Introduction

A method for the quantitative analysis of the different macronutrients in food stuff is called proximate analysis. Nutritional analysis began in 1861 and since then it has have been continuously developed, modified and improved. The analysis uses 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

Energy 244 kcal / 101 kj
Protein 15 g
Total Fat 16 g
- Saturated Fat 9.0 g
- Trans Fat 1.4 g
Carbonhydrates 3.5 g
- Sugars 0.7 g
Sodium 0.64 g

Kjeldahl

Crude Fat or Total Fat

Extraction Units

Carbonhydrates & Sodium

NIR
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.

Milk is sent for testing to an external lab for fat and protein determination, which is an inherent element in the process chain. The amount of fat and protein per kg determines the value of the milk and results in profit for the farmer (Milchgeld). This money defines the farmer's investment.

The 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 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’s milk has been constantly on the rise, and so we have improved our offering in this area too.

As a result, alongside cow’s milk, we also process an increasing amount of goat’s milk particularly into fresh cheese, but also cheese, yogurt and drinking milk and to some extent also sheep’s milk into cheese, yogurt, butter and drinking milk in Switzerland. Outside of Switzerland too (the Netherlands, Spain and the US), we have a number of sites that have specialized in processing goats’ milk for decades already.

Distribution to the end-user

Lab results confirm product conformity including:
- sterility approval
- control of physical, chemical and sensory parameters
- storage testing

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

Do you choose a solvent from the list?

- Petroleum ether
- Diethyl ether
- n-Hexane
- Chloroform

Does your food sample require a hydrolysis prior to extraction?

Yes

Manual

Sample type

Processed food

See standard and regulations

Compliant to SOX

Compliant to other method?

Yes

Non-processed food

- Raw Material
- Natural Products

Processed food sample

- Mostly free fat
- Fat ≈ extractable matter

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

Extraction SOX

Extraction HE

- Speed is important
- Solvent consumption (90 mL)
- Compliant with other instrument suppliers
- High reproducibility (RSD)

Extraction ECE

- Costs are key
- Solvent consumption (70 mL)
- Convenience is important
- High reproducibility (RSD)

See standard and regulations

Application

- Soxhlet Extraction
- Hot Extraction
- Extraction ECE

Fat Extraction

Fat (gravimetric) either total fat or crude fat

Talk to expert: application@buchi.com
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 SpeedDigest K-425
- Neutralization Scrubber K-415 (DuoScrub™)
- Distillation Unit K-350

Solution «Kjeldahl Flexibility»
- IR Digestion SpeedDigest 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)
- Solids (powder, fine powder, grinded, whole seeds)

Laboratory / Quality Control Off-line
- NIRFlex N-500 Solids + Transflectance cover
- NIRFlex N-500 Liquids
- NIRFlex N-500 Solids

Production At-line
- NIRMaster + Transflectance cover
- NIRMaster

Sample type?
- Liquids
- Solids

Sample type?
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>
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<tr>
<td>Goods inspection</td>
<td>+</td>
<td>+</td>
<td>+++</td>
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<tr>
<td>Quality control / labeling</td>
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Characteristics

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<tr>
<th>Characteristics</th>
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<tbody>
<tr>
<td>Range of applications</td>
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<tr>
<td>Variation in sample types</td>
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<td></td>
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<tr>
<td>Automated throughput</td>
<td>++</td>
<td>+++</td>
<td>+</td>
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<tr>
<td>Speed of analysis</td>
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<tr>
<td>Compliance</td>
<td>+++</td>
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<tr>
<td>Detection of adulterants</td>
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<td>+++ (NPN)</td>
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<tr>
<td>Unattended operation</td>
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<tr>
<td>No contact with chemicals</td>
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<tr>
<td>Ingress protection rating</td>
<td>++ (IP 20)</td>
<td>+++ (IP 65)</td>
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<tr>
<td>Low initial costs</td>
<td>+++</td>
<td>+++ / +++ / +</td>
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<tr>
<td>Low running costs</td>
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<tr>
<td>Eco-friendly</td>
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Technical Data

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<tbody>
<tr>
<td>Throughput in 9 h</td>
<td>~ 18 samples</td>
<td>120 samples</td>
<td>~ 190 samples</td>
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<tr>
<td>Analysis time</td>
<td>~ 2 h/sample</td>
<td>200 min/20 samples</td>
<td>16 - 60 s/sample</td>
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<tr>
<td>Max. sample amount</td>
<td>10 g</td>
<td>&gt; 4 g/400 mL</td>
<td>395 cm³</td>
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<tr>
<td>Limit of detection (LOD)</td>
<td>0.1 %</td>
<td>0.02 mg N</td>
<td>0.1 %</td>
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</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.