Guidebook to Proximate Analysis
Introduction

A method for the quantitative analysis of the different macronutrients in foodstuff is called proximate analysis. Nutritional analysis began in 1861 and since then it has been continuously developed, modified and improved. The analysis uses a combination of techniques to determine protein, fat, moisture, ash and carbohydrates that are well documented due to the need for legal declaration requirements.

Ms. Cheese

Nutrition Facts
Serving Size per 100g

<table>
<thead>
<tr>
<th>Energy</th>
<th>244 kcal / 101 kJ</th>
</tr>
</thead>
<tbody>
<tr>
<td>Protein</td>
<td>15 g</td>
</tr>
<tr>
<td>Total Fat</td>
<td>16 g</td>
</tr>
<tr>
<td>- Saturated Fat</td>
<td>9.0 g</td>
</tr>
<tr>
<td>- Trans Fat</td>
<td>1.4 g</td>
</tr>
<tr>
<td>Carbonhydrates</td>
<td>3.5 g</td>
</tr>
<tr>
<td>- Sugars</td>
<td>0.7 g</td>
</tr>
<tr>
<td>Sodium</td>
<td>0.64 g</td>
</tr>
</tbody>
</table>
The proximate on a journey

As a leading Swiss milk processor, Emmi has strong ties to the Swiss population and agriculture industry. Some 6'500 milk producers supply the key raw material for Emmi’s wide range of dairy products. Process control and evidence of compliance with the regulations are important components of these internationally established standards. Several important elements for Emmi are the efficient implementation of the HACCP (Hazard Analysis and Critical Control Points) concept which is based on self-control and is well established in the food industry, and the ongoing review of all processes for continuous improvement.

During milking fat is determined by NIR to detect the richness of the milk.

The milk is centrifuged to separate cream and skimmed milk. Standard milk with different fat concentration levels is produced by adjusting the fat content. Fat and dry mass are determined with NIR fast screening.

If the final product requires higher concentration levels, cream (fat) and skimmed milk powder (protein) are added.

Once the milk has been processed into final products, quality control along with the declaration confirmation of the labels, takes place in the laboratory or on the production line.

The majority of our products are made from cow’s milk. In recent years, the demand for products made from goats or sheep milk has been constantly on the rise, and so we have improved our offering in the area too. As a result, alongside cow’s milk, we also process an increasing amount of goat’s milk particularly into cheese, but also yoghurt and drinking milk and to some extent also sheep’s milk into cheese, yoghurt, butter and drinking milk. Outside of Switzerland, too (the Netherlands, Spain and the US), we have a number of sites that have specialised in processing goats milk for decades already.

Milk with a pre-defined content for fat and protein arrives at Emmi. Milk is sampled directly from the tank to determine fat (fast screening with NIR) prior to the sampling of an aliquot milk portion.

The milk is processed into several standard milk types that will be used as the basic ingredients for final products such as pasteurized milk, cheese and yoghurt. During production of the final product, no further nutritional content determination takes place.

At line

Prior to final freezing, the BUCHI NIRMaster™ determines fat and dry matter in the pasty ice cream mixture.

Off-line

Quality control requires monitoring of the final product, such as yoghurt determining the target value for fat with the reference methods.

The final product is released to the consumer. All food safety aspects are vital; and so proximate analysis is of key commercial concern.
Fat determination by extraction

Fat Extraction

Fat (gravimetric) either total fat or crude fat

Do you choose a solvent from the list?
• Petroleum ether
• Diethyl ether
• n-Hexane
• Chloroform

Yes

No

Talk to expert: application@buchi.com or visit the decision tree:
www.buchi.com/extraction-decision-tree

Does your food sample require a hydrolysis prior to extraction?

Yes

Manual

Sample type

Processed food

Processed Food sample

Fat > 5 % Mostly free fat
Fat = extractable matter

Compliant to SOX

No

Yes

Bulky residue after hydrolysis and/or fat < 5%?

Non-processed food

• Raw Material
• Natural Products

Processed food

Food sample

Fat > 5 % Mostly free fat
Fat = extractable matter

Compliant to SOX

No

Yes

Compliant to other method?

No

Yes

Extraction SOX

Extraction HE

Extraction ECE

Application

Soxhlet Extraction

Hot Extraction

Extraction ECE

Chocolate

AOAC 963.15

AOAC 920.75

ISO 23275:1:2006

Dairy

ISO 8262-1

Bakery, cereal, nut

AOAC 945.16

AOAC 948.22

ISO 11085:2008

AOAC 2003.05

Meat

ISO 1443:1973

AOAC 991.36

ISO 1444:1998

Extraction SOX: Soxhlet Extraction
Extraction HE: Hot Extraction
Extraction ECE: Economic Continuous Extraction (Twisselmann)

See standard and regulations

Non-processed food

• Raw Material
• Natural Products

Processed food

See standard and regulations

Extraction ECE

• Costs are key
• Solvent consumption (70 mL)
• Convenience is important

Extraction HE

• Speed is important
• Very low solvent consumption (50 mL)
• Correspondance to third party automated extraction systems

Extraction SOX

• High reproducibility (RSD < 1 %)
• High analytical safety
• Very gentle process at low temperature

Low RSD (< 1 %)
Fat < 5 %
Fat < extractable matter

Yes

No

Yes

No
Protein determination by Kjeldahl

How many protein samples do you have to accomplish per day?

