 hours freeze-drying is needed for drying 350 sweetpotato samples (50 g fresh material each) in an industrial freeze dryer.
- Weigh the dried samples and take note of the exact weight. Use the fresh and dried weights to calculate the dry matter content of the samples.
- Mill the dried samples in a stainless steel mill (40 mesh) and place the milled sample in Whirl-Pak plastic bags.
- Store the milled sample at room temperature if the samples are going to be analyzed for minerals (XRF or ICP) or at -20 °C if other nutrients such as vitamin C, carotenoids or phenolics are also going to be analyzed.

Option 2. Using an oven (Figure 2B)

- Put the sweetpotato slices in a glass petri dish, take note of the exact weight and dry at 80 °C for 48 hours. Dried samples should have less than 3% residual moisture.
- Weigh the dried samples and take note of the exact weight. Use the fresh and dried weights to calculate the dry matter content of the samples.
- Mill the dried samples in a stainless steel mill (40 mesh) and place the milled samples in Whirl-Pak plastic bags.
- Store the milled sample at room temperature.

Note: Oven drying is used for mineral analysis only. Other nutrients are on risk of degrading due to the high temperatures.

Workflow for sampling of sweetpotato roots

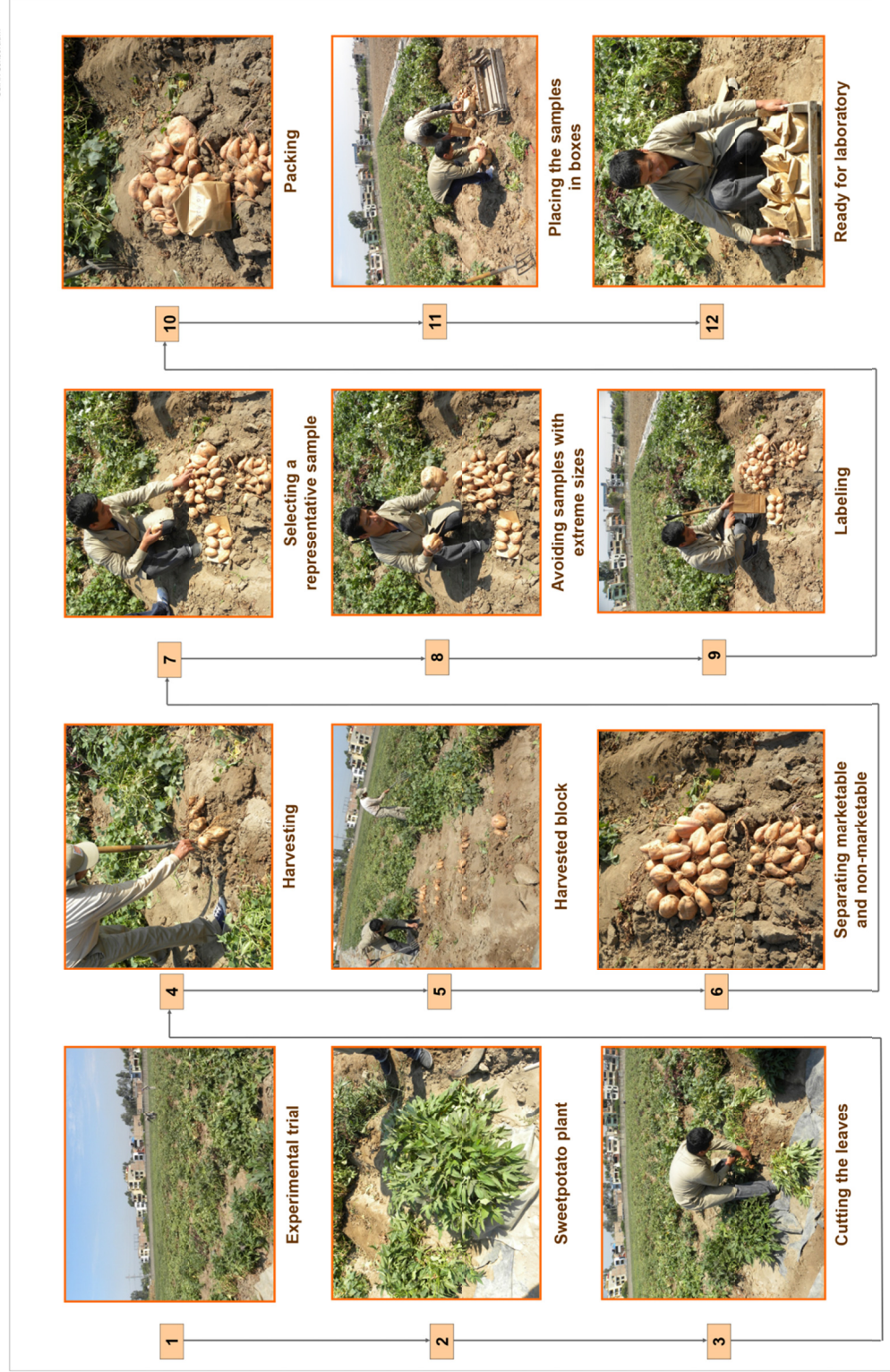


Figure 1. Workflow for field sampling of sweetpotato roots.

Workflow for sample preparation of freeze dried and milled sweetpotato samples



Figure 2A. Workflow for sample preparation of sweetpotato roots at CIP's Quality and Nutrition Laboratory.

