Guidebook
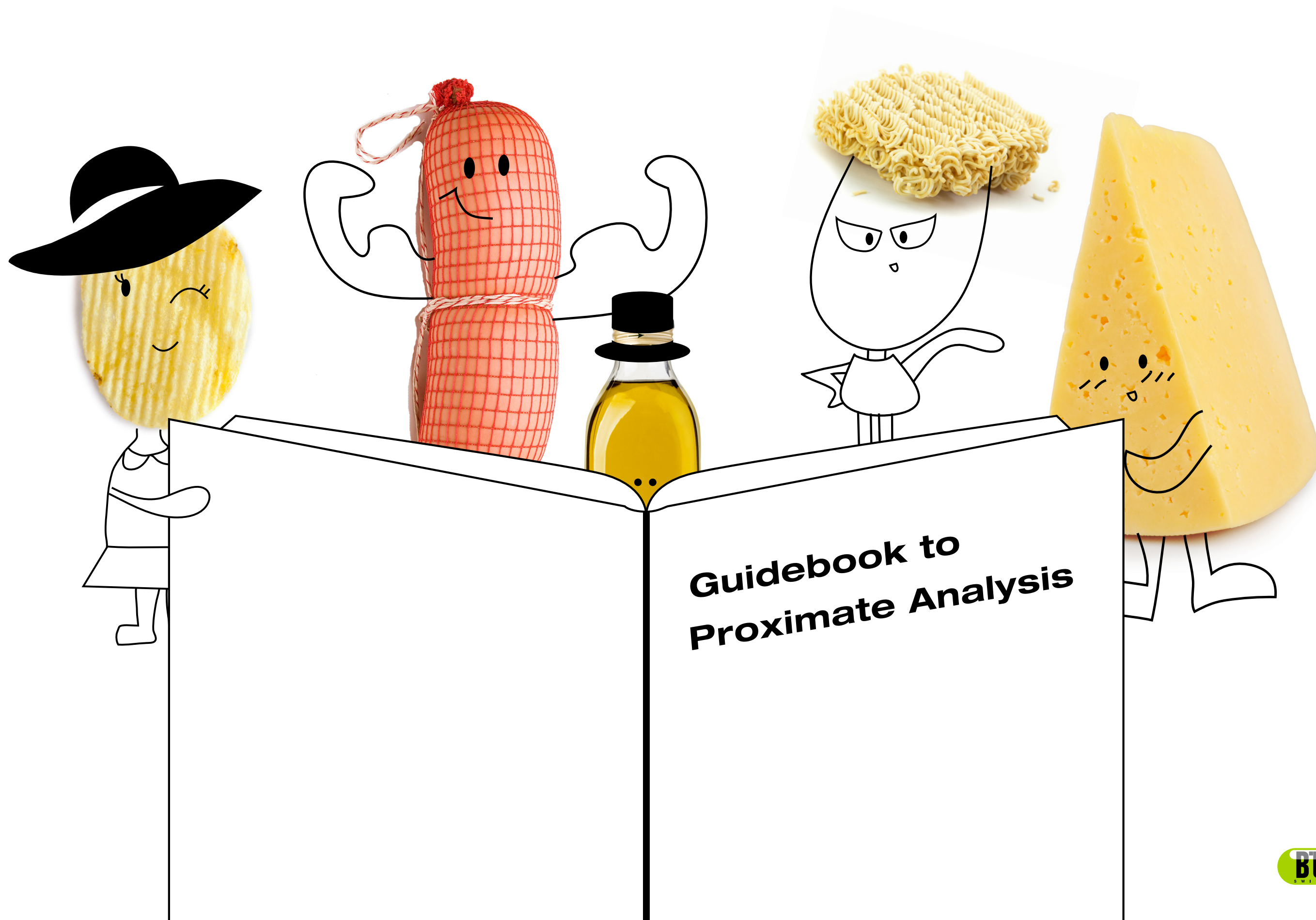## to Proximate Analysis

Guidebook to
Proximate Analysis

BUCHI
SWITZERLAND

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

Protein

Kjeldahl

Crude Fat or Total Fat

Extraction Units

Carbonhydrates & Sodium

NIR

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

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.