- < 10 samples/ per day
- 10 - 40 samples/ per day
- 40 - 140 samples/ per day

Solution «Kjeldahl Basic»
- IR Digestion SpeedDigester K-425
- Neutralization Scrubber K-415 (DuoScrub™)
- Distillation Unit K-350

Solution «Kjeldahl Flexibility»
- IR Digestion SpeedDigester K-439
- Neutralization Scrubber K-415 (DuoScrub™)
- KjelFlex K-360

Solution «Kjeldahl Throughput»
- Block Digestion KjelDigester K-449
- Neutralization Scrubber K-415 (TripleScrub™)
- KjelMaster System K-375 / K-376

Cost-effective proximate analysis by NIR

Sample type?

- Liquids (transparent, semi-transparent, suspensions)
  - NIRFlex N-500
  - NIRFlex N-500 Liquids
  - ProxiMate
  - NIRMaster

- Solids (powder, fine powder, ground, whole seeds)
  - NIRFlex N-500 Solids
  - NIRFlex N-500 Solids + Transflectance cover
  - ProxiMate
  - NIRMaster

Production
- At line

Laboratory / Quality Control
- Off line
Find your perfect match

<table>
<thead>
<tr>
<th>Area of application</th>
<th>Fat «Extraction»</th>
<th>Protein «Kjeldahl»</th>
<th>Proximate «NIR»</th>
</tr>
</thead>
<tbody>
<tr>
<td>R&amp;D</td>
<td>+++</td>
<td>+++</td>
<td>+</td>
</tr>
<tr>
<td>Production</td>
<td>+</td>
<td>+</td>
<td></td>
</tr>
<tr>
<td>Goods inspection</td>
<td>+</td>
<td>+</td>
<td>+++</td>
</tr>
<tr>
<td>Quality control / labeling</td>
<td>+++</td>
<td>+++</td>
<td>+++</td>
</tr>
</tbody>
</table>

Characteristics

Range of applications | + | ++ | +++ |
Variation in sample types | +++ | +++ | + |
Automated throughput | ++ | +++ | + |
Speed of analysis | + | + | +++ |
Compliance 1) | +++ | +++ | + |
Detection of adulterants | + | ++ (NPN) | +++ |
Unattended operation | ++ | +++ | + |
No contact with chemicals | + | + | +++ |
Ingress protection rating | (IP 20) | (IP 20) | (IP 65) |
Low initial costs | +++ | +++ / ++ / + 2) | + |
Low running costs | ++ | + | +++ |
Eco-friendly | ++ | + | +++ |

Technical Data

<table>
<thead>
<tr>
<th>Throughput in 9 h 3)</th>
<th>~ 36 samples</th>
<th>120 samples</th>
<th>400+ samples</th>
</tr>
</thead>
<tbody>
<tr>
<td>Analysis time</td>
<td>~ 90 min/8 samples</td>
<td>200 min/20 samples</td>
<td>~ 15 s/sample</td>
</tr>
<tr>
<td>Max. sample amount</td>
<td>10 g</td>
<td>&gt; 4 g/400 mL</td>
<td>395 cm</td>
</tr>
<tr>
<td>Limit of detection (LOD)</td>
<td>0.1 %</td>
<td>0.02 mg N</td>
<td>0.1 %</td>
</tr>
</tbody>
</table>

1) With respect to application regulations such as AOAC, ISO, DIN etc.  
2) Initial costs of the Kjeldahl products are very much depending on the level of automation  
3) Depending on sample composition, packaging material. No shift work assumed.

Customer Reference

### Determination of protein, TVBN and pepsin
Grobest Corporation Co. Ltd., Thailand  
**Customer:** leading aquatic feed producer  
**Application:** protein, TVBN (Total Volatile Basic Nitrogen) and pepsin are determined for QC purposes in raw material and finished goods with the help of Kjeldahl Solutions.

### NIRFlex® N-500 for sausage analysis
CPF Food Products Co. Ltd., Thailand  
**Customer:** Premium sausage manufacture  
**Application:** using the NIR Solution multiple components such as protein, fat, moisture and salt are analyzed for raw material inspection.

### Quality control of infant formula
Mead Johnson Nutrition, USA  
**Customer:** global leader in pediatric nutrition, best known for their flagship Enfamil® family of brands, including Enfamil® infant formula.

**Application:** BUCHI NIRFlex N-500 is used for both qualitative and quantitative assessment of incoming raw materials. Formula-specific NIR calibrations have been developed on the customer site to quantify protein, moisture and fat of in-process and finished formulas.

### Protein determination in wheat flour samples
TS Flourmill Co. Ltd., Thailand  
**Customer:** TS Flour Mill Co., Ltd. (Thailand) was established in 2007 and focuses on quality control from raw material until finished product.

**Application:** Auto-distillation is used for protein determination in wheat flour samples in order to review raw material quality during the manufacturing process and in final products.