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INTEGRATED FOOD SAMPLING TECHNIQUES

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ABSTRACT

Sampling techniques play a critical role in food analysis, allowing scientists to gather accurate and representative data about the quality and safety of food products. Due to the large number and diverse nature of food samples, careful sampling is crucial to ensure reliable results. In this article, we will explore some common sampling techniques used in food analysis and their importance in ensuring food safety. One widely used sampling technique in food analysis is random sampling. In this approach, samples are selected randomly from a population of interest. Another important technique is stratified sampling. This method involves dividing the population into distinct groups or strata based on specific characteristics, such as geographical location or production method. Systematic sampling is another commonly employed technique in food analysis. It involves selecting samples at regular intervals, typically based on a predetermined pattern. In addition to these techniques, there are several other specialized sampling methods used in food analysis, depending on the specific goals and requirements of the study. In recent years, the use of non-destructive sampling techniques has gained popularity in food analysis. Such methods enable scientists to extract samples without causing damage to the food product, allowing for further analysis or retesting if required. Techniques like hyperspectral imaging and near-infrared spectroscopy can provide valuable information about food quality and safety without altering the sample, making them particularly useful in industrial settings.

KEYWORDS: Food analysis, Hyperspectral imaging, Near-infrared spectroscopy.

INTRODUCTION

Food analysis is a critical component of ensuring food safety, quality, and compliance with regulations. However, conducting an accurate analysis requires a careful selection of representative samples from the heterogeneous food matrix. Sampling techniques play a crucial role in obtaining reliable results that accurately reflect the overall quality of the food. In this article, we will explore the importance of sampling in food analysis and discuss various techniques employed in the field.

Importance of Sampling in Food Analysis

Sampling is the process of collecting a small portion of a larger population or batch for analysis. In food analysis, the objective of sampling is to obtain a representative portion that accurately reflects the overall composition and quality of the food product. The accuracy of the analysis heavily relies on the representativeness of the sample taken. A poorly chosen sample can lead to biased results, rendering the analysis useless or misleading.

Sampling Techniques

1. **Random Sampling:** Random sampling is a widely used technique in food analysis. It involves selecting samples randomly from a population or batch. This method eliminates biases and ensures that every unit has an equal chance of being included in the sample. Random sampling is particularly useful when dealing with homogeneous products, such as grains or powders.
2. **Stratified Sampling:** Stratified sampling involves dividing the population into distinct subgroups or strata based on certain criteria, such as geographic location or production method. Samples are then randomly selected from each stratum, ensuring that every subgroup is adequately represented. This technique is beneficial when dealing with heterogeneous food products, such as mixed fruits, where different strata may exhibit significant variations in composition.
3. **Composite Sampling:** Composite sampling involves combining individual samples into a single representative sample. This technique is useful when analyzing large batches or homogeneous products with uniform distribution. By pooling multiple samples, composite sampling reduces the cost and time associated with analyzing individual samples while still providing reliable results.
4. **Systematic Sampling:** Systematic sampling involves selecting samples at regular intervals from a population or batch. This technique is suitable when dealing with large quantities of food products, such as canned goods on a production line. Systematic sampling ensures that every nth unit is selected, minimizing biases and providing an unbiased representation of the batch.
5. **Sequential Sampling:** Sequential sampling involves collecting samples at regular intervals during a continuous process, such as food production or packaging. This technique allows for real-time monitoring of quality throughout the entire process, ensuring early detection of any issues or variations and facilitating prompt corrective action.

Factors considered

The main factors to be considered when taking, and/or storing, samples for analysis are:

1. Correct order of sampling – especially if multiple tests are to be conducted.
2. Ensuring that the sample is representative of the lot.
3. Preventing cross-contamination.
4. Preventing degradation, of the sample and/or the measurand.
5. The reason for the test, e.g. ongoing quality control, compliance with Regulations or product investigations.
6. Any statistical analyses that may be required.

Order of testing

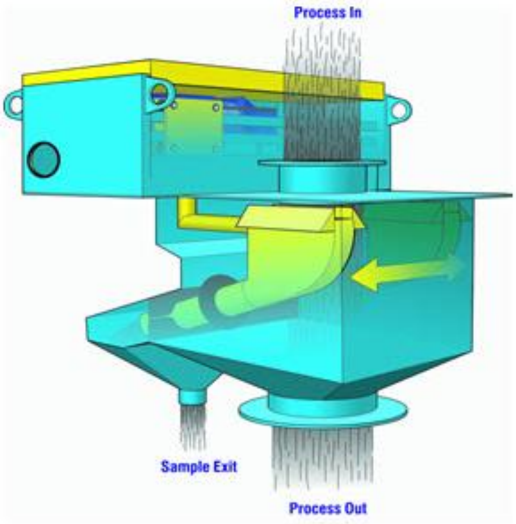
Samples for:

- Microbial testing should always be taken first, using an aseptic process.
- Physical contamination is next in priority.
- Chemical testing samples should be taken last.

Instruments for different types of product and storage states

Sample dividers

Ideal for Free Flowing Powders Suitable for use with powder chemicals, food stuff, feed and similar granular materials These hand held sample dividers will subdivide material samples into smaller portions by single or multiple passes. The important feature of Endecotts sample dividers is that each subdivision retains the characteristics of the original sample.



Sample Scoops

These Heavy Duty Sample Scoops are produced to the highest quality, are crevice free to minimise contamination and easy to clean.