Workflow for sample preparation of oven dried and milled sweetpotato samples

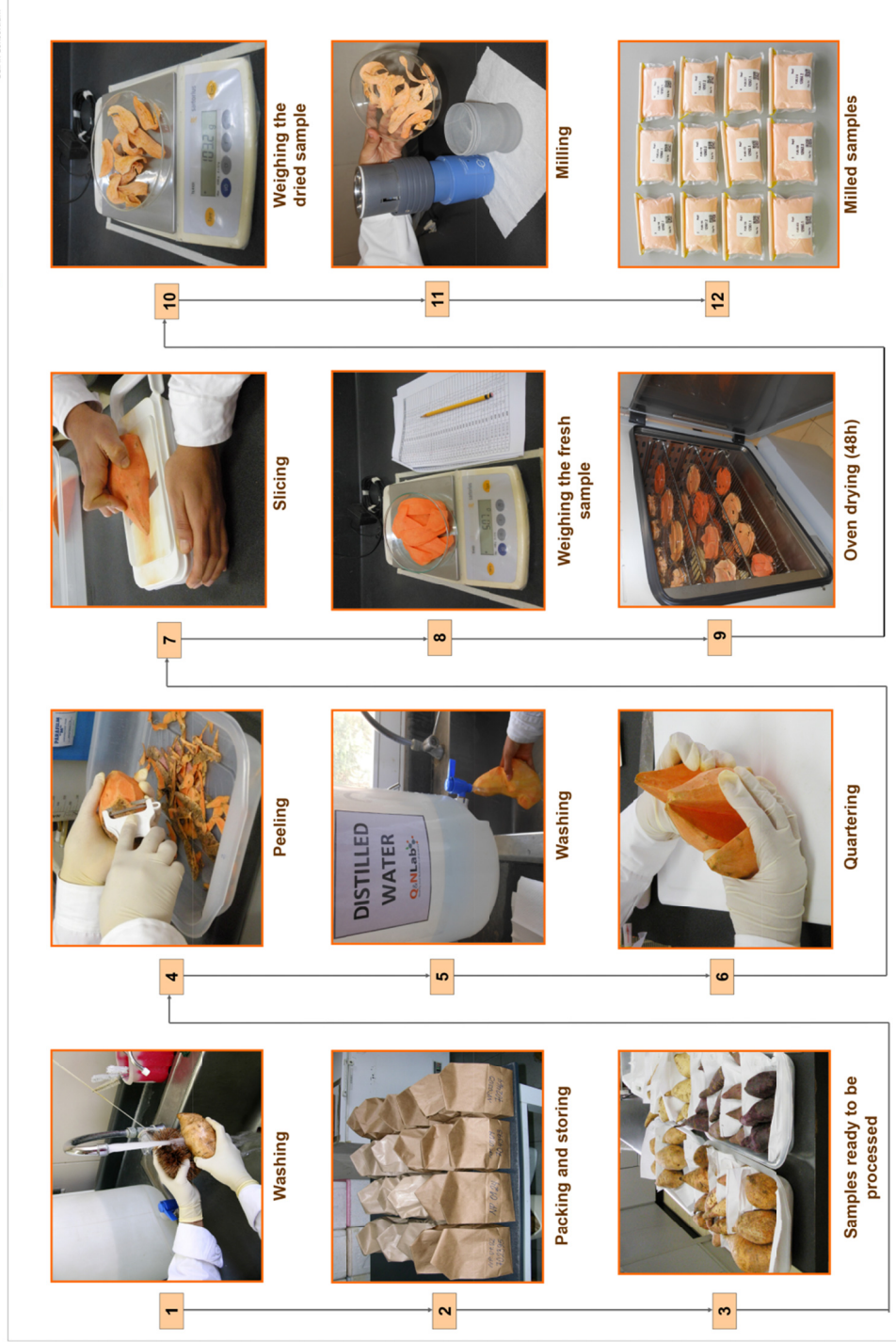


Figure 2B. Workflow for sample preparation of oven dried and milled sweetpotato root samples.

Potato

I. Field sampling of potato tubers (Figure 3)

- Make sure the tubers are mature and the plants are ready for harvesting.
- Cut the above parts of the plants to be harvested.
- Identify the plants to be harvested and cut the foliage.
- Harvest the tubers carefully with a garden tool (for example a fork), avoiding any tuber damage.
- Separate marketable and non-marketable tubers on the field.
- Select a representative sample. For this purpose, 7 to 10 potato tubers per genotype, clone or variety in each replication from the field should be collected at random. The tubers should have a representative size for the genotype, clone or variety.
- Avoid selecting damaged or greened tubers, tubers with extreme sizes, and tubers from plants that grew in the borders.
- Place the collected tubers inside a paper bag previously labeled with the corresponding identification code of the field plot.
- Place the paper bags with the potato tubers in a box and store them in proper conditions (dark, ventilated and fresh room, protected from dust, etc) until sample preparation. The potato samples should be processed for nutrient analysis as soon as they arrive at the laboratory (maximum 1 week after harvesting).

II. Sample preparation of potato tubers (Figures 4A and 4B)

- Wash the 7 to 10 potato tubers with abundant tap water (trying to remove any soil residue), rinse with distilled water and dry the tubers with paper towel.
- Put the potato tubers in a clean and labeled bag and store them at 5 °C.
- One day before processing, place the samples in white plastic trays, sorting in a correct order.
