The role of hygienic design in chocolate production safety

Dr. Matilda Freund

Vice President, Global Food Safety

October 2022

Mondelēz International

SNACKING MADE RIGHT

Mondelēz International

SNACKING MADE RIGHT

A TASTE OF WHO WE ARE

MDLZ

At **Mondelēz International, Inc. (Nasdaq: MDLZ)** we make it our mission to evolve the role snacking plays in consumers' lives by delivering the **right snack**, for the **right moment**, made the **right way**.

79K We have approximately **79,000 diverse and talented employees** around the world

$28.7B 2021 net revenues of approximately **$28.7 billion**

150+ Our snacks are enjoyed in more than **150 countries****

35% 35% of 2021 net revenues from **emerging markets**

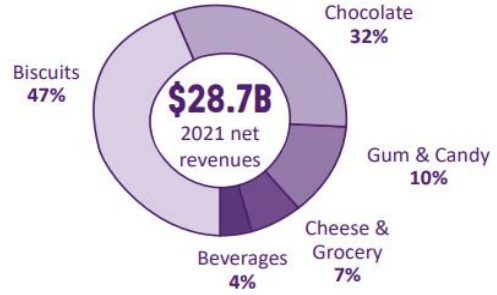
4 **4 Regions** with **15 Business Units** around the world

$50M **$50 million charitable contributions** in local communities in 2021*

#1 **#2** We hold the #1 market share globally in **biscuits** and #2 market share globally in **chocolate,** with a growing presence in baked snacks

*Includes both cash and product donations
** 2021 category position. Source: Euromonitor

% OF 2021 NET REVENUES BY CATEGORY



% OF 2021 NET REVENUES BY GEOGRAPHY

Mondelēz International

CHEDG EUROPEAN HYGIENIC ENGINEERING & DESIGN GROUP

CÔTE D'OR

LACTA

TOBLERONE

Cadbury Dairy Milk

Alpen Gold

Marabou

Agenda

1. Overview
2. Microbiology of Chocolate
3. Overview of Chocolate Production
4. CCPs in chocolate
5. Hygienic Design Impact
6. Summary

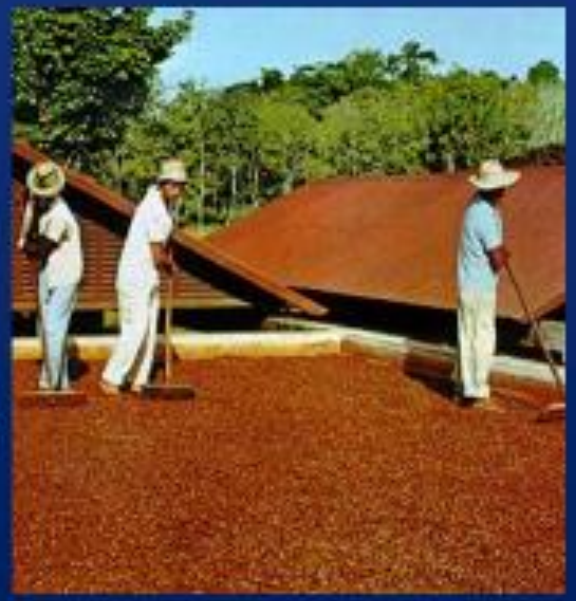
Organism of concern in chocolate - *Salmonella*

- *Salmonella* is one of the leading causes of illness in the world.
  - 1.35 million illnesses, 26,500 hospitalizations, and 420 deaths in the United States every year (CDC).
- Salmonellosis symptoms include fever, abdominal pain, diarrhea, nausea and sometimes vomiting.
- Onset occurs 6–72 hours (usually 12–36 hours) after ingestion of *Salmonella*, and illness lasts 2–7 days.
- There are 2500 serotypes of *Salmonella.*

