



Food and Agriculture Organization  
of the United Nations

# Sampling of foods for analysis

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Based on Greenfield and Southgate, 2003



# Sampling

- Obtaining a portion that is representative of the whole
- Its important to clearly define your population
- Adequate sampling techniques helps ensure sample quality
- The quality of sampling and analytical data is a major determinant of database quality



# Objectives of Sampling

- **Primary:** To collect food samples that are representative and then to ensure that changes in composition do not take place between collection and analysis.
- **Secondary:** To document natural variability in samples as it relates to factors such as season, geography, cultivar and husbandry.



# Some basic terms

- **Sample**
  - A portion selected from a larger quantity of material
    - General term used for a unit taken from the total amount of food
- **Sampling protocol**
  - A predetermined procedure for the selection, withdrawal, preservation and preparation of the sample
    - Sometimes called a sampling plan
- **Characteristic**
  - The property or constituent that is to be measured or noted
    - Description of the food, nutrient and other analyses



# Some basic terms

- Homogeneity
  - The extent to which a property or constituent is uniformly distributed
    - Foods are usually heterogeneous or must be assumed to be so
- Sampling error
  - The part of the total error associated with using only a fraction of the total population of food and extrapolating it to the whole population. This arises from the heterogeneity of the population Sometimes called a sampling plan
  - Because of the heterogeneous nature of foods, replicate samples must be taken when estimating the composition of the population of a food



# Some basic terms

- Batch

- A quantity of food that is known, or assumed, to be produced under uniform conditions
  - Batch numbers should always be noted when sampling foods

- Unit

- Each of the discrete, identifiable units of food that are suitable for removal from the population as samples and that can be individually described, analyzed or combined
  - These units form the basis of most food analysis work (e.g. an apple, a bunch of bananas, a can of beans, a prepared dish)



# Sampling approach

- The selection of a representative sample and the combined protocols for sampling and analysis must be based on a clear understanding of the nature of the foods and the population of food being studied (i.e. all the individual units of the food).



# Sources of Food

- **Bulk commodities**

- Meat carcasses, bulk consignments of grain, fruit, vegetables, wine, edible fats
- Compositional data obtained are commonly used in commerce or for surveillance of imports or the misuse of growth stimulants and industrial recipes
- Standard sampling procedures developed: these should be followed: International Organization for Standardization (ISO, 2003); Official Methods of the Association of Analytical Communities (AOAC International, 2002, 2003); Codex Alimentarius (FAO, 1994; FAO/WHO, 2003)





# Sources of Food

- **Bulk commodities**

- Several samples may need to be taken from separate sacks, cases, packages or carcasses, and at several points in a silo or container
- Random sampling is preferable to the collection of readily accessible units.
- It is advised to take samples during the loading or unloading of a consignment.
- Special probes or triers are required for sampling finely particulate foods (e.g. sugar, grain), fluids (e.g. milk) or solids (e.g. cheese).
- Nutrient analyses are often limited to major components, but generally involve many analysed samples



# Sources of Food

- **Wholesale commodities and Foods**

- Meat carcasses, prime cuts, bulk packs of foods, often for institutional use
- Sampling of wholesale foods generally follows the principal approaches used with bulk commodities. Randomization of sampling is essential.
- Food compositional data also useful in intake assessment



# Sources of Food

- **Retail foods**

- Foods as sold to the consumer, e.g. meat cuts, vegetables, fruits, wine, processed foods
- These foods constitute the majority of foods included in food composition databases in industrialized countries.
- For primary products such as meats, fruits or vegetables, the major concern of the sampling protocol is to ensure that the complete range of sales outlets is represented



# Sources of Food

- **Retail foods**

- The potential for regional variation also needs to be covered in the design of the sampling protocols.
- Proprietary foods constitute an important range of foods in many countries and their composition should be included in the database.
- Where a database is prepared by government personnel there is often reluctance to include brand names.



# Sources of Food

- **Field or garden produce**
  - Foods grown or gathered, hunted animals
  - These sources of food are often ignored in industrialized countries.
  - These foods tend to be much more variable – the composition of plant foods is especially dependent on the soils and fertilizer treatments.
  - Food composition used mainly to assess household and individual food and nutrient intake.
  - Most field or garden produce is eaten seasonally as fresh and then preserved according to traditional methods that can differ substantially from commercial practice.



# Sources of Food

- **Uncultivated and wild foods**

- Many communities, especially those living a “hunter-gatherer” or semi-nomadic style of life, consume substantial quantities of wild plant and animal foods.
- Their inclusion in a database can be very useful for those studying the nutrition of such groups.
- Collecting samples of these foods can pose particular problems. They may be difficult to identify properly and also tend to be variable in composition and maturity
- Random sampling is virtually impossible and “convenience” sampling, as the opportunity arises, is the only option.