- Peel the tubers with a high-grade stainless steel or ceramic peeler, wash them again with distilled water, dry using paper towel, and cut each tuber longitudinally in 4 sections with a high-grade stainless steel or ceramic knife. Peeling should be done carefully, with minimum removal of the flesh.
- Obtain 3 – 4 slices of each of two opposite sections of each tuber to obtain a 50 g weighed sample. Use a high-grade stainless steel or ceramic slicer.

Option 1. Using a freeze drier (see figure 4A)

- Put the potato slices in polyethylene bags and take note of the exact weight.
- Store the samples in a freezer at -20°C and freeze-dry them until the residual moisture is less than 3%. (At CIP's Quality and Nutrition Laboratory, 72 hours freeze-drying is needed for drying 350 potato samples (50 g fresh material each) in an industrial freeze dryer.
- Weigh the dried samples and take note of the exact weight. Use the fresh and dried weights to calculate the dry matter content of the samples.
- Mill the dried sample in a stainless steel mill (40 mesh) and place the milled sample in Whirl-Pak plastic bags.
- Store the milled sample at room temperature if the samples are going to be analyzed for minerals (XRF or ICP) or at -20 °C if other nutrients such as vitamin C, carotenoids or phenolics are also going to be analyzed.

Option 2. Using an oven (Figure 2B)

- Put the potato slices in a glass petri dish, take note of the exact weight and dry at 80 °C for 48 hours. Dried samples should have less than 3% residual moisture.
- Weigh the dried samples and take note of the exact weight. Use the fresh and dried weights to calculate the dry matter content of the samples.
- Mill the dried samples in a stainless steel mill (40 mesh) and place the milled samples in Whirl-Pak plastic bags.
- Store the milled samples at room temperature.

