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SAMPLE COLLECTION, HANDLING AND PREPARATION

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Based on Greenfield and Southgate, 2003

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Sample collection

- The adequacy and condition of the sample or specimen received for examination are of primary importance
- If samples are improperly collected: the laboratory results will be meaningless
- Sampling protocol should be clearly defined
  - Start with description of primary food product

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Sample collection

- Identity of the food
  - Common/alternative name
    - E.g. Maize, Nigeria beans
  - Scientific name (Genus, species, variety)
    - E.g. Zea mays, Vigna unguiculata
  - Plant food (entire plant/part e.g. roots)
  - Animal food (entire animal/part)
  - State of maturity (ripe immature)
  - Other details

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Sample collection

- Need to know:
  - Number and size of sample to be collected
  - Distribution of samples
  - Stratification to be used
- Sample label should be permanently attached to the sample
  - Common name of food
  - Sample code number
  - Date of receipt in Lab.

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Sample collection

- During sample collection:
  - Collection details
    - Date and time of collection
    - Name of collector
    - Place of origin
    - Sampling point/addresses (roadside stall, farm, market)
    - Condition of cultivation (feed regime, altitude, irrigation)
    - Purchase price
    - Graphical record (Photograph, visual record with scale)
    - Transport conditions (mode and conditions of transport)

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Sample collection

- Description of sample collected: after sample collection
  - Food type (Legume, fruit juice, milk product)
  - Local use of foods (Famine. Festivals)
  - State of food sample (solid, semisolid, viscous, or liquid)
  - Process and preservation methods (canned smoked)
  - Preparation method (cooking)
  - Extent of preparation (raw, fully cooked, reheated)

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Sample collection

- Description of sample collected: after sample collection
  - Extent of preparation (raw, fully cooked, reheated)
  - Packing medium (brine, oil)
  - Container or wrapping (can glass)
  - Contact surface (can , glass)
  - Label or list of ingredients (estimated by inspection)

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Sample collection

- Description of sample collected: after sample collection
  - Batch number
  - Weight of food collected/individual items
  - Number of items
  - Weight of common measure or portion

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Sample collection

- Things to note
  - Deliver samples to the laboratory promptly with the original conditions maintained as nearly as possible
  - If products are in bulk: storage procedures, choice of containers, modes of transport should be considered
  - Use containers that are clean, dry, leak-proof, wide-mouthed, sterile, and of a size suitable for samples of the product.

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Sample Transportation

- Things to note
  - Whenever possible, avoid glass containers, which may break
  - For dry materials, use sterile metal boxes, cans, bags, or packets with suitable closures.
  - Identify each sample unit (defined later) with a properly marked strip of masking tape.
  - Transport frozen or refrigerated products in approved insulated containers of rigid construction

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Sample Handling

- During Handling
  - Aim: To protect the sample from changes in composition and contamination
    - Things to note
      - Weight and nature of edible/inedible matter (Prior to further processing (outer wilted leaves)
      - Method of preparation (Cooking or not, time, temperature of preparation)
      - Weight before/after cooking
      - Ingredients added if any

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Sample Handling

- During Handling
  - Method of mixing and reduction (grinding, homogenization)
  - Types of storage (addition of preservatives, temp of storage)
  - Methods used of take analytical samples
  - Storage of analytical samples or further processing
  - Name and signature of person completing record
  - Date of record
  - Other details

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Sample Preparation

- Preparation of analytical portions
  - If the particle size or bulk is too large for analysis, it must be reduced in bulk or size for analysis
  - Documentation of sample preparation is very important
  - Separate edible/inedible portions, record descriptions and weigh all parts
  - Measure portion sizes, weights, volumes, density etc.

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Sample Preparation

- **Homogeneous foods**
  - Solids:
    - *Friable: crumble and mix.*
    - *Sticky: freeze and crush at low temperature.*
    - *Hygroscopic: take portions rapidly into pre-weighed sealable containers for weighing.*
- Emulsions.
  - Take by weight rather than volume; warm and mix.
- Liquids with suspended solids.
  - Homogenize, or sample during gentle mixing.

