



Control of pathogens in by-products

A holistic approach

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Agenda.

- 1 Introduction
- 2 Which byproducts are used in Feed Production?
- 3 Salmonella control in Feed Production
- 4 Recontamination Control
- 5 The Challenge

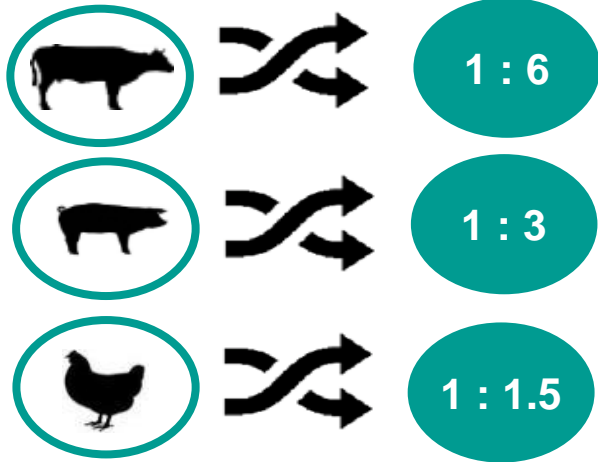


Introduction

Three major trends transforming the feed industry.

Animal Nutrition & Sustainability

Feed Conversion Ratios



Changes in genetics of species

- Nutritional advice for increased use of byproducts in the diet
- Particle granulation, etc.
- Less antibiotics needed

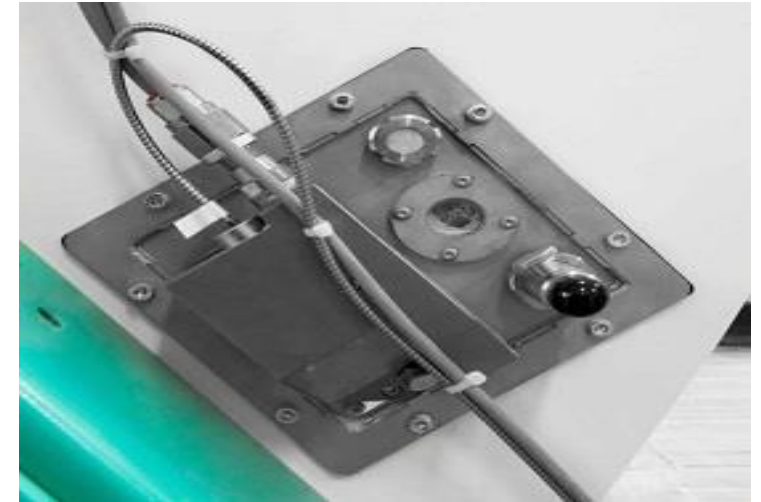
Feed Safety



Anti microbial resistance

- Validated hygienization process
- Mycotoxin reduction
- Feed safe design

Internet of Things



Master efficiency and quality

- Traceability
- Online data clustering
- Self regulating production

Use of Byproducts in the feed industry

Why are byproducts used to feed animals?

- Industrial processes for cereals (milling & bioenergy), and proteins (oilseeds) create side streams
- Help recycle the streams from the processing of grains and oilseeds (reduce waste)
- Sustainable process
- Adequate nutritional value
- Economical Benefits

Food and Feed Safety – A global challenge



Complex, global supply chains

Increasing and new **threats** to food and feed safety

Complex and **evolving** regulatory environment

Increasing speed and reach of **social** and **business** impact

Food and Feed Safety-A global challenge.



- 1 in 10 people fall ill every year after eating contaminated food (WHO, 2015)
- children under 5 years old affected the most



- 1.3 billion tonnes of food is lost or wasted every year
- 25% of this is caused by spoilage by microorganisms



- An average cost of a recall is \$10 million
- Most recalls are because of microbial contamination)

Key driver to improve feed safety standards

The significance of *Salmonella* contaminations in feed

Salmonella
infected
feed

Salmonella
infected
chicken

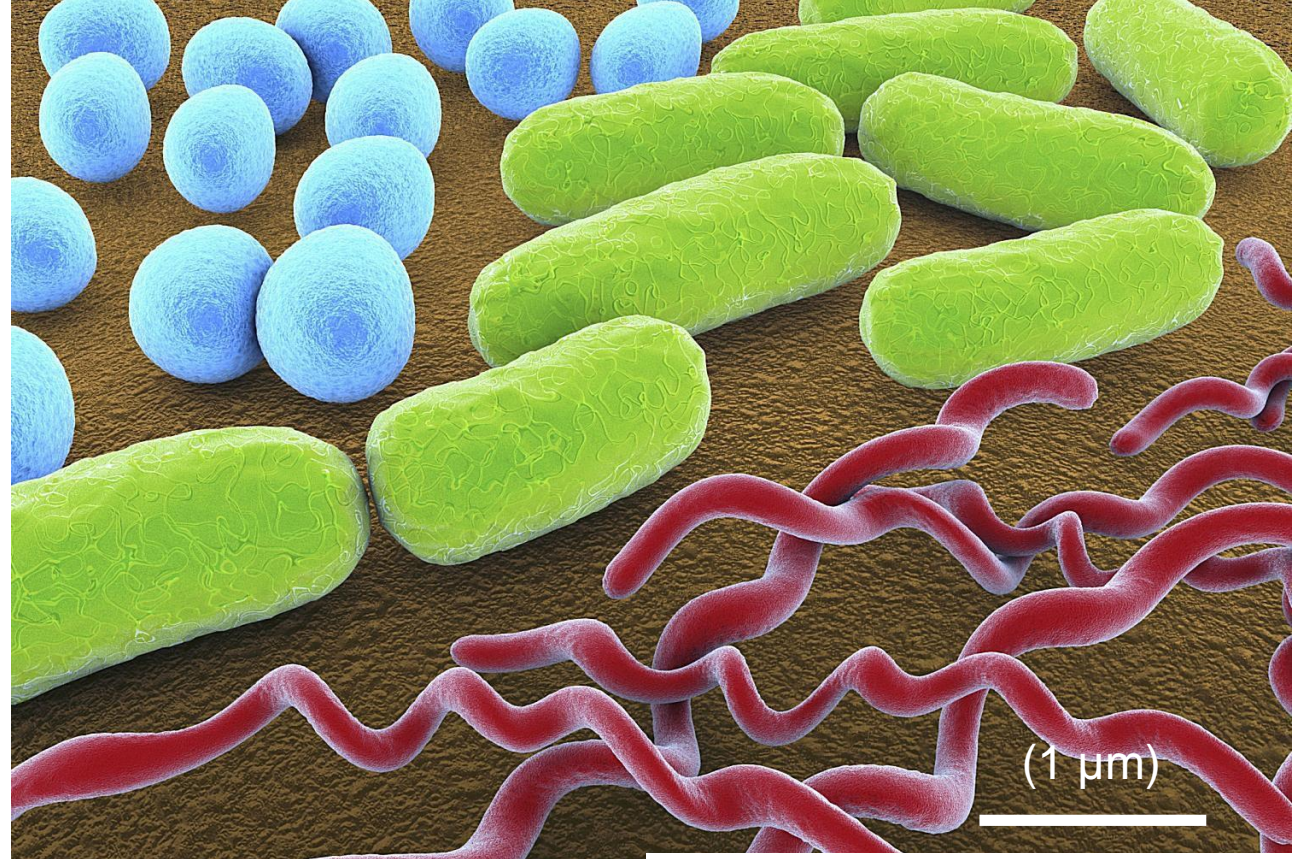
Introduction
of
Salmonella
into the food
value chain

Salmonella
infection in
humans



Short focus on bacteria

- small (~1.5 μm) compared to human hair (~50 μm) and live everywhere
- may harm humans and animals (pathogens)
- can be characterized and quantified
- can survive dry conditions
- can live with little nutrients
- need water to grow / multiply
- Inactivation through:
 - moist heat + high temperatures
 - fast kill (steaming)
 - dry heat + high temperatures
 - slow kill (drying/ roasting)



Total plate count (TPC) =
Gesamtkeimzahl (GKZ)

Typical Lab analysis

- ✓ Total plate count (TPC)
- ✓ Yeast & molds
- ✓ Enterobacteriaceae or coliforms
- ✓ Salmonella (absent in a 25 g food sample)

Which byproducts are used?

