Egyptian Food Control System

The Role of NFSA in Inspection & Sampling of Cereal Grains

Prepared by: Moustapha Nabeel Mohammed; (Ph.D.)

National Food Safety Authority (NFSA)
Outline

• NFSA Regulations for Egyptian Food Control.
  o Quality Infrastructure
  o Risk-based Inspection Paradigm
• Food Sampling (Part 1):
  o Commonly Used Terms & Definitions
  o Basic Sampling Statistics
• Food Sampling (Part 2):
  o Devices & Tools
  o Packaging & Transportation of Samples
  o Sample Coding, Labels & Records
• Sampling Plans & Procedures.
  o Chemical Hazards (Pesticides, Heavy Metals)
  o Microbiological Hazards
  o Mycotoxins in Cereals & Grains
Food Hazards in Cereal Grains Products

Main Food Hazards

Food Allergens
(Non toxic ingredients that can be harmful)
e.g. Gluten

Food-borne Pathogens
Campylobacter – Salmonella - Listeria
Fungi

Agro-chemicals Residues
- Pesticides

Physical Contaminants
Glasses
Metallic pieces

Food Irradiation &
Radioactive substances

GMO Issues

Contaminants
Metals (Pb, Cd, As)
Mycotoxins

The Role of NFSA in Inspection & Sampling of Imported Grains | FAO 2019
Regulatory Environment for Food Safety
National & International Food Standards
Sampling Methodologies / Permissible (Maximum Limits)

- Standards
- Guidelines
- Code of Practice
- Recommendations
- Advisory texts
- Pesticides MRLs
- Contaminants Mls

Sampling Methodologies
Test Methods
Permissible (Maximum Limits)
Hygienic Practice
Labelling
Import & Export
Inspection & Certification
etc.
NFSA Regulations for Egyptian Official Food Control

- Quality Infrastructure
- Risk-based Inspection Paradigm
The Role of NFSA in Inspection & Sampling of Imported Grains | FAO 2019

**Risk-based Inspection System on Cereal Grains Consignments**

- The NFSA as a Competent Authority control and response procedures are based on a process of regular checks with appropriate frequency.
- This is in accordance to risk level assessment principle for risk analysis.
- If a risk is identified, appropriate measures are rapidly taken.

---

**Categorizing Risk Level**

1. Source of potential biological/chemical risks.
2. Risk level of country of origin.
3. Grain consumption rate.
4. Adverse effect on certain consumer groups.
5. Percentage of failed analysis result (the higher the percentage failed, the higher the risk)
### Risk-based Inspection System on Cereal Grains Consignments

<table>
<thead>
<tr>
<th><strong>Green Channel</strong></th>
<th>The consignment shall be subject to document review and if accepted, will proceed for final health clearance.</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Yellow Channel</strong></td>
<td>In addition to document review, the consignment shall be subject to cargo examination at the designated inspection centers and if accepted, will proceed for final health clearance.</td>
</tr>
<tr>
<td><strong>Red Channel</strong></td>
<td>In addition to both document review and cargo examination, the consignment shall be subject to representative sampling for the food item(s) for laboratory analysis and accepted, will proceed for final health clearance.</td>
</tr>
</tbody>
</table>
Inspection Levels and Switching Rules

Risk Management
- Control Authority
  - Audit-Strategies
  - Sample plans
  - Monitoring systems
  - Risk reduction plans

Risk Assessment
- Risk Database

Risk Communication
- Consumers
  - Industry
  - Importers/Exporters
  - Politicians

Authorisations / Outcome of audits and investigations

Monitoring
- Environment
- Production of Plants
- Production of Animals
- Slaughter house/Dairy

Research

Food Processing

Retail

Consumer

Foods in National & International Trade

The Role of NFSA in Inspection & Sampling of Imported Grains | FAO 2019
Food Sampling

- Commonly Used Terms & Definitions
- Basic Sampling Statistics
- Sampling Plans
Basic Sampling Statistics

- **Population**
The entire collection of items one wishes to study.

- **Sample**
Is part of the population, it is the set of items one actually does study.

- **Statistical inference**
  ✓ What is the shape of the distribution?
  ✓ Do the values of the variable tend to fall into a bell-shaped, flat, u-shaped pattern?
  ✓ A common distribution is the normal distribution.
    • What is the location?
    • How much variation?
What to Sample

- Containers.
- Ship storage (bulk, sacks, packages)
- Trucks, trains.
- Silos
- Pack Houses
- Warehouses
- Retail (packages)
- Etc.