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Sample Preparation

- **Reduction by quartering**
  - The principle is that the quarter should be representative of the whole
  - Any symmetrical food should be cut into quarters, and one-quarter of each batch taken for processing for analysis
  - Large items, if symmetrical, can be reduced in size by this technique
  - Oval or elongated foods (e.g. potato or cucumber) should be cut into eighths, and two-eighths taken for a quarter,

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Sample Preparation

- **Reduction by quartering**
  - Food lots of small items (flour, rice, legumes, small fruits, chopped mixed units).
    - The bulk is tipped into a uniform pile on a clean, inert surface
    - Turned over several times with a polythene or glass spatula.
    - The pile is leveled and then divided into four equal segments.
    - Two opposing segments are taken and the other two discarded.
    - The remaining segments are mixed and further reduced in the same way

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Sample Preparation

- **Reduction by quartering**
  - Foods consisting of fairly large, separate, but similar portions, such as loaves of bread or joints of a meat, should be quartered and sampled then processed for analysis.
  - Segmented foods sampling e.g. packets of biscuits, cartons of eggs, batches of bread rolls.
    - Take every fourth item to form a composite sample.
    - For sliced loaves, take every fourth slice and one end slice, which then must be thoroughly crumbed before further reduction.

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Sample Preparation

- **Examples of analytical sample preparations**
  - Nuts.
    - Batches of nuts should be ground separately with a pestle and mortar, then mixed together thoroughly in a bowl.
    - An analytical portion should be taken for inorganic analyses and the remaining mixture should be homogenized mechanically for further analyses.
  - **Eggs:**
    - - Fresh. Fresh eggs should be shelled and mixed briskly with a fork; after analytical portions are taken for inorganic analyses, the remainder is homogenized mechanically.
    - - *Dried. Dried eggs should be handled as flour.*

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Sample Preparation

- **Examples of analytical sample preparations**
  - **Fruit.**
    - **Large fruits (e.g. pineapples or watermelons) and medium-sized ones (e.g. apples)** must be quartered.
    - Small fruits (e.g. cherries) should be quartered by the method used for particulate foods.
    - Quarters should be coarsely chopped and combined, and unhomogenized analytical portions should be taken for immediate vitamin C and inorganic analyses.
    - The remaining mixture can then be homogenized to produce an analytical sample for other analyses.

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Sample Preparation

- **Examples of analytical sample preparations**
  - Meats and fish (raw, cooked and processed).
    - The fat and muscle of some meats are more conveniently analysed separately and the results combined to produce the final values.
    - The edible portion of each unit is chopped coarsely with a sharp knife (fish is flaked with a fork) and mixed thoroughly in a bowl with a spatula.
    - A portion is removed, frozen and crushed in a polythene bag, and used for inorganic analyses.
    - The remainder of the analytical sample is minced and mixed thoroughly again; portions are taken for further analyses.
    - Care must be taken to avoid fat separation during mixing

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Sample Preparation

- **Examples of analytical sample preparations**
  - ***Leafy vegetables and vegetable inflorescences.***
    - ***Small leafy vegetables*** should be mixed together in a bowl, chopped coarsely and mixed again briefly.
    - A large portion should be taken for inorganic analysis and another portion into metaphosphoric acid for vitamin C analysis.
    - Large tight-leaved vegetables (e.g. cabbage, iceberg lettuce) must be quartered.

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Sample Preparation

- **Examples of analytical sample preparations**

  - All large leafy vegetables must be chopped coarsely and mixed, and this must be done very quickly

  - After the mixing, analytical portions should be taken for analyses of vitamin C, vitamin A, carotenes, vitamin E and inorganic nutrients

  - The remainder can be chopped further. Stalks are often difficult to reduce and may have to be chopped separately and reintegrated into the food sample.