Use of Byproducts in the feed industry

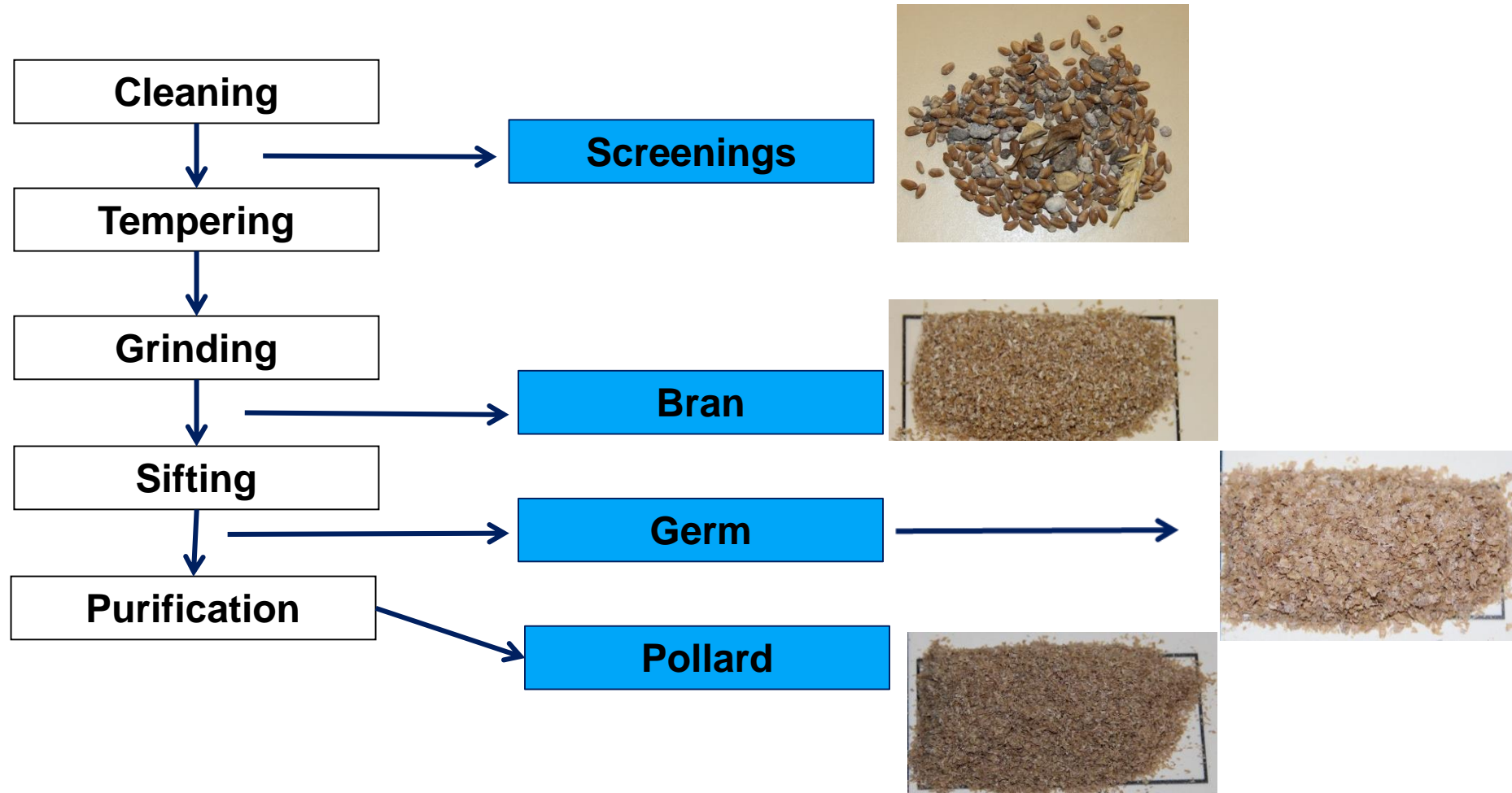
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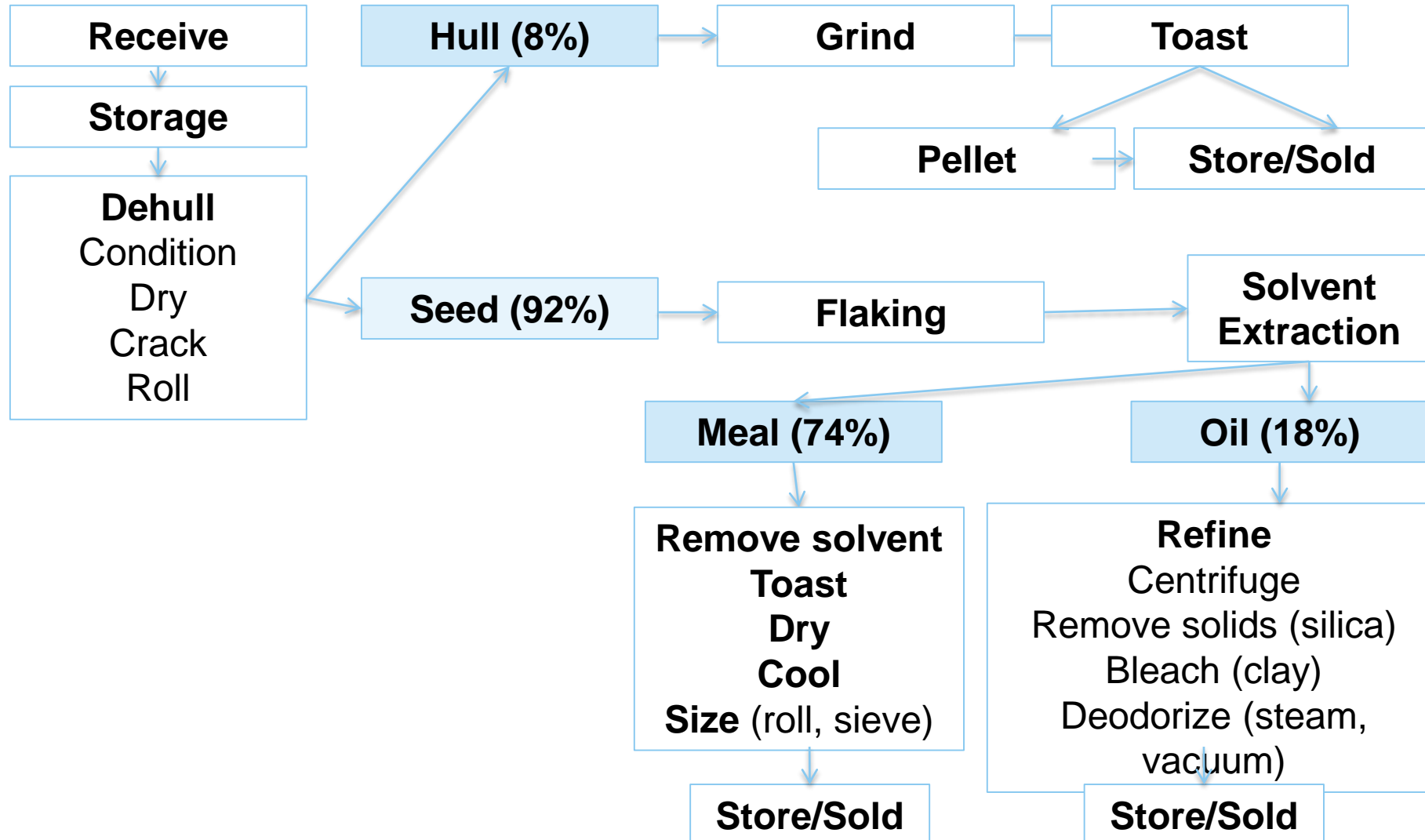
Which byproducts are used in the feed industry?