Purpose of Sampling

- Regulatory (picked for evaluation for legal actions).
- Monitoring (to review quality, safety, freshness & preferences in market place).
- Dietary Exposures.
- Assigning the grade factors.
- Etc.

The sample integrity, homogeneity, & representativeness is vital for a fair & meaningful inference & subsequent actions.
Commonly Used Sampling Terms

- **Sampling Procedure** used to draw or constitute a sample.

- **Sampling Plan**
  Planned/predetermined procedure (scheme) for the selection, withdrawal, preservation, transportation, and preparation of the portions to be removed from a population (lot/Batch as samples).

- **The Characteristic**
  A characteristic is a property, which helps to identify, or differentiate between, items within a given lot.
  **Uniform characteristics:** means same origin, producer, variety, packer, type of packing, markings, consignor.
Commonly Used Sampling Terms

- **Consignment**
  A consignment is a quantity of some commodity delivered at one time. It may consist a set of several lots.

- **Lot**
  - A quantity of a food material delivered at one time & known, or presumed, by the sampling officer to have uniform characteristics conditions.

- **Batch**
  - means a set of identifiable quantity of products obtained from a given process under practically identical circumstances & produced according to a single manufacturing in a given place within one defined production period (same manufacturing cycle).
Consignment

PRIMARY SAMPLE

BULK SAMPLE

FINAL SAMPLE

LAB SAMPLE

Lot + Lot + Lot

Taken from Single Place in the Lot

Combined of All Primary Samples Taken from the Lot

* Bulk Sample
** Representative Part of Bulk Sample

* Intended to Laboratory
** Final Sample
*** Used as a whole or subdivided into representative portions

The Role of NFSA in Inspection & Sampling of Imported Grains | FAO 2019
Collection of Primary Samples

Lot
A quantity of a food material delivered at one time and known, or presumed, by the sampling officer to have uniform characteristics such as origin, producer, variety, packer, type of packing, markings, consignor, etc. A suspect lot is one which, for any reason, is suspected to contain an excessive residue. A non-suspect lot is one for which there is no reason to suspect that it may contain an excessive residue.

Notes. (a) Where a consignment is comprised of lots which can be identified as originating from different growers, etc., each lot should be considered separately.
(b) A consignment may consist of one or more lots.
(c) Where the size or boundary of each lot in a large consignment is not readily established, each one of a series of wagons, lorries, ship’s bays, etc., may be considered to be a separate lot.

Official Sampling Methodologies challenge is to be merged with:
Feasibility – Cost – Robustness

Minimum Disruption of Business
The Role of NFSA in Inspection & Sampling of Imported Grains | FAO 2019

Sampling an object.

Quality control samples

Field
- co-located (replicates)
- Spiked in field
- Field blanks
- Control site sample(s)

Laboratory
- duplicates
- Spiked
- blanks
- RMs

object

increments

sample

Gross sample

storage

Representative parts of the object

Representative parts of the sample. Sub-samples

analyses

(x ± y) units

The analytical result(s) can only be as good as the sample(s) collected.
7.3 Sampling

7.3.1 The laboratory shall have a sampling plan and method when it carries out sampling of substances, materials or products for subsequent testing or calibration. The sampling method shall address the factors to be controlled to ensure the validity of subsequent testing or calibration results. The sampling plan and method shall be available at the site where sampling is undertaken. Sampling plans shall, whenever reasonable, be based on appropriate statistical methods.

7.3.2 The sampling method shall describe:

a) the selection of samples or sites;

b) the sampling plan;

c) the preparation and treatment of sample(s) from a substance, material or product to yield the required item for subsequent testing or calibration.

NOTE When received into the laboratory, further handling can be required as specified in 7.4.

7.3.3 The laboratory shall retain records of sampling data that forms part of the testing or calibration that is undertaken. These records shall include, where relevant:

a) reference to the sampling method used;

b) date and time of sampling;

c) data to identify and describe the sample (e.g. number, amount, name);

d) identification of the personnel performing sampling;

e) identification of the equipment used;

f) environmental or transport conditions;

g) diagrams or other equivalent means to identify the sampling location, when appropriate;

h) deviations, additions to or exclusions from the sampling method and sampling plan.
Cereals & Grains

- Egypt Production & Imports Index
- Sampling Methodologies - Challenges
Risks Associated With Incorrect Sampling

MRLs/MLs

- Under/Over Reported MRL: Loss of food, Economic damage for farmers & importers/exporters
- False Negative: Consumer Safety are Compromised
- False Positive: Loss of food, Economic damage for farmers & importers/exporters