The majority of our products are made from cow's milk. In recent years, the demand for products made from goat's 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 specialised in processing goat's milk for decades already.

Product groups

- Cheese 31 %
  Matured cheese (such as Emmentaler AOP, Le Gruyère AOP or Appenzeller®), fondue, raclette
- Fresh cheese 5 %
  Mozzarella, ricotta, mascarpone, cheese spread and similar
- Powder/concentrates 3 %
  Primarily milk powder
- Other products/services 5 %
  We have well-positioned, professional logistics services in Switzerland in particular, which we also provide to other companies.
- Dairy products 31 %
  Milk, cream and butter
- Fresh products 25 %
  Yogurt or milk-based beverages (such as Emmi Caffe Latte), desserts
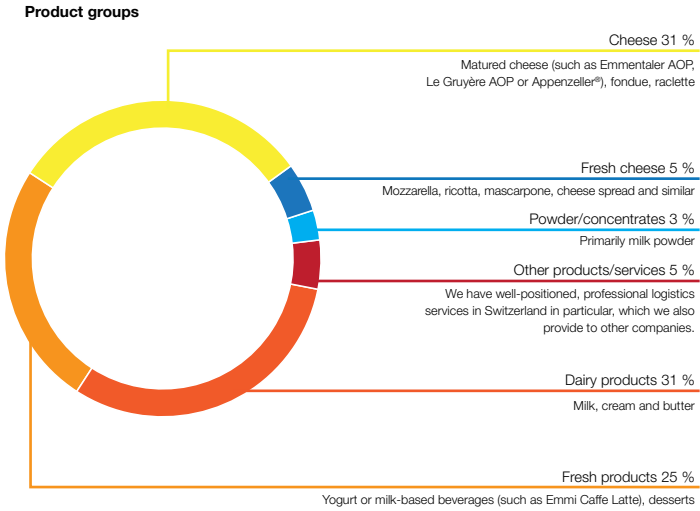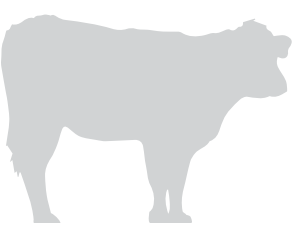

During milking fat is determined by **NIR** to detect the richness of the milk.

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.

| At the farmer | External Lab | Milk load from a milk producer | Standardization of milk | Monitoring of final products |