- DDGS (from Corn & Wheat ethanol production)
- Oilseeds industry byproducts (protein meals and fatty acids)
- Wheat byproducts
- Corn byproducts
- Bakery residues
- Byproducts from the nuts and fruit industries

Wheat By-Products



Oilseed Processing



Oilseed Meals



Sunflower



Safflower



Canola/Rapeseed

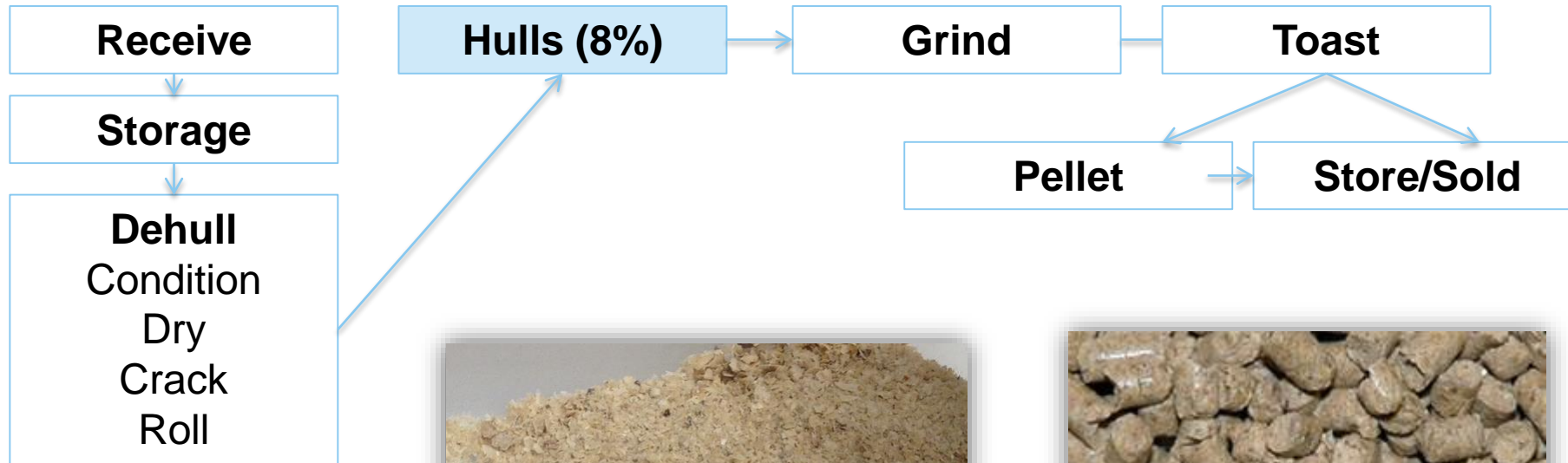


Flax/Linseed



Soybean

Oilseed Hulls

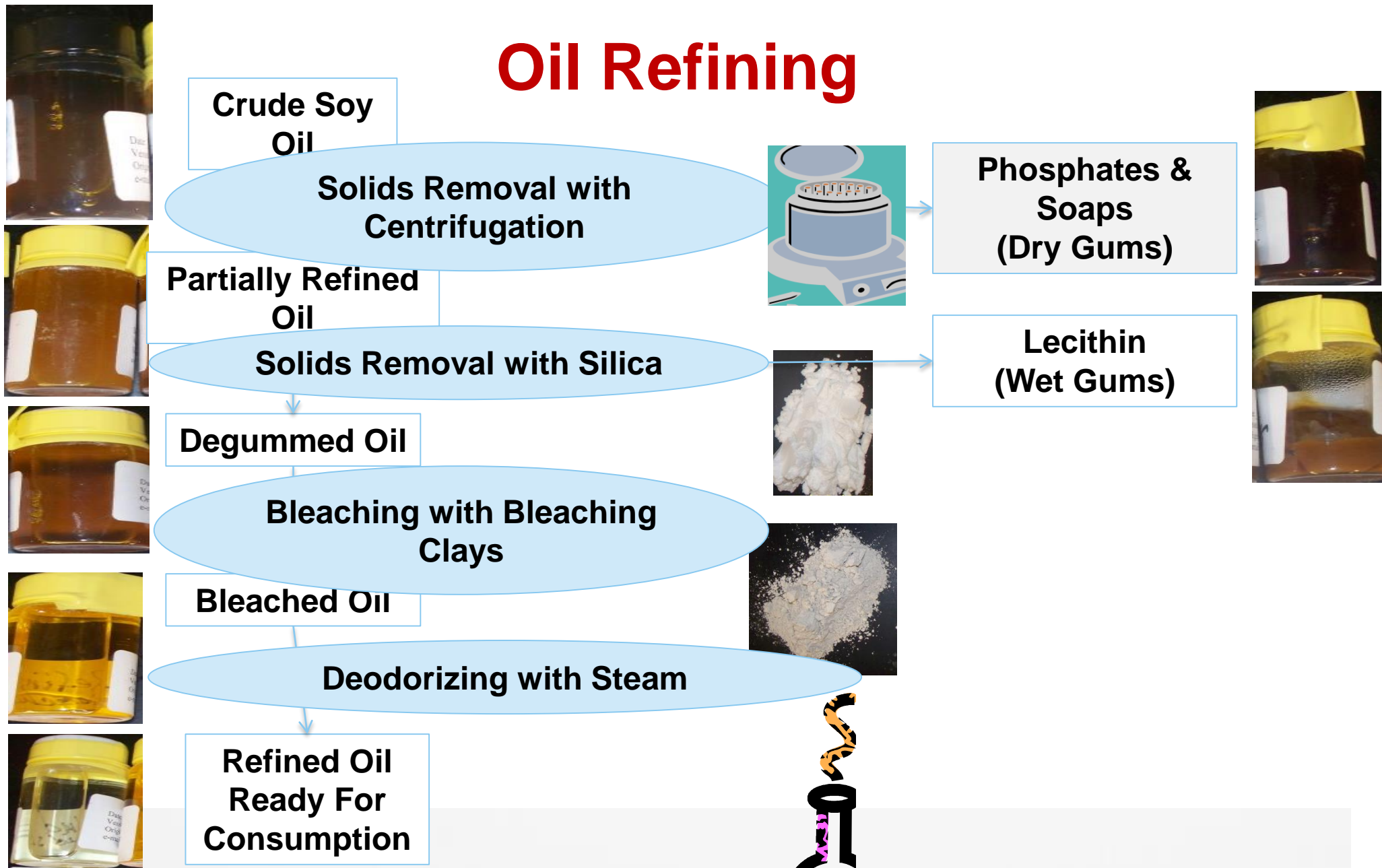


Soy hulls



Pelleted soy hulls

Oil Refining



Salmonella control in feed production

Microorganisms move around as passengers

AGRICULTURAL PRODUCTION

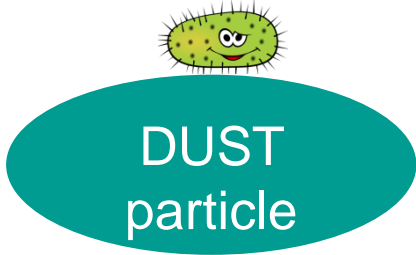
Contaminated irrigation water



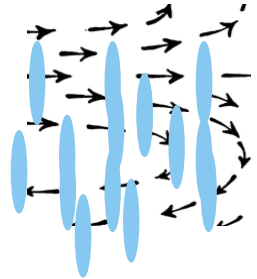
Manure-treated soil



FOOD PROCESSING



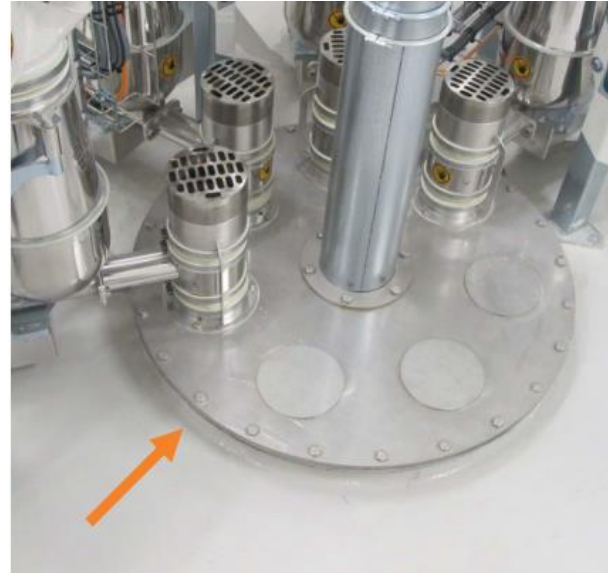