Total Error
- Sampling Error: ± ? %
- Analytical Error: ±20-30 %
Sampling Uncertainty
Commodity in the Market

\[ U = 2 \times S_1 \times CV \times R \]

Results = \( R \pm U \) (mg/kg)

Non-compliant

Compliant

Decision Limit = DL = 2MRL
(for pesticide residue)

Whitker Model for AL
(for Mycotoxins)

Sampling Uncertainty
Pre-marketed Control

Non-compliant

Compliant

The Role of NFSA in Inspection & Sampling of Imported Grains | FAO 2019
Sampling Variability & The Sources that contributes to the Sampling Uncertainty

• **Heterogeneity**: Distribution of the analyte in the lot (Variation in growing seasons, Variation in harvested grain, Variation within the farm store, Variation within loads delivered from farm).

• **Size of the primary samples**.

• **Effects of specific sampling strategy** (e.g., random, stratified random, proportional etc.).

• **Transportation and preservation of sample**.
Sampling Variability & The Sources that contributes to the Sampling Uncertainty

- With 76% of total error, sampling is usually the largest error source in mycotoxin analysis.

Table 3.1. Effect of sample size on the range of results bracketing the 95% confidence limits in a cottonseed lot containing 100 μg/kg aflatoxin

<table>
<thead>
<tr>
<th>Sample size (kg)</th>
<th>Standard deviation (μg/kg)</th>
<th>Concentration of aflatoxins in sample (μg/kg)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Low(^a)</td>
</tr>
<tr>
<td>1</td>
<td>87</td>
<td>0</td>
</tr>
<tr>
<td>2</td>
<td>62</td>
<td>0</td>
</tr>
<tr>
<td>4</td>
<td>45</td>
<td>13</td>
</tr>
<tr>
<td>8</td>
<td>32</td>
<td>37</td>
</tr>
<tr>
<td>16</td>
<td>24</td>
<td>53</td>
</tr>
<tr>
<td>32</td>
<td>10</td>
<td>84</td>
</tr>
</tbody>
</table>

\(^a\) The low concentration value was calculated as 100 - (1.96 * standard deviation); a value of 0 was recorded if a negative result was obtained.

\(^b\) The high concentration value was calculated as 100 + (1.96 * standard deviation).

\(^c\) CAST (2003) number was 96.

Adapted, by permission of the publisher, from CAST (2003).
## Mycotoxins: General Standard For Contaminants And Toxins In Food And Feed (Codex Stan 193-1995/2018)

### Method of sampling for Cereals and Cereal Products

Number of incremental samples to be taken for lots of <50 tonnes

<table>
<thead>
<tr>
<th>Weight</th>
<th>No. of Incremental Samples</th>
<th>Aggregate Sample Weight (kg)</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt; 50 kg</td>
<td>3</td>
<td>1</td>
</tr>
<tr>
<td>&gt; 50 kg - ≤ 500 kg</td>
<td>5</td>
<td>1</td>
</tr>
<tr>
<td>&gt; 500 kg - ≤ 1 tonne</td>
<td>10</td>
<td>1</td>
</tr>
<tr>
<td>&gt; 1 tonne - ≤ 3 tonnes</td>
<td>20</td>
<td>2</td>
</tr>
<tr>
<td>&gt; 3 tonnes - ≤ 10 tonnes</td>
<td>40</td>
<td>4</td>
</tr>
<tr>
<td>&gt; 10 tonnes - ≤ 20 tonnes</td>
<td>60</td>
<td>6</td>
</tr>
<tr>
<td>&gt; 20 tonnes - ≤ 50 tonnes</td>
<td>100</td>
<td>10</td>
</tr>
</tbody>
</table>

**Large lots of cereals**

Number of incremental samples = 100 + \( \sqrt{t} \)

Equivalence between ISO EN 24333:2009 and GAFTA Rules 124 with Regulation 519/2014 (For FBO)
Sampling & Testing
Harmonization & Impacts

Flow of Food Trade

Food Control Areas
- Quality (Consumer appeal)
- Safety (Consumer health)
- Authenticity (Compliance with legislation)
- Traceability (Product identity/integrity)

COUNTRY B
National Legislation
Sampling by Method B
Testing by Lab B
(QC Criteria, Validation, Accreditation)

Egypt
National Legislation
Sampling by Method A
Testing by Lab A
(QC Criteria, Validation, Accreditation)

The Role of NFSA in Inspection & Sampling of Imported Grains | FAO 2019
## Cereal Grains