Note: Tubers can be stored at 5⁰C for minerals, vitamin C, carotenoid and phenolic analysis but not for sugar analysis. Oven drying is used for mineral analysis only. Other nutrients are at risk of degrading due to the high temperatures.

Workflow for sampling of potato tubers

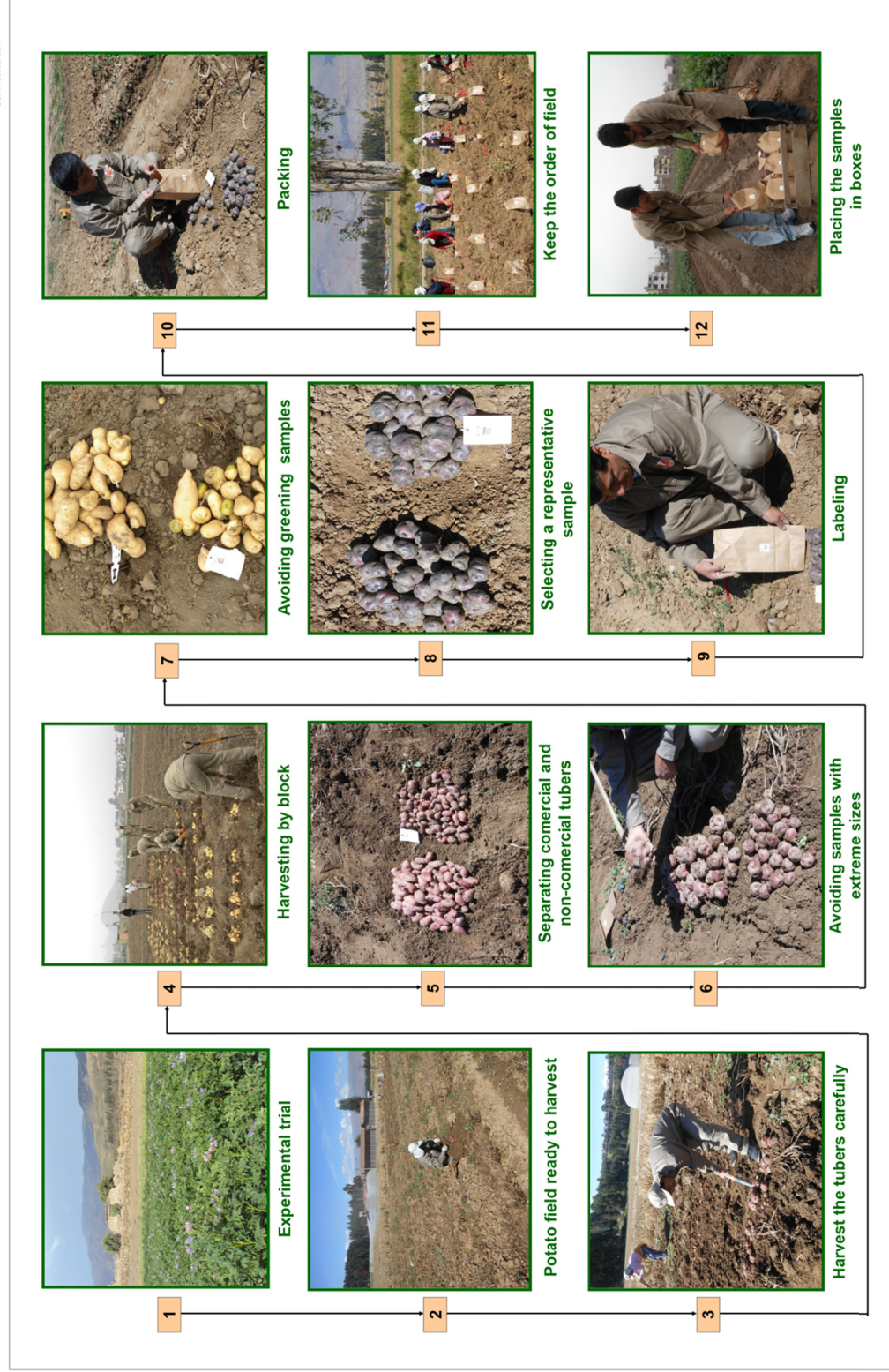


Figure 3. Workflow for field sampling of potato tubers.