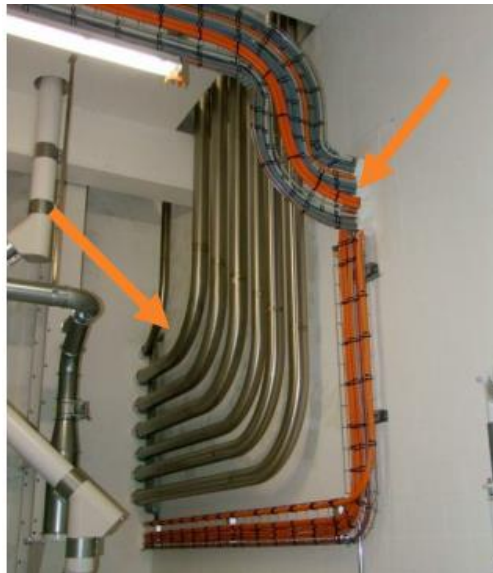
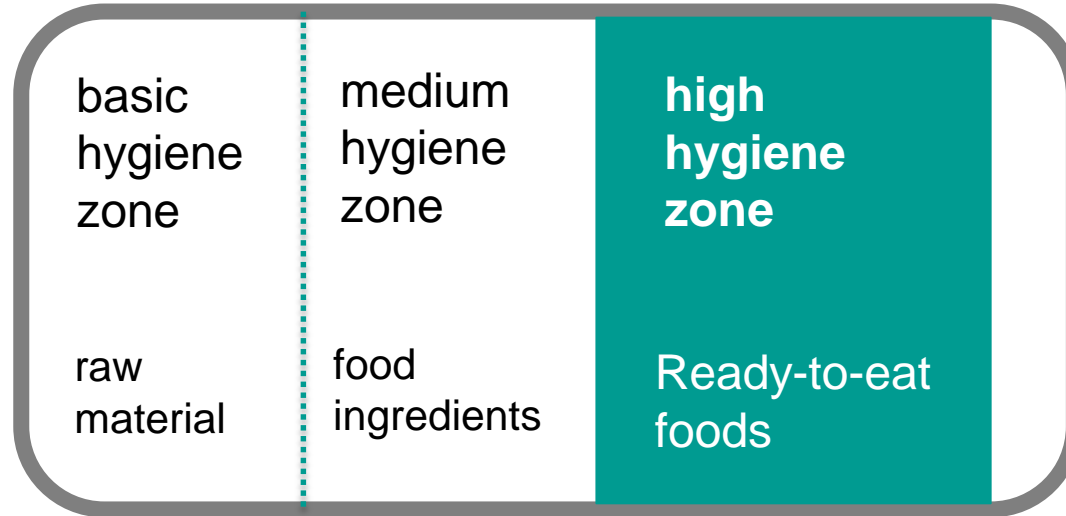
Air / aerosols



Food Safety starts with a hygienic lay out of the factory



Factory zoning



The effect of product residues and condensation

Condensation / insufficient drying increases the available water in the system

Growth of microorganisms like bacteria and molds is promoted

Transfer of bacteria and molds onto the feed

- Heating of equipment with **heating mats** at the conditioner, retentioner and pellet press significantly **reduce condensation**
- **Enable air drying systems** to dry out the equipment after production and minimize growth of microorganisms and improve cleanability and sanitation



- **Condensation has to be prevented**
- **Avoid moisture accumulation on the equipment after production**