<table>
<thead>
<tr>
<th>Sea Ports</th>
<th>HS Code</th>
<th>Food Type</th>
</tr>
</thead>
<tbody>
<tr>
<td>Alexandria</td>
<td>010</td>
<td>Wheat – Corn – Rice – Sorghum</td>
</tr>
<tr>
<td>Al-Dekhila</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Damietta</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Suez/Port Tawfik</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Al-Adabiya</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sokhna</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Port Said</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Port Said East</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Safaga</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Al-Arish</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Naweiba</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
المصدر:
وزارة التموين والتجارة الخارجية
(الشركة المصرية القابضة للصوامع والتخزين)
Fit-for-Purpose Cereal Grains Sampling Plans

- Bulk Sampling Plans
- Packaged Sampling Plans
- Silos Sampling Plan
- Trucks Sampling Plan
Bulk & Packaged Sampling Plans

The Role of NFSA in Inspection & Sampling of Imported Grains | FAO 2019

Source: IUPAC Sampling Process
# Regulations & Standards on Sampling Plans & Procedures

<table>
<thead>
<tr>
<th>Methods of Sampling for the Determination of Heavy Metals for Compliance with Regulatory MLs/PLs</th>
<th>Methods of Sampling for Foods for Determination of Pesticide Residues in Food for Compliance with Regulatory Pesticide MRLs</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>CXS 193-1995</strong>: General Standard For Contaminants &amp; Toxins In Food</td>
<td><strong>Codex Guideline 33-1999</strong></td>
</tr>
</tbody>
</table>

| Microbiological Criteria for Foodstuffs to Assess the Acceptability of a Lot/Batch Application of a Two-class or Three-class Attributes Sampling Plan | Methods of Sampling for the Determination of Mycotoxins for Compliance with Regulatory MLs |

| Packages and Sampling Methods of Analysis for Foods (ES 1559/2008) |  |
Bulk & Dynamic Sampling Plans
Bulk Sampling Plans from Silos
**Bulk & Static Sampling Plan**

*Static Sampling (Trucks)*

- Truck containing up to 15 tonnes: five sampling points (middle and approximately 50 cm from sides).
- Truck containing 15 to 30 tonnes: eight sampling points.
- Truck containing 30 to 50 tonnes: eleven sampling points.

ISO 24333:2009
*Cereals and cereal products - Sampling*
**Static Sampling Plans from Containers (Packages, Sacs)**

**Example:**
Lot $B_1 = 400$ kg  
Individual Package $\beta_3 = 250$ g

**Means 1600 individual packages**

Bulk sample $\beta_t = 1$ kg  
Primary sample $\beta_2 = 200$ g.

**This means that one package should be taken per 320 ($1600/320 = 5$ packs)**

---

**Frequency** ($\nu$) = \[
\frac{B_1 \cdot \beta_2}{{\beta}_t \cdot \beta_3}
\]

- $B_1 =$ Weight of lot
- $\beta_2 =$ Weight of primary sample
- $\beta_t =$ Weight of bulk sample
- $\beta_3 =$ Weight of package

**Example Calculation:**

\[
\text{Frequency} (\nu) = \frac{400 \times 0.200}{1 \times 0.250} = 320
\]
Static Sampling Plans from Containers (Packages, Sacs)
Bulk Sampling Plans from Warehouses

Bulk Sampling (Warehouse)

Sampling methods

Inhomogeneous distribution of mycotoxins (red) in grains.

- Collect incremental samples as described for each product.
- Mix incremental samples together thoroughly to form the aggregate samples.
- Mix aggregate sample thoroughly.
- Prepare the laboratory samples. Collect scoops from different points in the aggregate.
- Place into an adequate bag. Label samples properly and store accordingly.
- Send samples to Romer Labs for analysis.

The Role of NFSA in Inspection & Sampling of Imported Grains | FAO 2019
Sampling Plans for Packaged Cereal Grains

Primary Sample (100 gm weight)

Aggregate Sample (1-10 kg weight)

Lab Sample (1-10 kg weight)

The Role of NFSA in Inspection & Sampling of Imported Grains | FAO 2019
Cereal Grains Sampling

Devices & Tools

Packaging & Transportation of Samples

Sample Coding, Labels & Records
Sampling Devices & Tools

Equipment is suitable for purpose and checked to ensure fitness for use.