Sleeve Sampler

Ideal for Free Flowing Powders Suitable for use with powder chemicals, food stuff, feed and similar granular materials Ideal for sampling large volumes at great depths. At the required depth pull up the sampler slightly. This will force the sleeve down so that the product can fall into the sample chamber.

The Sampling Spear

Powder, Granules or Crystals

Samples of powders granules or crystals are usually taken with a ‘spear the spear is thrust at an angle into the material (the opening underneath) rotated two or three times and then carefully withdrawn with the opening uppermost. The contents are then discharged into the sample container.

Sample storage

Samples must be stored:

- In a suitable container, which may be security tagged/sealed. Essential for legal samples
- At a suitable temperature e.g. samples taken for testing of volatile chemicals, or unsaturated fatty acids, may benefit from frozen storage, but conversely freezing may affect the outcome of microbial testing. In general, samples for microbiology testing should be kept in the state in which they are intended to be stored, i.e. chilled should stay chilled, ambient stay at ambient temperature. N.B. Do not freeze the sample if testing for undeclared freezing.
- Under conditions that prevent degradation of the sample, or the analyte to be tested. For example, many vitamins are light sensitive, so samples sent for analysis should be protected from light using dark packaging, or by wrapping the sample packaging in aluminium foil.
- In containers that prevent cross-contamination, e.g. if testing for:

i. Metal elements, it would not be sensible to wrap samples in aluminium foil
ii. Plasticisers, samples should not be placed into plastic bottles
iii. Glass contamination, the sample must not be placed inside a glass container.

Sampling protocols for chemical analysis

The overall validity and repeatability of the analytical result is totally dependent upon the sampling protocol employed. If the product is relatively homogenous, e.g. wines, oils, milk and other liquids, it is often acceptable to sample from any point in the chain, such as from the bulk tank, bottling line or from the finished product in the bottle or carton. However, it should be noted that some bulk tanks will contain sediments, or the liquid may stratify under certain conditions. For example, at low storage temperatures, fats may settle into different layers depending upon the mix of saturated and unsaturated fats present in the bulk tank. These types of products should be agitated and well mixed before sub-samples are taken for testing. Consideration should also be given to any other factors that may affect the reliability of the sampling process e.g. pipework dead ends can be a source of residual contamination.

If the product is more granular (e.g. cereals, figs, nuts, apples), sufficient samples should be taken so that, as far as possible, they are representative of the lot. Complex samples, such as ready meals and muesli, will require great attention to detail if a reliable sample is to be obtained for chemical analysis.

Complex samples for chemical analysis must therefore be blended or combined to produce a homogenous sample before testing. The level of homogeneity to be achieved will be dependent upon:

- **The chemical to be tested and the likely source of any contamination -** for example, for some naturally occurring chemicals, such as mycotoxins, contamination is often very heterogeneous within a lot. This means that much of the product may contain little or no mycotoxin contamination, but there could be hot spots of high-level contamination. Another example of potential heterogeneity of chemical residues is pesticides on fruit and vegetables'.

- **Unit size -** for products with small particle sizes, e.g. blended herbs and spices, and sugar, the distribution of any chemical residue is likely to be fairly consistent. Larger size products, such as unmilled grain, fruit and nuts, should be milled to a small particle size and mixed well before analysis.
- **Samples size employed by the laboratory -** due to increasing sensitivity of testing, many laboratories use less than 2 grams of sample per test. In fact, many laboratories have miniaturised their analytical processes so that only 0.1 to 0.2 gram is used. This means that the small sample to be tested has to be milled, and well mixed, if the final result is to be representative of a lot.

Replicate sampling and analysis

If efficient and controlled mixing and blending of samples is not possible, for Quality Assurance (QA) purposes, it may be acceptable to use a less homogenous test sample and to conduct analysis on multiple samples, taken randomly from an individual lot. The combined data can then be used to provide an estimate of any product contamination. On-going analysis from QA testing of multiple production batches (plotted versus time) can also be useful. In this approach the more rigorous sampling/mixing/blending procedures would be limited to products that require further investigation, e.g. in the case of potential non-compliance with legal maximum limits.

Another tool for reducing the cost of testing is to employ composite samples. These are often made up from a number of replicate samples (typically n >5), taken across production batches, which are then mixed, or blended, before sending to the laboratory for testing. When using this approach, it is recommended that portions of the sub-samples, used to make the blend, are retained. This allows for the individual samples, used to prepare the composite, to be tested at a later date. This is particularly important if the source of contamination is likely to be heterogenous, e.g. mycotoxins, or when it will be necessary to identify which of the sub-samples may have caused an issue.

- For a suitable length of time. Samples kept for a long time, before testing, may not be representative of the original product that was sampled.

Sample shipping and storage requirements should also be discussed and agreed with the receiving laboratory.

CONCLUSION

Sampling techniques play a crucial role in food analysis, serving as the foundation for accurate and reliable results. By employing appropriate sampling techniques, such as random, stratified, composite, systematic, or sequential sampling, food analysts can obtain representative samples that reflect the overall quality and composition of a food product. Careful consideration of the appropriate sampling technique for the specific food matrix is essential to ensure accurate analysis, regulatory compliance, and consumer safety. As the demand for safer and higher quality food products continues to rise, sampling techniques will remain at the forefront of food analysis, ensuring that consumers can trust the integrity of the food they consume.

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