Factors influencing growth of MOs

Living conditions of Salmonella

- Temperature
- Moisture
- Time
- Water activity
- pH value
- Nutrients
- Salt

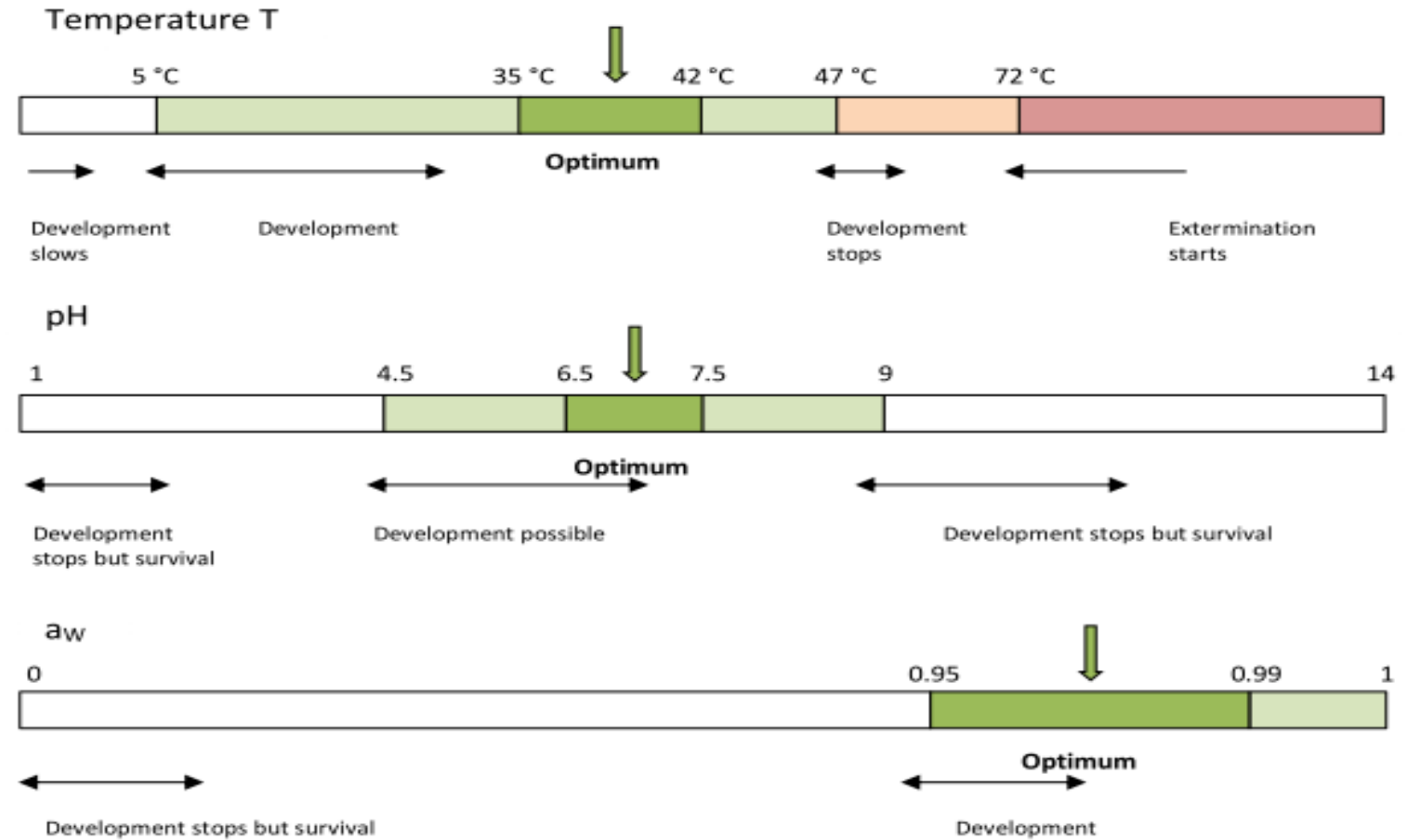
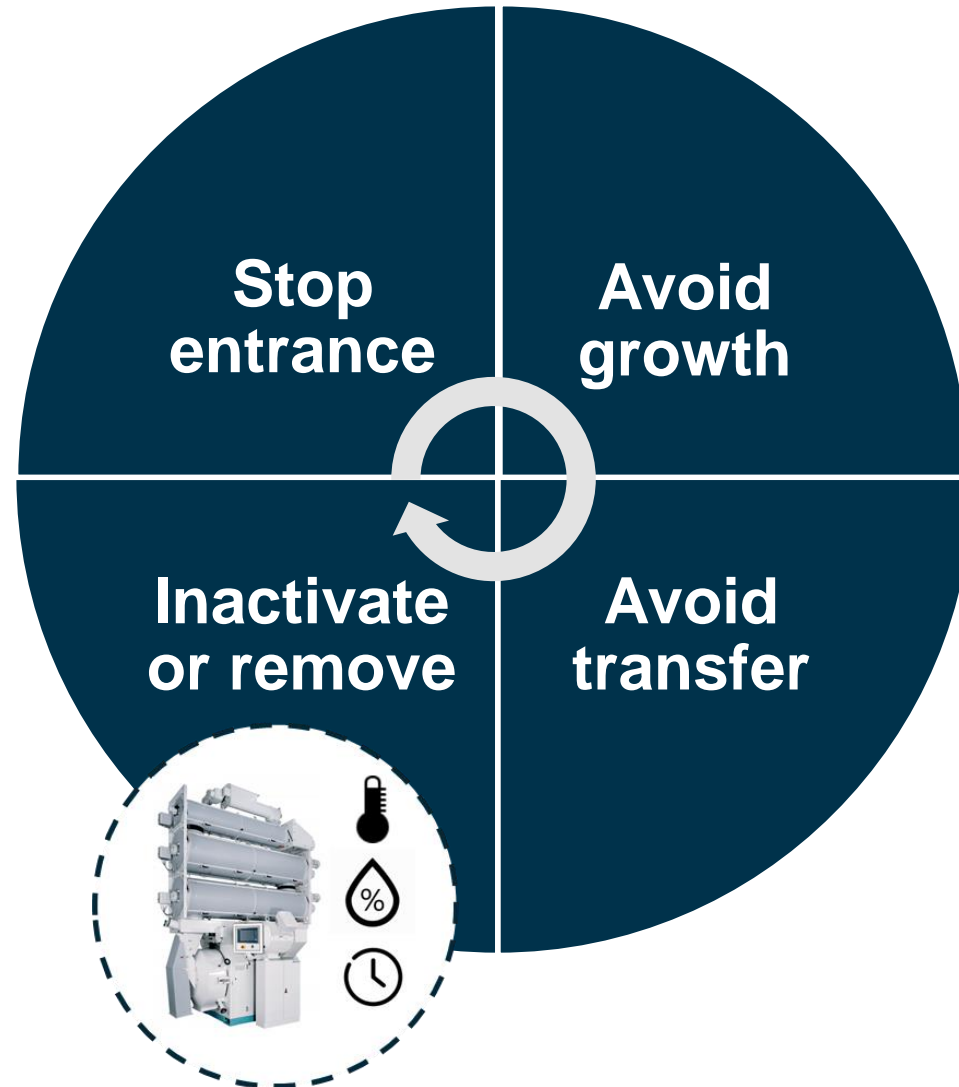


Figure 5: Living conditions of Salmonella [in accordance to (Fediol, 2014)]

Solutions to control *Salmonella* in feed processing

- Raw material control
- Raw material handling
- Hygienic facility design from roof to drain

- Thermal treatment
- Process validation
- Cleaning & disinfection



- Keep dry (war on water)
- Cooling
- Preservatives (acids)
- Cleaning
- Hygienic design

- Factory design & zoning
- Hygienic design
- Air/ water/ waste management
- Packaging
- Personnel hygiene