Unique properties of *Salmonella* important to chocolate industry

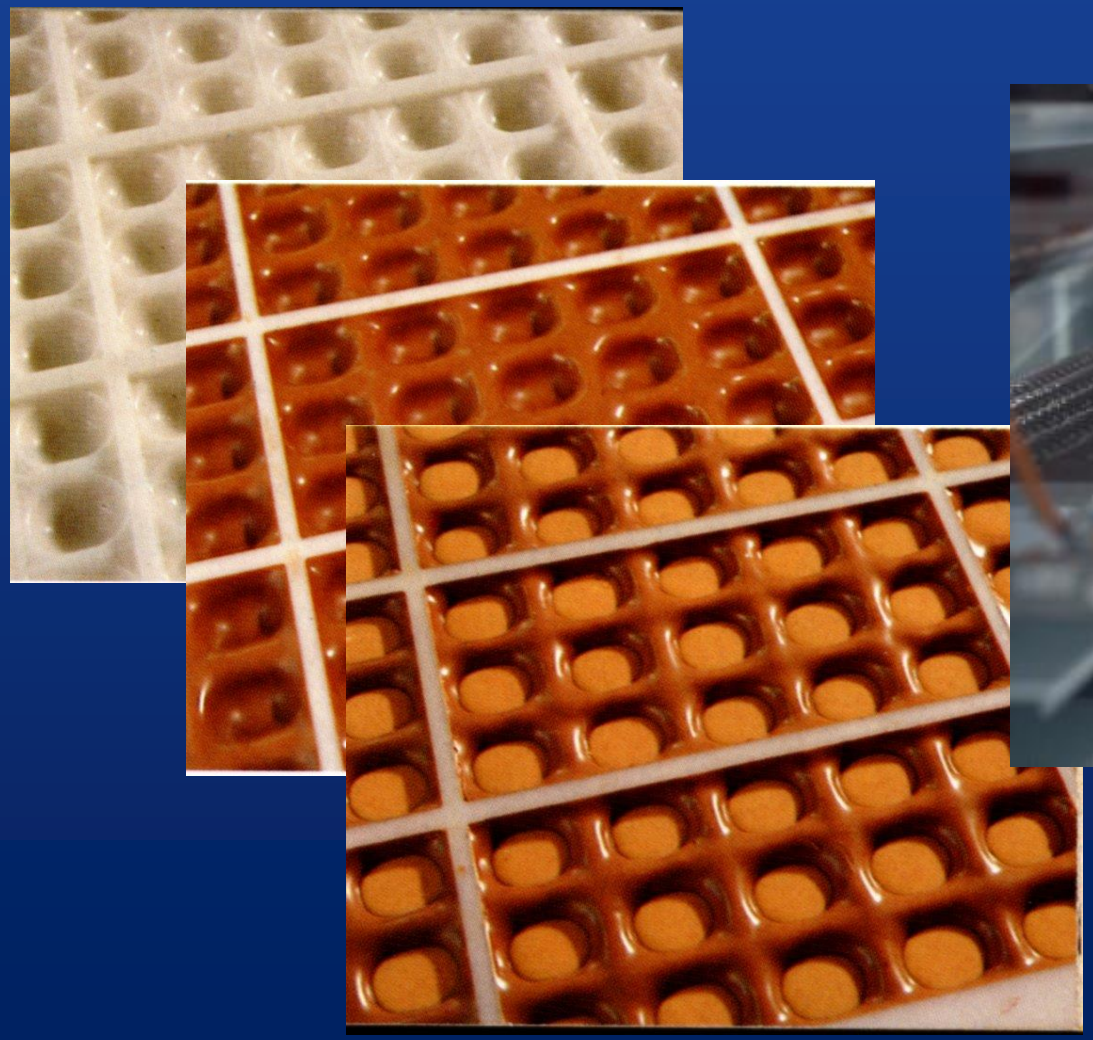
- *Salmonella* is a ubiquitous and hardy bacteria that can survive for long periods in a dry environment.
- Present in raw cocoa beans and nuts.
- Extremely low levels of *Salmonella* can cause illness in dry and high fat foods e.g.
  - 3 cfu/g in peanut butter (1996)
  - 2 cfu/g in chocolate (1983)
  - 0.3 cfu/10g in chocolate (2006)
- Contamination is often low level and not evenly distributed – difficult to detect
- Heat resistance of *Salmonella* is highly dependent on the water activity of the materials to be heat treated e.g.
  - *Salmonella* Senftenberg in raw milk D-value at 67.5°C: 0.046 min
  - *Salmonella* Senftenberg in chocolate D-value at 70°C: 440 min