# Sources of Food

- **Foods as consumed**
  - Foods at the level of consumption, e.g. cooked dishes (single or multiple ingredients), street foods
  - These foods – “on the plate” – comprise cooked foods of all kinds, including complex mixed dishes.
  - Simulation of the cooking procedures in the laboratory or dedicated kitchens is often used to prepare samples for analysis



# Sources of Food

- **Foods as consumed**
  - Collection of cooked dishes from a randomly selected range of households would provide more representativeness, and is sometimes, therefore, the preferred approach
  - Samples of institutionally prepared foods from, for example, hospitals, industrial and public canteens and educational establishments, are more easily obtained
  - Food composition used to assess individual consumption and nutrient intake





# Major sources of variability in nutrient composition

Foods are inherently variable in composition, and the approach to sampling and the design of the sampling and analytical protocols need to take account of this factor.



# Major sources of variability in nutrient composition

- **Geographical samples**

- In a single country there may be a wide diversity of soil and climatic conditions
- Variations in food marketing and food preparation within different parts of a country
- Geographically-specific data may be presented in the database as a supplement to nationwide and/or region wide averages.



# Major sources of variability in nutrient composition

- **Seasonal samples**

- Seasonal variations in nutrient composition need to be accommodated in the combined protocols.
- Plant foods are especially prone to variation: water, carbohydrate and vitamin content
- Fish :especially in fat content
  - milk and milk products exhibit variations in vitamin:due to seasonal differences in feeding patterns



# Major sources of variability in nutrient composition

- **Physiological state and maturity**

- The states of maturity of plants and animal foods cause variation in composition
- Concentrations of sugars, organic acids and vitamins in many plants, and of fats and some minerals in animal foods.
- The storage of plant foods affects water and vitamin contents and levels of some organic nutrients: residual plant metabolism in storage.



# Major sources of variability in nutrient composition

- **Cultivar and breed**

- These may be a significant source of variation for some nutrients
- It is desirable to document the cultivar or breed variation within the database.



# Major sources of variability in nutrient composition





## Nutrient composition of banana cultivars

<b>Banana Variety</b>	<b>Edible Portion</b>	<b>Water g</b>	<b>Energy kJ (kcal)</b>	<b>Calcium mg</b>	<b>Phos mg</b>	<b>Iron mg</b>	<b>β carotene mcg</b>
<b>Cavendish</b>	<b>64</b>	<b>74.4</b>	<b>435 (104)</b>	<b>139</b>	<b>20</b>	<b>0.8</b>	<b>75</b>
<b>Botoan</b>	<b>57</b>	<b>74.4</b>	<b>422 (101)</b>	<b>21</b>	<b>27</b>	<b>0.4</b>	<b>25</b>
<b>Ternatensis</b>	<b>62</b>	<b>66.3</b>	<b>552 (132)</b>	<b>15</b>	<b>19</b>	<b>0.9</b>	<b>370</b>
<b>Lacatan</b>	<b>69</b>	<b>68</b>	<b>527 (126)</b>	<b>21</b>	<b>34</b>	<b>0.8</b>	<b>360</b>
<b>Violacea</b>	<b>67</b>	<b>73.1</b>	<b>447 (107)</b>	<b>19</b>	<b>21</b>	<b>0.7</b>	<b>285</b>
<b>Compressa</b>	<b>57</b>	<b>72.2</b>	<b>460 (110)</b>	<b>23</b>	<b>36</b>	<b>0.9</b>	<b>190</b>
<b>Ternatensis</b>	<b>64</b>	<b>66.2</b>	<b>560 (134)</b>	<b>11</b>	<b>24</b>	<b>0.7</b>	<b>325</b>
<b>Tuldoc</b>	<b>76</b>	<b>74.8</b>	<b>414 (99)</b>	<b>26</b>	<b>28</b>	<b>1.6</b>	<b>1370</b>
<b><i>Uht en yap</i></b>		<b>69.5</b>					<b>2780</b>



# Methods of sampling

- **Random sampling**

- Random samples are collected in such a way as to ensure that every item in the population of the food being sampled has an equal chance of being collected and incorporated into the sample to be analyzed
- It is more usual to set up a stratification of the food population.





# Methods of sampling

- **Stratified sampling**

- In this method the population of food is classified into strata, taking into account the most important causes of variation.
- Units of sampling are taken from defined strata (subparts) of parent population. Within each stratum the samples are taken randomly
- Often the most suitable method for use in database work. Strata may be regional, seasonal, retail sale point, etc., as defined by knowledge of the food being studied



# Methods of sampling

- **Selective sampling**

- Samples are taken according to a sampling plan that excludes material with certain characteristics or selects only those with defined characteristics
- Most commonly used in the analysis of contaminants. Can be used, with caution, for database work
- Legitimately used in the analysis of contamination, where the objective may be to identify maximal exposure to contaminants.



# Methods of sampling

- **Convenience sampling**

- Samples are taken on the basis of accessibility, expediency, cost or other reason not directly concerned with sampling parameters
- Rarely suitable for database work but may be the only practicable way to sample wild or uncultivated foods or composite dishes from selected households



## Limits on sampling methods

In all methods the compositional data obtained can only be an estimate of the composition of the food and are subject to limitations imposed by the variation in the composition of foods



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# THANK YOU

For more on food composition, visit [www.fao.org/infoods](http://www.fao.org/infoods)