Designing the feed pelleting process into a trusted kill step

Steam conditioning →

Holding time →

Process control →

Pelleting →



Definition of



Time



Temperature



Moisture

... in a specific recipe



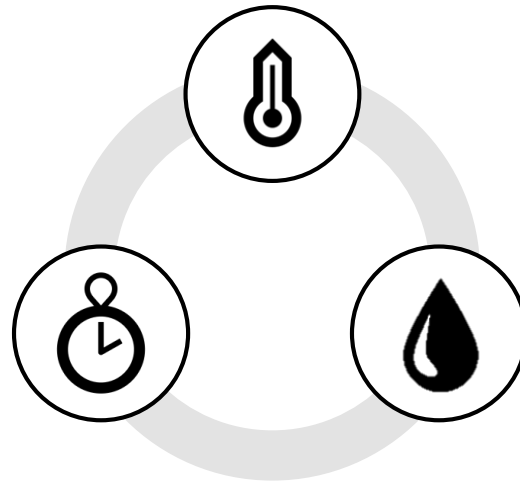
KILL STEP



Salmonella reduction through controlled heat treatment

Main parameters influencing *Salmonella* reduction

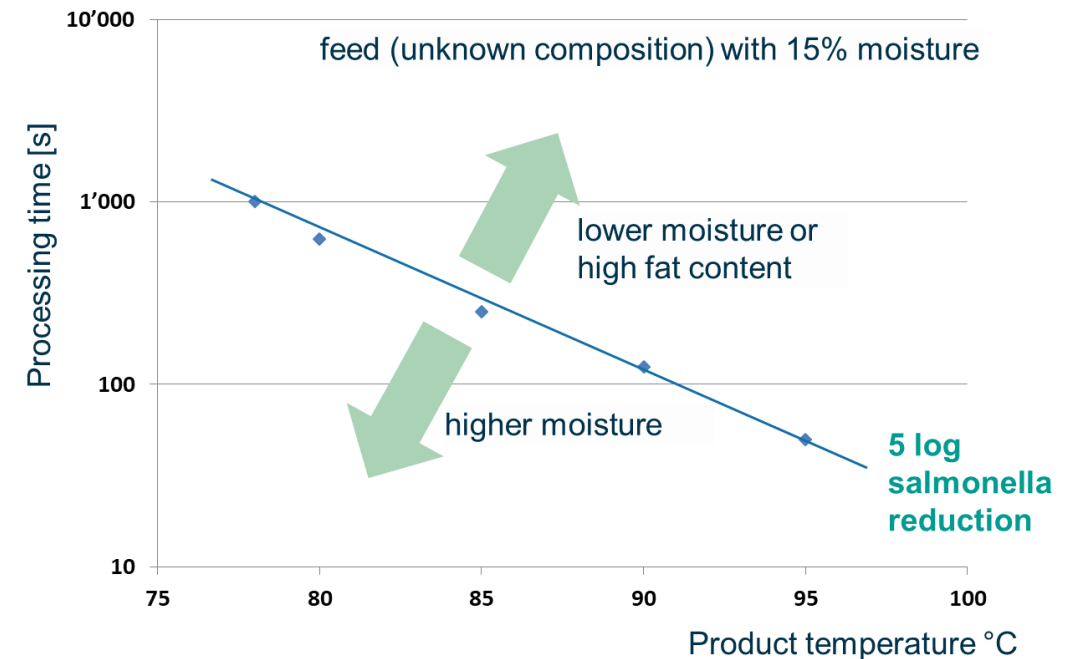
- Temperature
- Moisture
- Time



Other parameters influencing *Salmonella* reduction

- Fat content
- Protein content
- pH value

Salmonella inactivation through heat treatment



Automation

The key enabler for feed safety

Recipe sequencing

Avoiding cross contamination between incompatible feed recipes

Traceability

Traceability functionality builds transparency in the value chain – Knowing the content of every batch

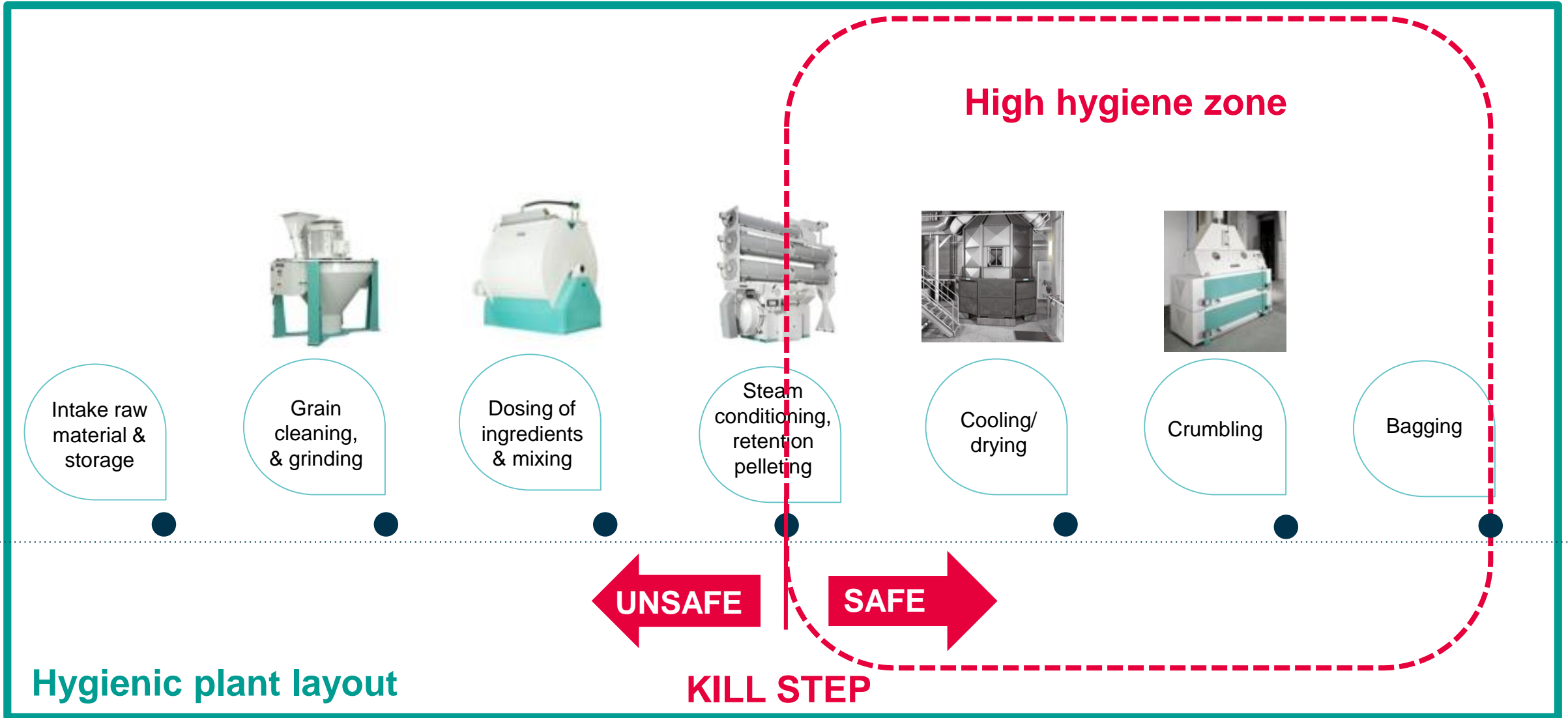
Operation Log

User management for authentication and logging of operation activities



Recontamination control

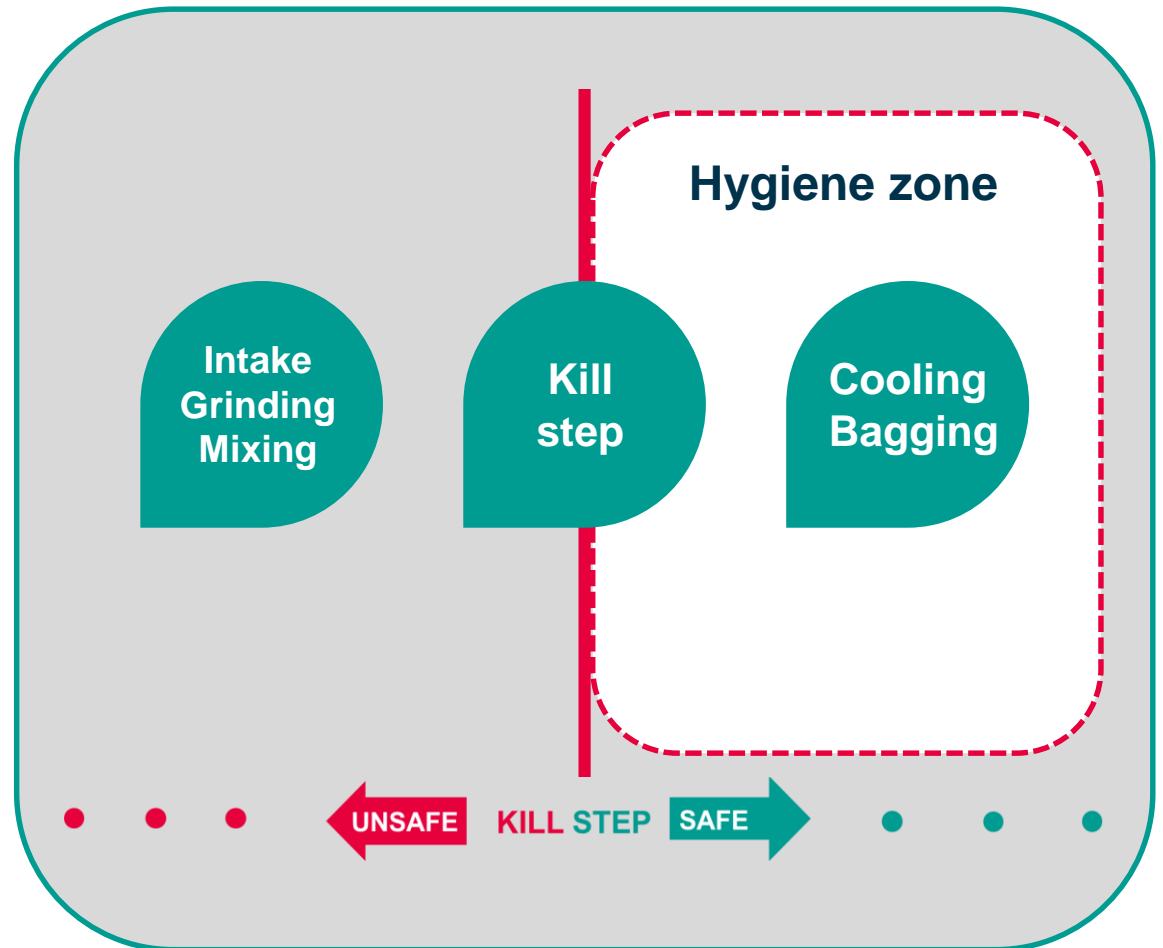
Comprehensive solutions for feed safety.