Cocoa Bean Handling



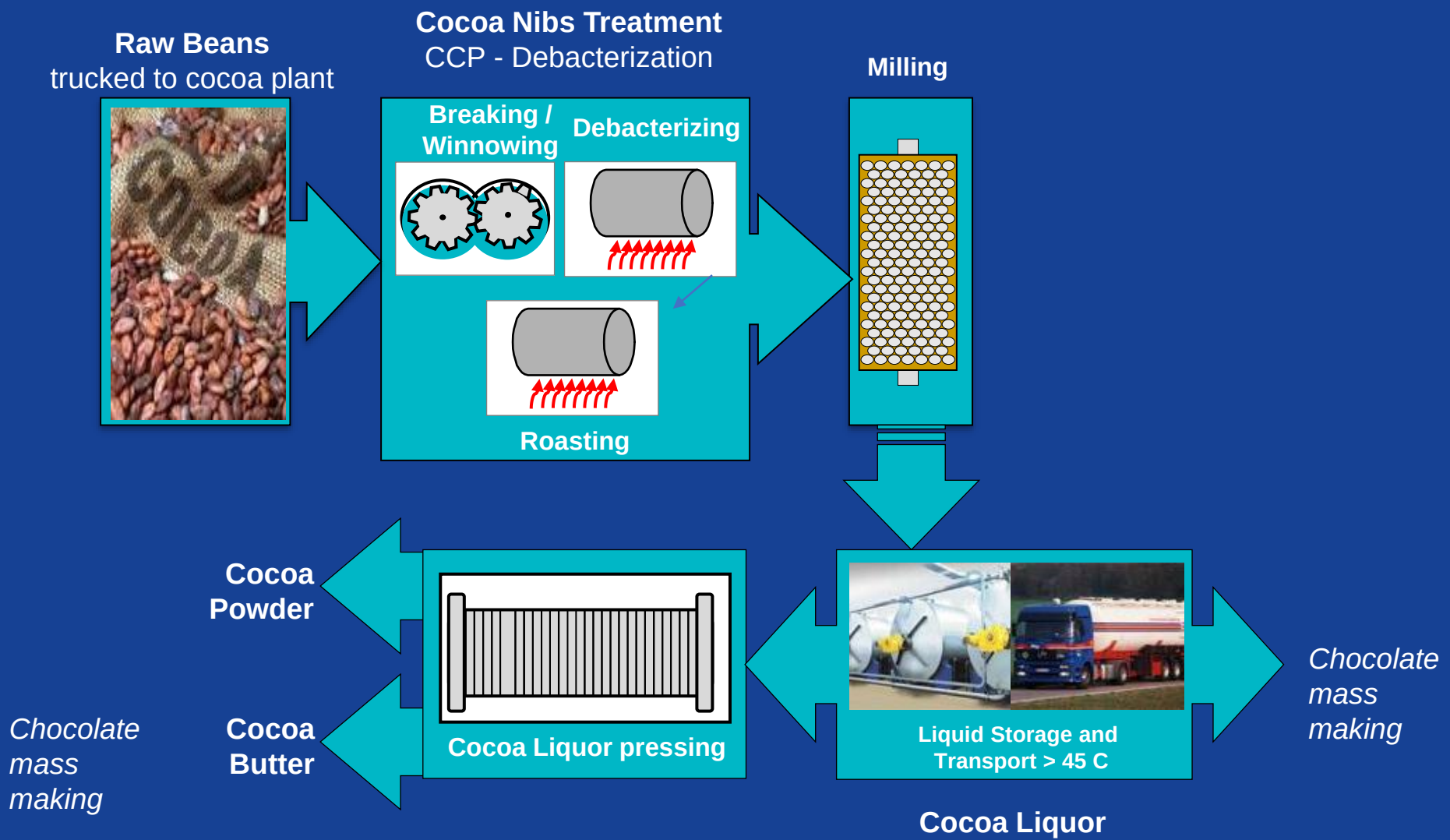
Nut handling

Overview of chocolate production



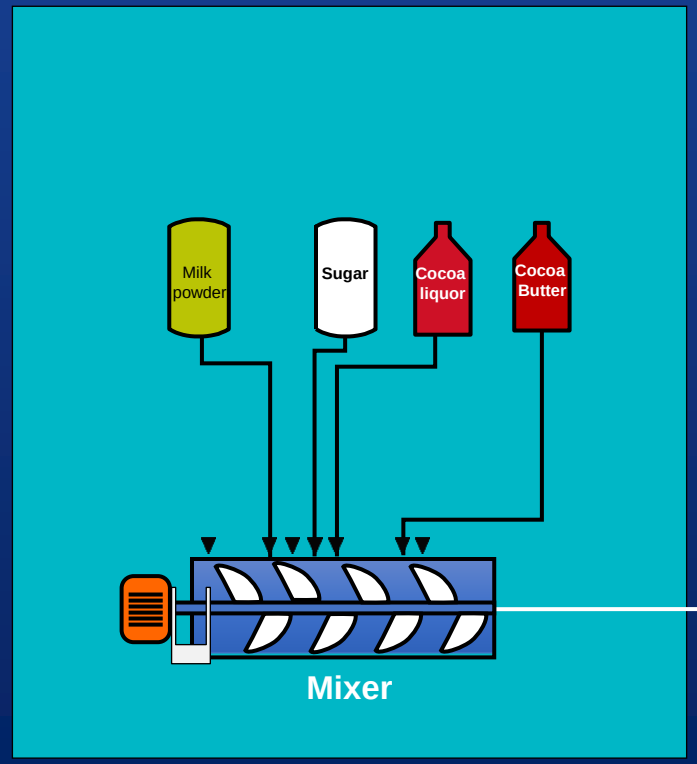
Cocoa process

Cocoa beans to cocoa liquor, cocoa butter & cocoa powder

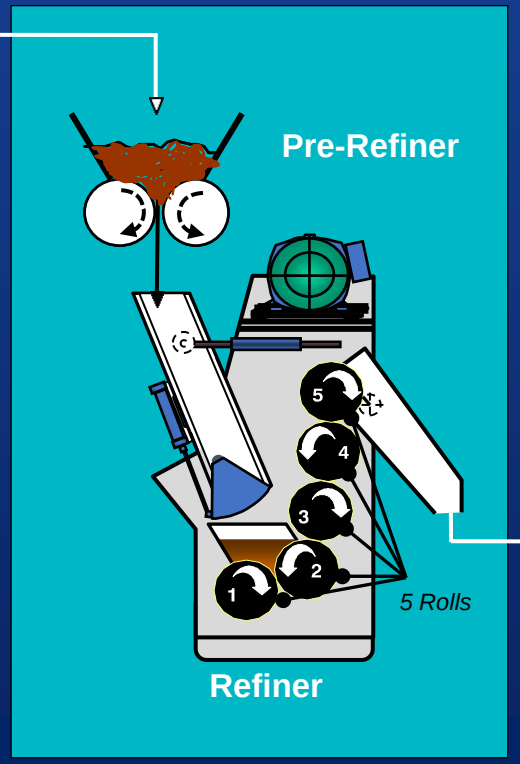


Chocolate Mass process

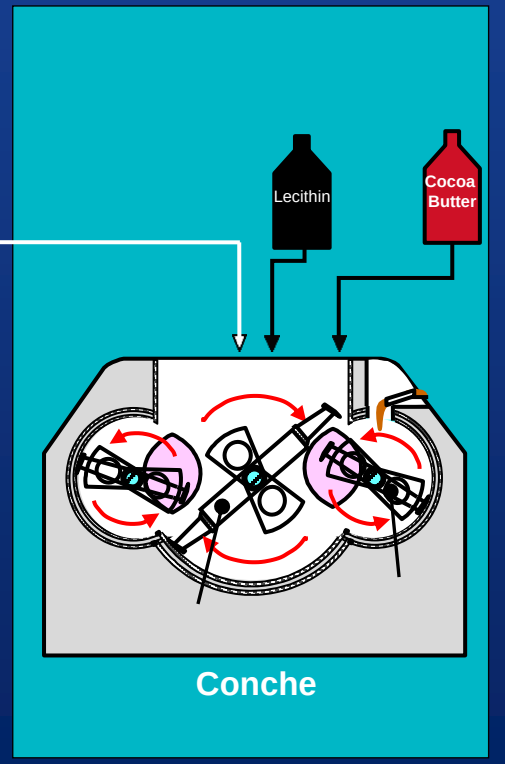
Ingredient Mixing



Milling