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Sample Preparation

- **Examples of analytical sample preparations**
  - **Prepared composite foods and dishes.**
    - This is the form in which most foods are consumed.
    - Items should be briefly homogenized, carefully mixed, then rehomogenized.
    - It can be assumed that laboratory homogenization will not introduce any contamination greater than that arising during domestic or commercial food preparation.

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Sample Preparation

- **Examples of analytical sample preparations**

  - Care is required to blend in the individual pieces of muscle, fat, vegetables, etc., which may be found in mixed prepared foods.
  - Portions for vitamin C assay are best taken from the mixed homogenate before it is rehomogenized.
  - If the prepared foods are hot, speed is essential to prevent moisture loss.
  - Total meals or diets can be handled in the same way.

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Sample Preparation

- **Some practical equipment requirements for handling and preparation of laboratory and analytical samples**
  - **General:**
    - Trays (for carrying foods)
    - Chopping boards (polythene, wood)
    - Oven thermometer, meat thermometer
    - Waring blender
    - Pestle and mortar
    - Ball mill
    - Hammer mill

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Sample Storage

- Keep ground samples in glass or plastic containers with air and water tight covers.
- Samples not analyzed immediately should be left in cold storage to minimise spoilage and other chemical reactions.
- Samples for lipid analysis – store under nitrogen at low temperature to prevent oxidation and unsaturated lipids

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Sample Storage

- Light may initiate oxidation so store in dark containers.
- For lipid analysis, antioxidants may be added if they wont interfere with the analysis
- It is therefore desirable to store a number of identical analytical samples
- Minimize the number of staff involved in taking portions from them.

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Sample Storage

Effects of sample storage and preparation on nutrient content and precautions required to minimize them

Effects	Potential Changes	Nutrients Affected	Precaution
Drying out	Loss of water	All nutrients	Design of protocol, Keep samples sealed, weigh food at start and during preservation
Absorption	Gain of water	All nutrients	Design of protocol, keep samples in sealed container
Microbial activity	Degradation/auto lysis/synthesis	Loss of CHO, proteins, gain in thiamin, Vit B6	Storage at low temperature, pasteurization or addition of inhibitors
Oxidation	Destruction of unsaturated fatty acids, loss of vitamins	Alterations in profile of fats	Store at -30C in sealed containers under nitrogen. Add antioxidants, bacteriostatic agents
Acid	Hydrolysis	Loss of sucrose and higher oligosaccharides	Store at low temperatures Neutralize acids

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Sample Storage

Effects of sample storage and preparation on nutrient content and precautions required to minimize them

Effects	Potential Changes	Nutrients Affected	Precaution
Alkaline	Destruction	Loss of thiamine	Avoid alkaline conditions and SO2
Light	Photo degradation	Loss of riboflavin	Protect from light
Contamination during sampling	From cooking vessels, soil, dust	Increase inorganic nutrients	Design protocol to minimize contamination, gently rinse with distilled water
Contamination from metallic blades, glassware	Increase in inorganic nutrients	Increase in major trace elements	Select apparatus with care Clean all utensils Store in plastic bags
Separation	Separation of fats	Changes in compositional Alteration in fibre content	Avoid over vigorous mixing and thaw/freeze cycles

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Sources of errors in sampling

- It is essential that all those involved in the sampling process are familiar with the objectives of the work and are clear about their roles.
- This will identify aspects that are unclear or impracticable and require modification to avoid errors.

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Sources of errors in sampling

Major Sources of errors in sampling

Source	Examples	Precaution
Food sample identification	Poor labeling of samples	Maintenance of documentation throughout sampling and analytical process
Nature of sample	Samples do not conform to the defined sampling protocol	Explicit instructions I sampling protocol, training of sample staff
Transport and handling	Samples contaminated, degraded or depleted during transport, loss of samples	Protocol specifies condition to be maintained, supervision
Analytical sample preparation	Incorrect mixing or homogenization	Proper supervision in laboratory Laboratory quality assurance
Analytical sample storage	Incorrect storage of samples	Proper laboratory techniques and supervision

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Thank you

For more on food composition, visit www.fao.org/infoods