Focus on post-kill step hygiene

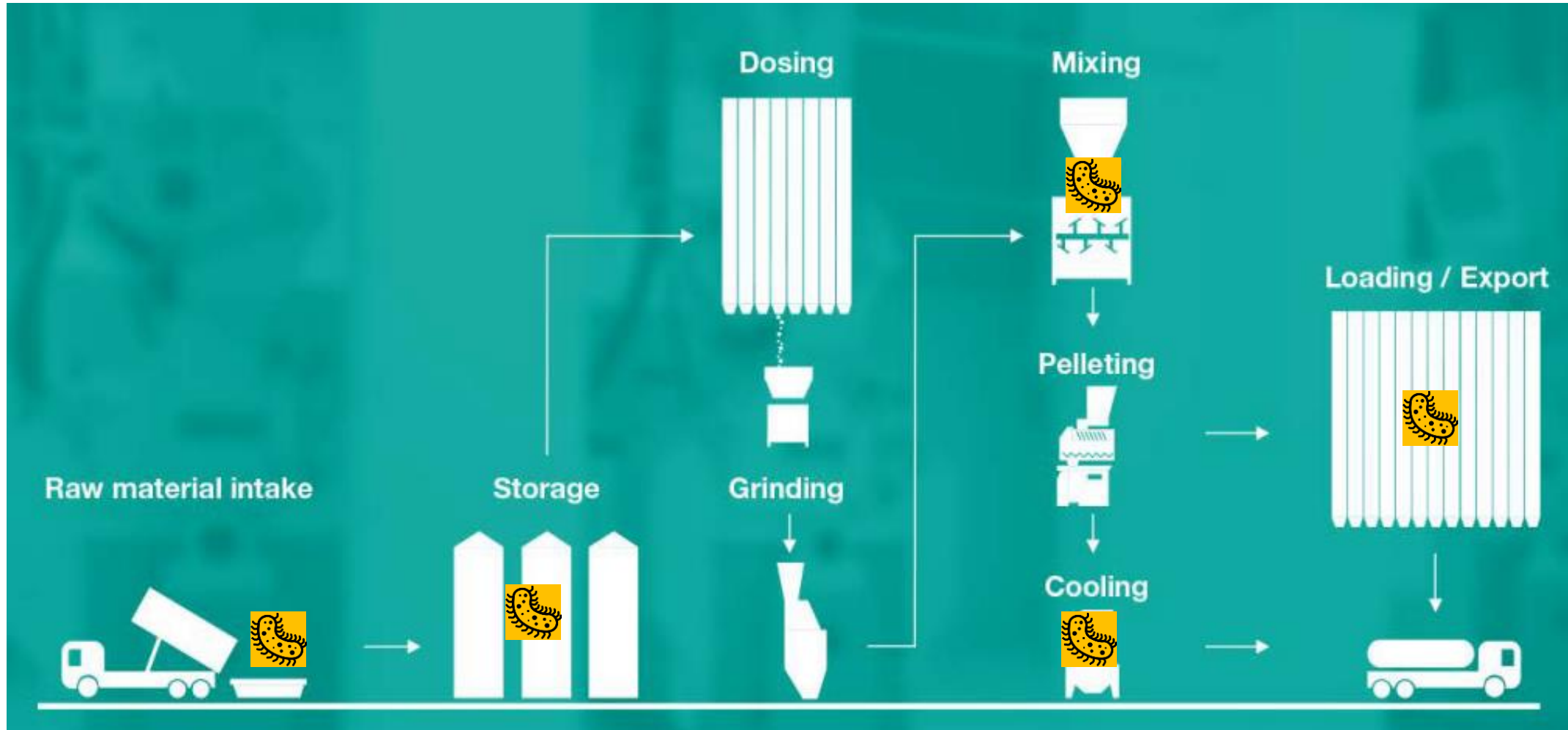
Hygiene measures to avoid recontamination

- **Hygiene zones:** separate handling of raw material & end product
- **Air management:** clean (filtered) cooling air
- **Avoid dust** as source of contamination
- **Avoid condensation:** water brings risk of microbial growth
- **Focus on cleaning & disinfection**
- **Train operators**



In case of an incident

RCA: Where and Why did it happen?



What to do if *Salmonella* is found?

Check raw materials

- Were there higher contamination levels than usual?
- CoAs from approved suppliers
- Different supplier?
- Check raw material intake
- Check raw material storage

Check whole production line

- When was the last cleaning?
- Are there any spots of condensation
- Are there spots of product accumulation/spoilage?

Check kill step

- Unusual Production rates
- Target temperature, moisture retention time reached?
- Are the steam conditions stable?
- Heating mat set temperature

Check the cooler

- Product flow (accumulation)?
- Condensation issues?
- Maintenance issues?

Clean the production line

- Empty elevator boots
- Clean the mixer
- Clean the conditioner and retentioner
 - Focus on transition pieces!
- Clean the pellet mill
- Clean the cooler
- Flush the lines
- Check / Clean the silos
- Sanitation program

The Challenge

How to put it all together?