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 yogurt determining the target value for fat with the reference methods.
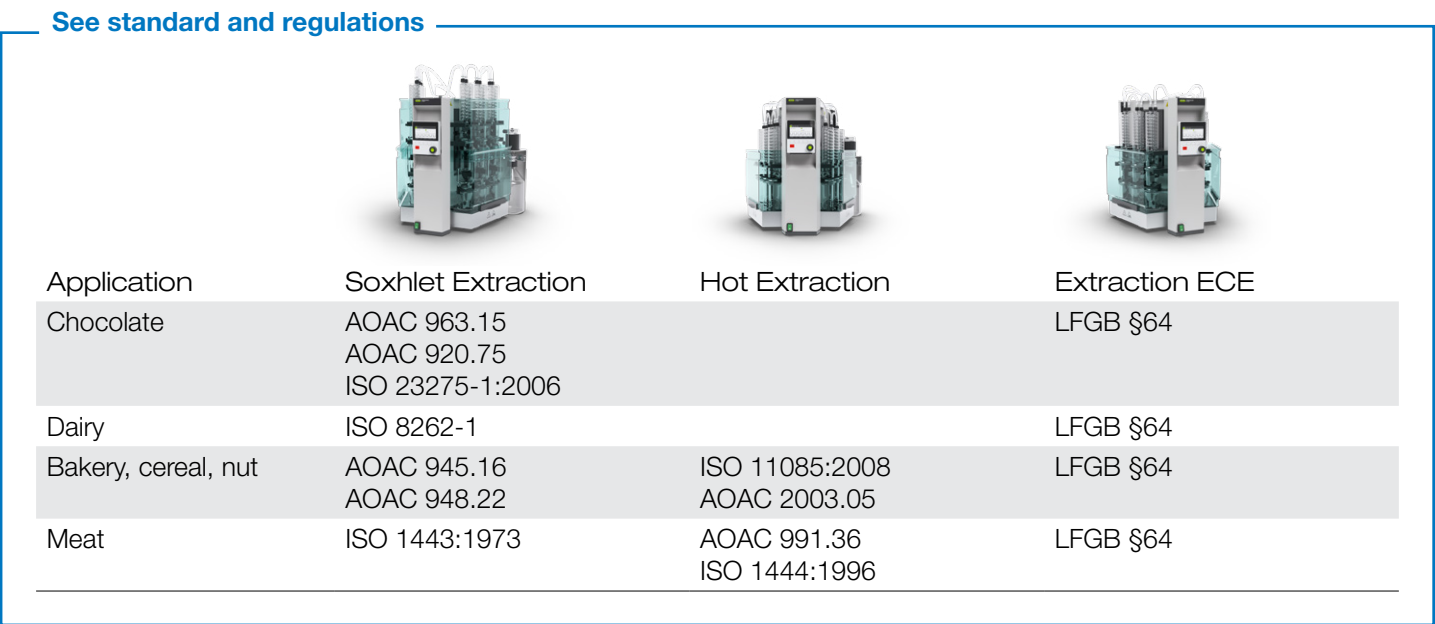
Distribution to the end-user

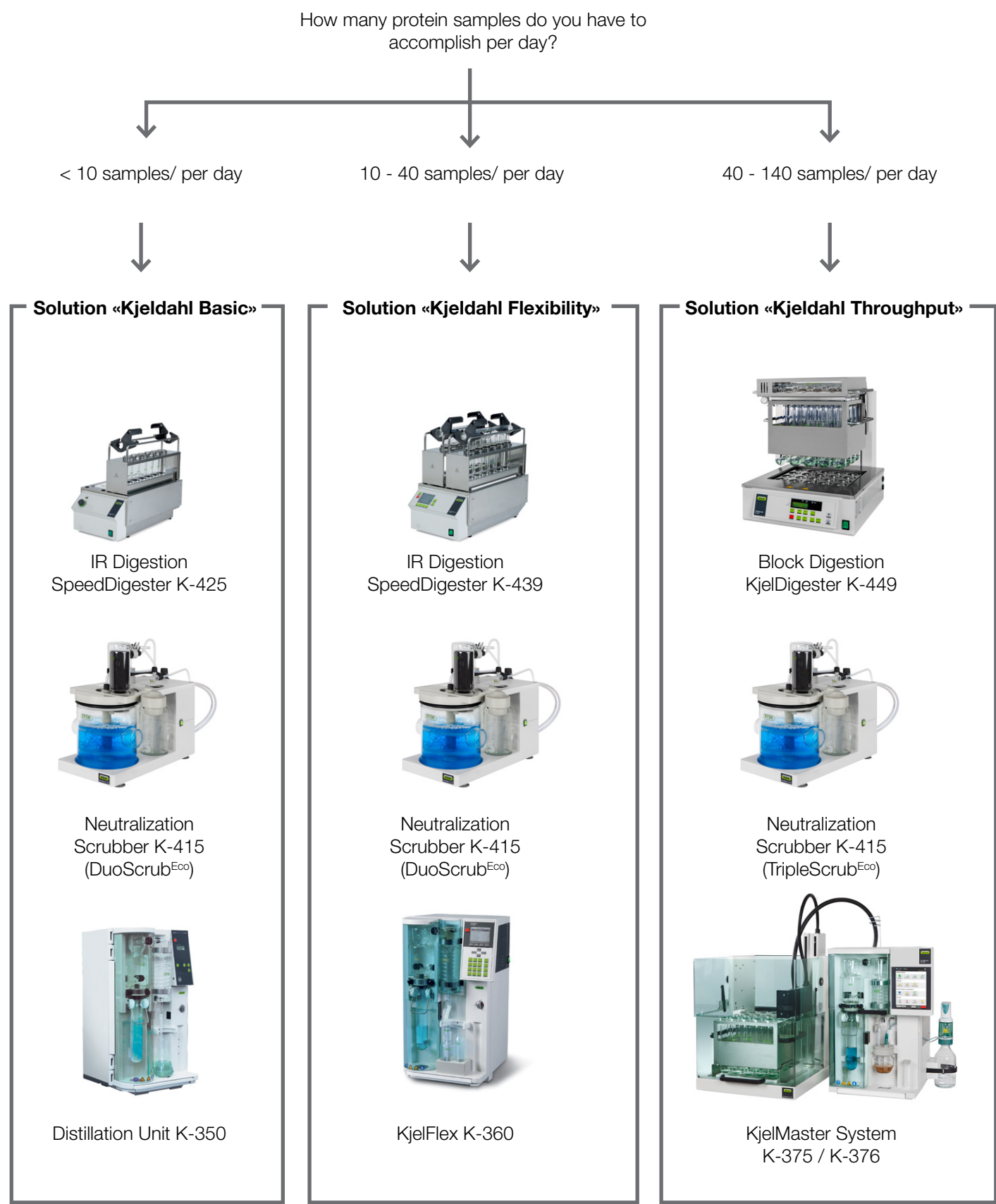Lab results confirm product conformity including:
- sterility approval
- control of physical, chemical and sensory parameters
- storage testing