Conching



Tempering & Moulding

Molding
= Tempering + Forming + Cooling

Hot Chocolate Mass → Tempering → *Tempered Chocolate Mass* → Depositing (forming)

1. Warm empty mold
2. **Depositing**
3. Vibrating/Scraping
4. Cooling
5. De-Molding

Solid Product

Nut Processing

Harvest (Raw Nuts)

Pre-cleaning

Storage

De-Shelling

Cleaning & Sorting

Storage

Roasting

CCP

Sorting

Packaging

Storage

Shipping/Delivery

Critical Control Point for Biological Hazards

Cocoa Beans

- Roasting
- Steam Pasteurization (Debacterizer)

Nuts

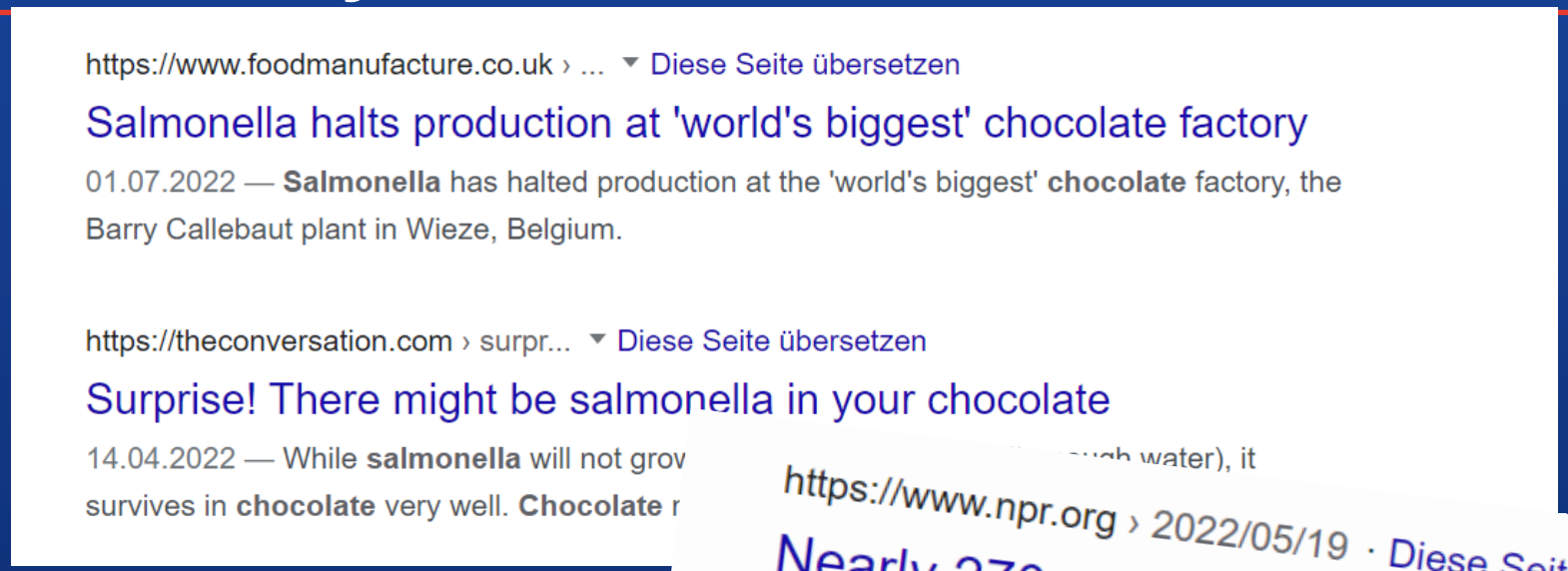
- Roasting - Oil or Dry (continuous or batch process)
- Steam Pasteurization
- Blanching (hot water), e.g. almonds
- PPO (Gas) treatment (used in USA & Mexico)

