QUALITY CONTROL TESTS FOR IRON, VITAMIN A AND C, AND FOLIC ACID

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FORTIFICATION: CHALLENGES

- **Gouvernement**
  - Legislation
  - Technical standards
  - Inspection/control
  - Information

- **Industry**
  - Quality assurance
  - Quality control (fast methods)
  - Premix/feeder technology

- **Distribution**
  - fortified

- **Consumer**
  - Are products accepted?
  - Are products bought?
  - Are products consumed?
  - Micronutrient status?
  - => Continuous monitoring system needed!
Who has already heard of AES, AAS or ICP?

Who is able to explain these techniques?
Excitation

Energy + \text{Ground StateAtom} \rightarrow \text{Excited State Atom}

Decay

\text{Excited State Atom} \rightarrow \text{Ground State Atom} + \lambda

AES = \text{Atomic Emission Spectrophotometry}

AAS = \text{Atomic Absorption Spectrophotometry}

1 = \text{NO OXYGEN ADDED; 4 = 100 \% OF OXYGEN}
Atomic Absorption Spectrophotometry

Setup of an Atomic Absorption Spectrophotometer

Light Energy + Ground State Atom → Excited State Atom → $\Delta$ absorption
Atomic Absorption Spectrophotometry

Principle Behind Atomic Absorption Spectrophotometry

Absorption
Inductively Coupled Plasma (ICP)

**Emission**

6000 – 10 000 °C

AES and AAS
1900 – 3000 °C

**Principle behind ICP-Optical Emission Spectrophotometry**
ADVANTAGES

- Many mineral components can be determined in one single run (Fe, Br, Ca, Cu, Mg, Mn, N, K, S, Zn, ...)
- Relatively low cost per run
- Sample preparation is not that complex or time consuming
- Accuracy of ± 7 to ± 30 %

DISADVANTAGES

- Device and maintenance costs are very high (> 50000 USD + 1000 USD/year)
- Need for a trained laboratory technician
- Requires standard curve and frequent (elaborate) calibration should be performed
Vitamin A and B9 (Folic Acid)

HPLC is the most precise way to quantitatively determine concentrations of vitamin A and folic acid.
Iron spot test

1. Solution A: Thiocyanate / HCl
2. Solution B: Hydroperoxide

Ferreus fumarate = Fe$^{2+}$
Fe$^{2+}$ $\rightarrow$ Fe$^{3+}$
Fe$^{3+}$ + thiocyanate = red dot

NaFeEDTA = Fe$^{3+}$
Fe$^{3+}$ + thiocyanate = red dot

Low concentration

Higher concentration
Vitamin C – Ascorbic acid

1. Solution A: Ferric sulphate and sulphuric acid
2. Solution B: Potassium ferricyanide

Oxidation-reduction reaction leads to the formation of a blue color complex

➔ Semi-quantitative

QC check to look if flour improvers are added (correctly). Ascorbic acid is no flour fortificant
FAST MEASURING TECHNIQUES FOR FORTIFICANTS
Wheat NaFeEDTA

$y = 1.1306x + 11.539$
$R^2 = 0.9972$

$y = 1.1182x + 10.677$
$R^2 = 0.9828$
– Premix is composed of different components
– Every component requires a well established methodology: AES, AAS, ICP, HPLC
– Requires trained personnel
– Fast methods have been developed
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