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

Application	Soxhlet Extraction	Hot Extraction	Extraction ECE
Chocolate	AOAC 963.15 AOAC 920.75 ISO 23275-1:2006		LFGB §64
Dairy	ISO 8262-1		LFGB §64
Bakery, cereal, nut	AOAC 945.16 AOAC 948.22	ISO 11085:2008 AOAC 2003.05	LFGB §64
Meat	ISO 1443:1973	AOAC 991.36 ISO 1444:1996	LFGB §64

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

No

Yes

Does your food sample require a **hydrolysis** prior to extraction?

Yes

No

Manual

semiautomated
HydrolEx H-506

Sample type

Non-processed food
- Raw Material
- Natural Products

Processed
food

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

Yes

No

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

Sample type

Non-processed food
- Raw Material
- Natural Products

Processed
Food sample

Fat > 5 % Mostly free fat
Fat ≈ extractable matter

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

Yes

Compliant to SOX

No

Compliant to other method?

No

Yes

See standard and regulations

Yes

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

No

Yes

Extraction SOX
- High reproducibility (RSD «1 %))
- High analytical safety
- Very gentle process at low temperature

Yes

Extraction SOX

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

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
(DuoScrubᴱᶜᵒ)

Distillation Unit K-350

Solution «Kjeldahl Flexibility»

IR Digestion
SpeedDigester K-439

Neutralization
Scrubber K-415
(DuoScrubᴱᶜᵒ)

KjelFlex K-360

Solution «Kjeldahl Throughput»

Block Digestion
KjelDigester K-449

Neutralization
Scrubber K-415
(TripleScrubᴱᶜᵒ)

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

ProxiMate

ProxiMate

Production At-line

NIRMaster
+ Transflectance cover

NIRMaster

Find your perfect match

Area of application	Fat «Extraction»	Protein «Kjeldahl»	Proximate «NIR»
R&D	+++	+++	+
Production	+	+	+++
Goods inspection	+	+	+++
Quality control / labeling	+++	+++	++

Characterictics

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

Throughput in 9 h [3]	~ 36 samples	120 samples	400+ samples
Analysis time	~ 90 min/6 samples	200 min/20 samples	~ 15 s/sample
Max. sample amount	10 g	> 4 g/400 mL	395 cm
Limit of detection (LOD)	0.1 %	0.02 mg N	0.1 %

[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.

+ applicable   ++ more applicable   +++ most applicable

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 Enfa 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.