Steam treatment is more effective than dry roasting to remove S*almonella*.

Important Considerations

- Critical control point (CCP) to remove *Salmonella* in chocolate is many steps away from finished product - manufacturers must rely on suppliers, carriers and others.
- The supply chain for chocolate is very long and involves many countries, shipping methods and processing steps.
- Robust controls to prevent recontamination of the material must be in place.
  - Supplier programs – supplier often delivering CCP and transporting materials
  - Zoning and environmental monitoring to validate controls are working
  - Utilities – Air and Water
  - Maintenance controls
  - Sanitation/Pest Control
  - Good Manufacturing Practices (GMPs)
- Tools for monitoring and cleaning chocolate processes are not state of the art e.g. dry cleaning methods.
- If there is an issue, chocolate equipment is difficult to clean and may result in long downtimes in a plant.

Recently, chocolate has been in the headlines


https://www.foodmanufacture.co.uk › ... ▾ Diese Seite übersetzen

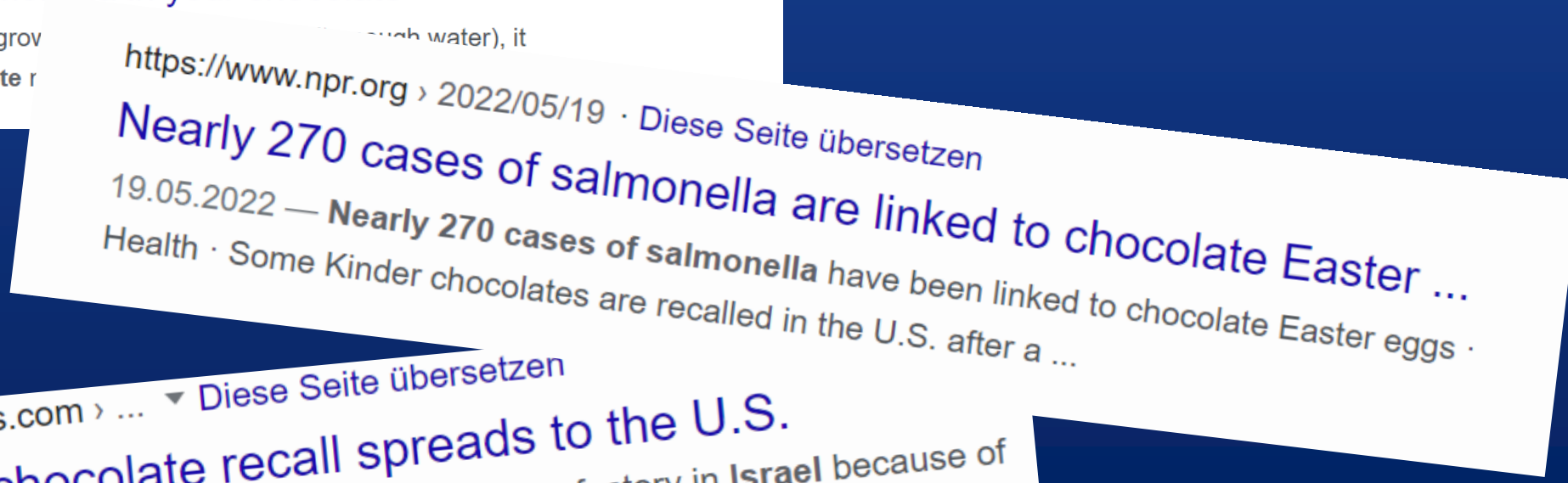
Salmonella halts production at 'world's biggest' chocolate factory