- Spears & Scoops
- Container for Primary Simple
- Multi-Aperture Sequential Spears
- Moisture-meter
- Temp. Probe
- Temperature probe
Sampling **Devices & Tools**

LDPE, crystal-clear - 0.05 mm strong film - With "zipper" closure – Various Sizes (20*30 cm & 30*40cm) - Can be frozen - Can be labelled - Sterile – Waterproof.
Sampling Devices & Tools

- Carrying cases
- Notebooks
- Appropriate Personal Protective Equipment
- Insulated boxes
- Adequate supply of hard frozen ice blocks
- Food grade sampling bags
- Sample Labels
- Seals
- Disposable paper towels
- Measuring jugs
- Funnels

- Chopping boards
- Scissors
- Knives
- Spoons
- Can Openers
- Sample containers
- Glass bottles
- Thermometer (Calibrated)
- Disinfectant wipes
- Sterile sample jars
- Sterile knives and spoons as necessary
- Swabbing equipment
- Water sampling bottles
- Disposable gloves
Packaging & Transportation of the Lab Sample

- Place the laboratory sample in a clean, inert container,
- Seal & label the container, attach the **sampling record (Sampling Protocol)**.
- Deliver the sample to the lab as soon as practicable.
- Avoid spoilage in transit, e.g. fresh samples should be kept cool & frozen samples must remain frozen.
- Light degrades many pesticides; it is therefore advisable to protect the sample & any solutions or extracts from needless exposure.
- Extended storage in freezers can cause moisture to migrate to the surface of the sample then to the freezer coils, slowly desiccating the sample.
Labels & Records

- Label each sample with the appropriate sample identification. The label & ink should be such that the writing will not be illegible if the label becomes wet.

- Attach the label securely so that it cannot come loose during shipment, & place the label so that it will not become wet.

- Complete the **Sampling Report** (residue data sheets) clearly & accurately with all the requested trial details.

- The completed sheets should be protected by enclosing them in protective polythene bags which should be sent with the sample.

**Use a label on the outside of the shipping container**
Sample Coding & Traceability

All records must be traceable (LIMS)

- Check sample sheet details (packaging details, batch codes, etc.).
- Check weight / number of units.
- Assign unique laboratory code.
Summary & Conclusions

- The maximum allowable limits for residue and contaminants in cereal grains would at low levels (µg/kg).
- Sampling is very important step when controlling a commodity of a lot with legal limits.
- Too Many Assumptions About “Good” Sampling Are Untrue.
- Documented Procedures (SOP, sampling plan).
- Trained and authorized samplers (e.g. NFSA officials).
- Fit-for-purpose sampling plans (methods, equipment/tools, methodology, etc.).
- Detailed sample protocol.
- Transport sample to laboratory using containers to maintain sample in good condition.
- Samples shall be taken, handled and labelled in such a way as to ensure their legal, scientific and technical validity (EU Regulation 625/2017).
Thank You!

Moustapha Nabeel Mohammed
lab@nfsa.gov.eg

General Administration for Laboratories Affairs
National Food Safety Authority
References

- Egypt wheat sector review, country highlights, prepared under the FAO /EBRD cooperation, Food and Agriculture Organization of The United Nations, Rome, 2015
- Egyptian grain production and trade, market snapshots, Food And Agriculture Organization Of The United Nations, December 2017.
- Sampling procedures for the official control on food of non-animal origin, Italian Maritime, Air, and Border Health Offices (USMAF), Italy
- Guidance document for competent authorities for the control of compliance with eu legislation on aflatoxins.
- Guidance document for the implementation of commission regulation (EU) No. 519/2014 of 16 may 2014 amending regulation (EC) No. 401/2006 laying down the methods of sampling and analysis for the official control of the levels of mycotoxins in food.
- US dept. of agric. grain inspection (USDA/GIPSA).
- Legislation on chemical contaminants, food safety authority of Ireland, January 2015.
References

- For the control of levels of mycotoxins: Commission Regulation (EC) 401/2006
- For the control of levels of lead, cadmium, mercury, inorganic tin, 3-MCPD and benzo(a)pyrene in foodstuffs: Commission Regulation (EC) No 333/2007
- ISO 18593:2004 Microbiology of food and animal feeding stuffs -- Horizontal methods for sampling techniques from surfaces using contact plates and swabs
- ISO 28590:2017 Sampling procedures for inspection by attributes -- Introduction to the ISO 2859 series of standards for sampling for inspection by attributes
- ISO 28591:2017 Sequential sampling plans for inspection by attributes
- ISO 28592:2017 Double sampling plans by attributes with minimal sample sizes, indexed by producer's risk quality (PRQ) and consumer's risk quality (CRQ)
- ISO 28593:2017 Acceptance sampling procedures by attributes -- Accept-zero sampling system based on credit principle for controlling outgoing quality.