The Challenge

Providing nutritious and safe feed

Feed additives promote animal growth and health

Increasing demand for feed safety

Increasing conditioning temperatures
and retention times

Degradation of additives during hygienization

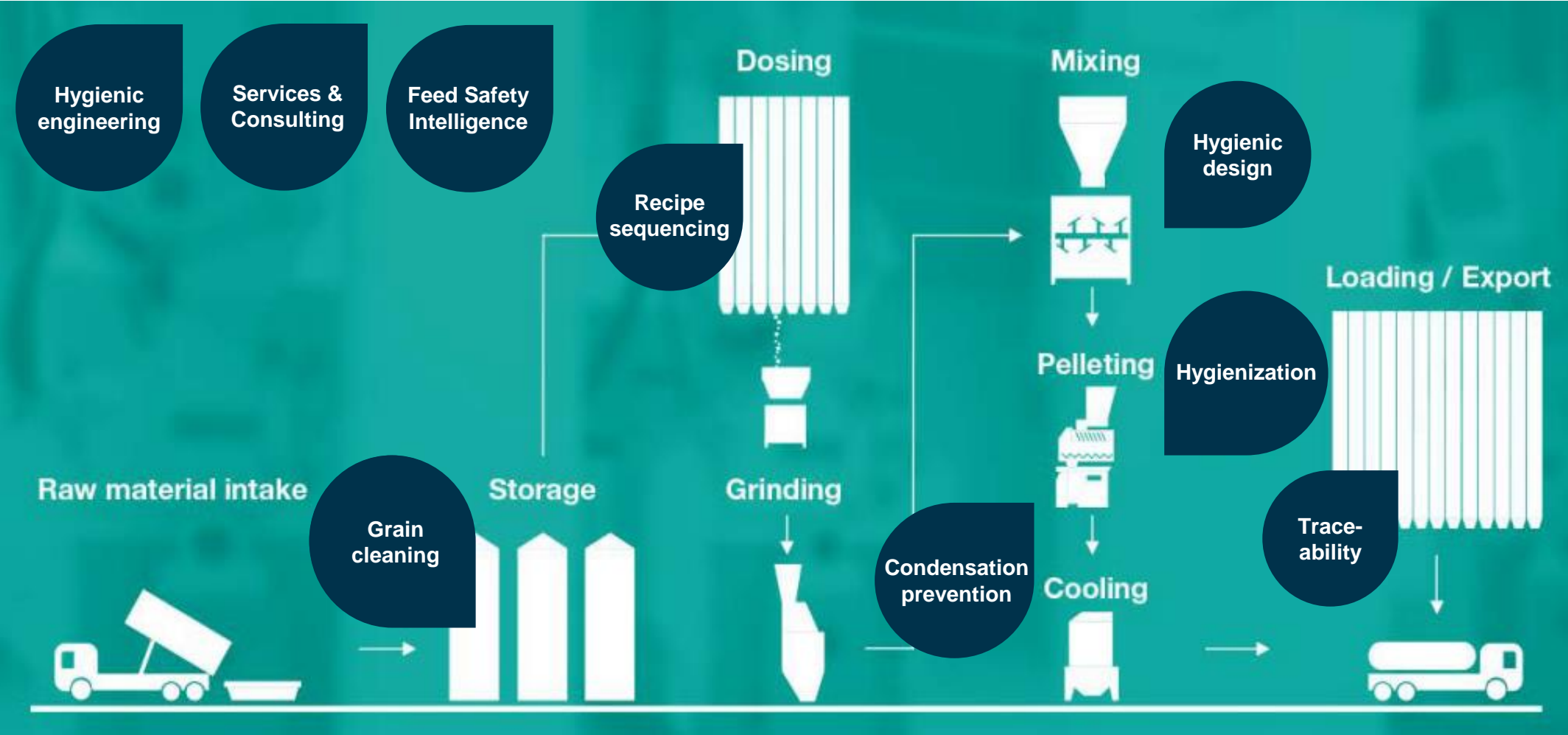
Combination of product and process knowledge to maintain nutritional value and feed safety

Global Trends in Feed Safety

- Grain cleaning
- Use of air filters
- Increased use of conditioning and retentioning systems
- Long time retentioning systems
- Mash treatment
- Validation of the kill step
- Higher Feed Safety standards in the plants
- Traceability
- Automation solutions



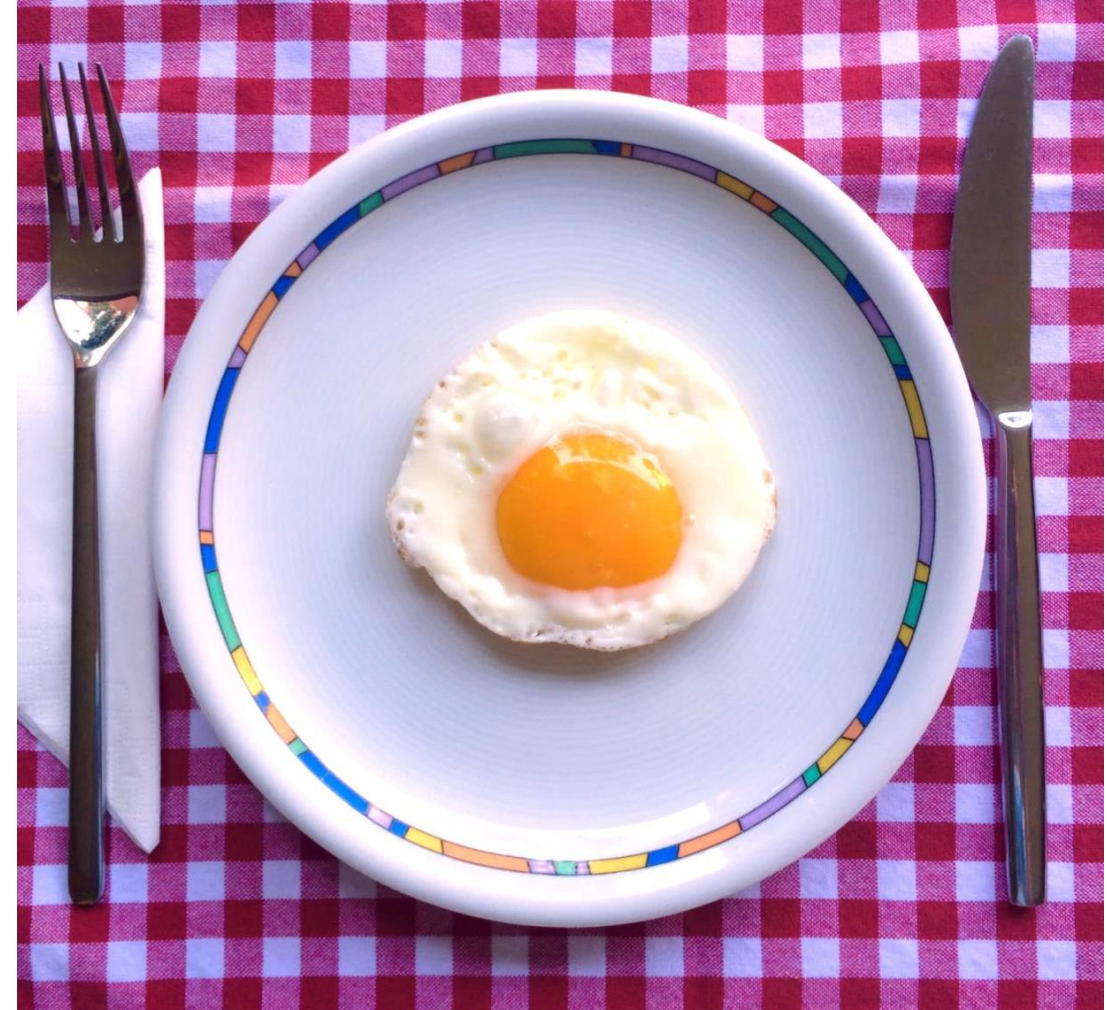
Feed Safety Solutions



Summary

1. **Food and Feed Safety programs ensure management of microbial pathogen risk in Feed and Food**
2. **Industrial byproducts are essential for economic and sustainable feed diets**
3. **It's very important to understand how individual byproducts are produced to calibrate their potential nutritional contribution to the different animal species**
4. **Microbial pathogens thrive in a lot of environments and substrates where byproducts are produced and utilized. Therefore, adequate preventative controls that are effective need to be implemented. This might include a “kill step”**
5. **Adequate hygiene needs to be implemented after the kill step to avoid cross contamination**
6. **Buhler is your partner in Food and Feed Safety!**

Safe feed = Safe food



Thank you!

Questions?

Please contact me at the following address:

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