Workflow for sample preparation of freezing and drying milled potato samples



Figure 4A. Workflow for sample preparation of freeze dried and milled potato tuber samples.

Workflow for sample preparation of oven dried and milled potato samples

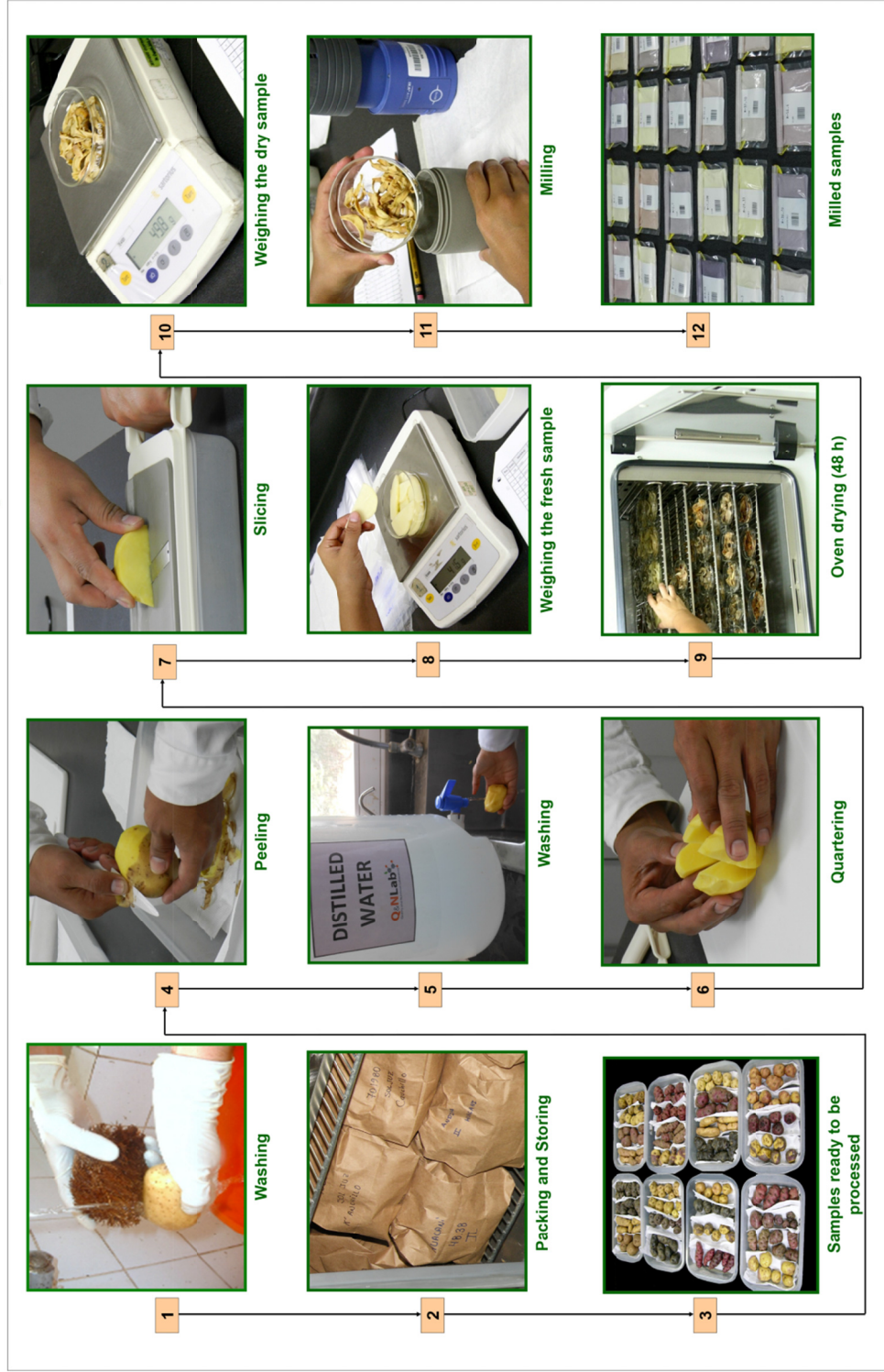


Figure 4B. Workflow for sample preparation of oven dried and milled potato tuber samples.