01.07.2022 — **Salmonella** has halted production at the 'world's biggest' **chocolate** factory, the Barry Callebaut plant in Wieze, Belgium.

https://theconversation.com › surpr... ▾ Diese Seite übersetzen

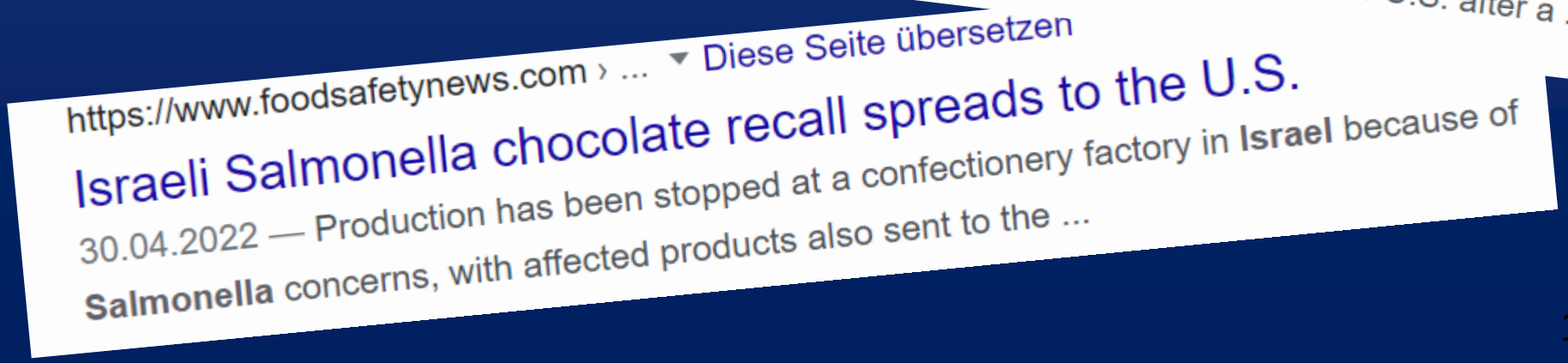
Surprise! There might be salmonella in your chocolate

14.04.2022 — While **salmonella** will not grov ...ugh water), it survives in **chocolate** very well. **Chocolate** r


https://www.npr.org › 2022/05/19 · Diese Seite übersetzen

Nearly 270 cases of salmonella are linked to chocolate Easter ...

19.05.2022 — **Nearly 270 cases of salmonella** have been linked to chocolate Easter eggs · Health · Some Kinder chocolates are recalled in the U.S. after a ...


https://www.foodsafetynews.com › ... ▾ Diese Seite übersetzen

Israeli Salmonella chocolate recall spreads to the U.S.

30.04.2022 — Production has been stopped at a confectionery factory in **Israel** because of **Salmonella** concerns, with affected products also sent to the ...

Hygienic Design Failures

The following are hygienic design failures resulting in *Salmonella* contamination of chocolate in the industry

- Air handling (intake and exhaust design)
- Water recirculation systems and jacketed tanks
- Air filtration on tanks, tank loading and unloading areas
- Dead ends/ legs
- Poor infrastructure
- Maintenance activities

Air handling

- Situation: Sporadic low level *Salmonella* contamination.
- Root cause: Raw zone air exhaust located too close to clean zone air intake.
- Filter on air intake improperly installed.
- Contamination during certain times probably linked to wind direction.

- Minimum 5m (15ft) distance between air inlet vents of controlled manufacturing areas (clean areas) and raw area exhaust
  ASHRAE guideline
- EHEDG Guideline on Air Handling Systems in the Food Industry – Air Quality Control for Building Ventilation

Water recirculation systems and jacketed tanks

- Situation: Sporadic low level *Salmonella* contamination.
- Root cause: Tiny leak in a jacketed tank introducing small amounts of contaminated water into product.
- In chocolate processing, jacketed tanks are widely used to warm product for production purposes and small leaks are difficult to detect.
- Needed:
  - Technology to detect leaks on jacketed systems (e.g. pressure monitoring or testing)
  - Increased industry understanding that even closed water systems need to be sampled and monitored for contamination.
  - Better sanitizers or treatments for these systems?

- Regular testing of water circuits and quick action to address any out of spec results (e.g. high TVC counts, coliform).
- Inspection for leaks during any maintenance or deep cleaning.

Air filtration on tanks, tank loading and unloading areas

- Situation: Contaminated raw material leading to repeat finished product positive samples.
- Root cause: Improperly installed air filter on a tank that did not prevent environmental contamination entering product stream. Lack of maintenance to inspect.
- Note: many tank loading and unloading areas are not hygienically designed.

- Ensure air used for venting storage tanks and silos is filtered.
- Routine inspection of tank air filters to ensure they are intact.
- Preventative maintenance to routinely replace filters at tanks and silos.
- For sensitive raw materials, ensure tanker unloading in a clean environment e.g. indoors or vestibule or shielded area.

Dead end/legs

- Situation: Contamination in line reoccurring sporadically.
- Root cause: Line not able to fully flushed due to the presence of dead legs.
- Engineering not fully removing old lines or installing poorly designed lines that do not meet EHEDG guidelines.
- Additionally, drawings are often not updated. Shared lines not identified.

- Ensure proper installation and removal of lines.
- Update engineering drawings.
- Conduct studies to determine amount of flush needed to “clean” line.

Poor Infrastructure

- Situation: Finished product and environmental positives detected after heavy rains.
- Root cause: Water ingress into production facility (roof, door, walls).
- *Salmonella* is associated with bird droppings and soil. Any environmental water leak into a facility is of concern, especially roof leaks.
- Once *Salmonella* enters a facility, it is difficult to remove and can harbor in a dry state for long periods.

- Regular roof inspections and maintenance program.
- Regular floor inspections and replacement program.
- Pathogen environmental swabbing programs sampling at interfaces such a cleaning rooms where water is present.
- Ensure facility design takes into account likely env. conditions e.g. heavy rain.
- Ensure drainage systems are included in preventative maintenance programs.

Maintenance Activities

- Situation: Finished product positives detected after equipment downtime.
- Root cause: Maintenance interventions can introduce contamination that is difficult to remove despite cleaning.
- Special cleaning required after maintenance.
- Note: Zoning is still critical during plant shutdowns and maintenance activities.

- Special training for maintenance.
- Tool management program (Raw vs RTE).
- Maintain traffic patterns and air flow during downtime.
- Use of protective clothing.
- Contractor selection, controls, training and supervision.

Cleaning after an issue

- Chocolate lines are not wet cleaned and introduction of water in a chocolate plant is risky.
- Lines are cleaned by flushing product or ingredients and disassembly and removal for off-line cleaning of some equipment.
- Other surfaces are sanitized with alcohol or quat.
- Cleaning after a contamination is a significant burden in a chocolate plant.

Consequences of Contamination

- Our relationship with the consumer begins with Trust – any industry incident erodes that trust.
- Equipment is not designed to be wet cleaned – significant downtime with a contamination event – days to weeks not hours.