ANNEX 1

Recommendations to avoid sample contamination

The staff who participate in sample preparation must be conscious of the importance of avoiding contamination of potato and sweetpotato samples with minerals from other sources. Common contaminant sources include: Soil or dust on hands or equipment, skin care products on bare hands, dirty or rusty material, and lack of appropriate laboratory equipment.

Please consider the following recommendations to avoid contamination of your samples:

- Wash the potato tubers and sweetpotato roots very well to avoid possible contamination with minerals from the soil.
- Keep all materials used for sample preparation very clean and free of dust. At CIP's Quality and Nutrition Laboratory we use nitric acid (0.1%) to clean the material and the processing area used for sample preparation. (To prepare nitric acid 0.1% dilute 1.5 ml of nitric acid in 1 liter of distilled water.)
- Use stainless steel material and equipment to avoid contamination by rust and abrasion. Stainless steel material and equipment are generally thought not to cause iron contamination. However, some stainless steel products come in lower levels of hardness and can be a source of contamination. Alternatively, you can use ceramic knives, slicers and peelers.
- Restrict access to the sample preparation room only to people participating on this activity. People coming from the field should not enter the sample preparation area because they can bring soil on their clothes and shoes.
- Do not use hand or skin creams before sample preparation. Creams can be enriched with minerals and can contaminate your sample during processing.

ANNEX 2

Considerations to evaluate the mineral results as obtained by ICP

Aluminum and titanium are used as indicators of soil and dust contamination and chromium is used as an indicator of contamination by the deterioration of material and equipment used.

We consider a potato tuber or sweetpotato root sample to be contaminated when:

- The concentration of Al is higher than 4 ppm, even when Ti is not present;
- The concentration of Ti is higher than 0.1 ppm and the concentration of Al is higher than 2 ppm; and
- The samples contain Cr, which is generally reported as Cr <0.2 ppm.

We consider that a sample is possibly contaminated when the concentration of Al is higher than 2 ppm and lower than 4 ppm, even when there is no presence of Ti.

For example, in Table 1:

- Sample 1 has high iron concentration but, as indicated by the high levels of Al and Ti, the sample is contaminated.
- Samples 3, 4 and 5 have medium iron concentration but are also contaminated, as indicated by the high levels of Al and Ti.
- Sample 8 and sample 10 present high levels of iron, but the high levels of Cr indicate that those samples are also contaminated.
- Samples 2, 6, 7 and 9 are not contaminated and the mineral results are trustable.

Table 1. Iron, zinc, aluminum, titanium and chromium concentration of 10 samples

Samples	mg/kg				
	Iron	Zinc	Aluminum	Titanium	Chromium
Sample 1	33	31	7.7	0.33	< 0.2
Sample 2	31	24	1.5	<0.03	< 0.2
Sample 3	22	25	3	0.39	< 0.2
Sample 4	20	22	4.7	0.19	< 0.2
Sample 5	22	21	2.9	0.12	< 0.2
Sample 6	30	25	1.4	<0.03	< 0.2
Sample 7	29	32	0.79	<0.03	< 0.2
Sample 8	28	30	0.7	< 0.03	0.24
Sample 9	27	23	1	<0.03	< 0.2
Sample 10	53	29	0.8	<0.03	1.1



The International Potato Center (known by its Spanish acronym CIP) is a research-for-development organization with a focus on potato, sweetpotato, and Andean roots and tubers. CIP is dedicated to delivering sustainable science-based solutions to the pressing world issues of hunger, poverty, gender equity, climate change and the preservation of our Earth's fragile biodiversity and natural resources. www.cipotato.org



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