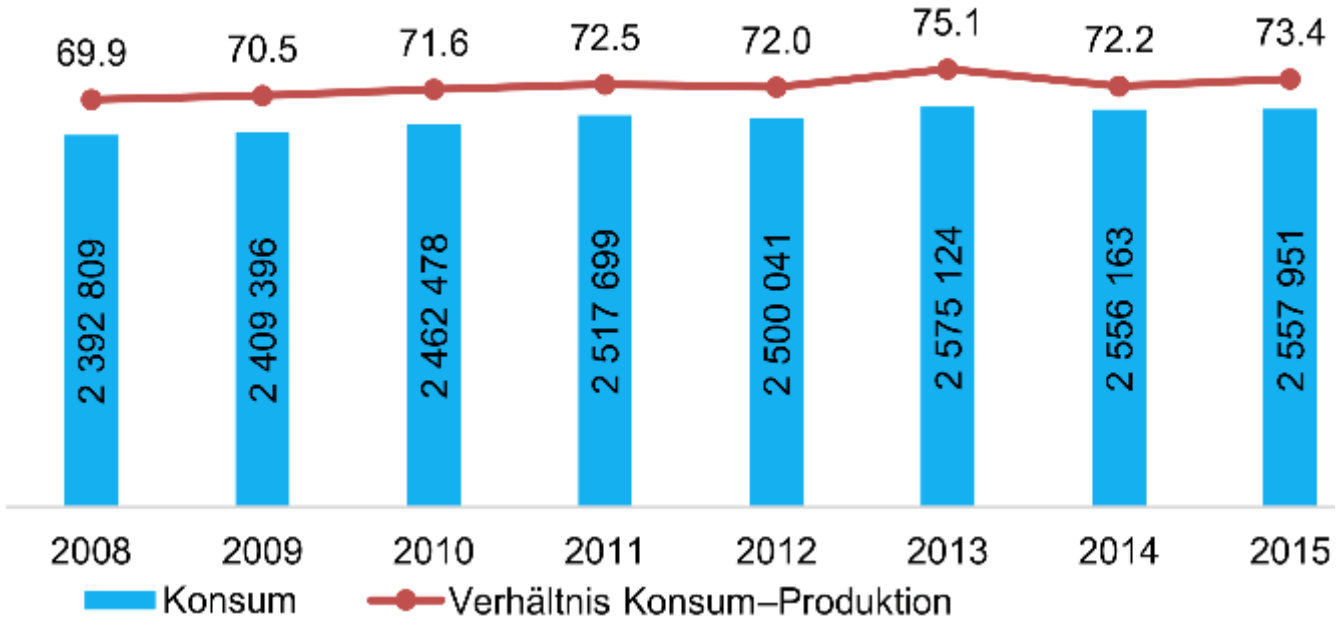
Milch und Milcherzeugnisse aus Sicht der Lebensmittelsicherheit

PD Dr. Sophia Johler
Institut für Lebensmittelsicherheit und -hygiene
Vetsuisse-Fakultät
Universität Zürich

Konsum und Produktion von Milchprodukten[1]

Konsum in Millionen Tonnen Vollmilchäquivalent

Verhältnis Konsum-Produktion in %



[1] Quellen: BLW, Fachbereich Marktanalysen; Agristat; BFS; TSM

Agenda

- **Milch und Säuglingsanfangsnahrung**
- Käse
- Sonderfall Alpkäse

Rohmilch

= tierische Milch, die nicht auf mehr als 40°C erhitzt wurde oder einer Behandlung mit ähnlichem Effekt unterzogen wurde[1]

- Verkauf möglich (z.B. ab Hof oder am Automaten)
- Hinweis, dass Milch vor Verzehr abgekocht werden muss
- Diverse Gesundheitseffekte zugeschrieben
  (z.B. Verhinderung von Asthma, Allergien...)

[1] (EC) 835/2004

Rohmilch Direktvermarktung

Blick

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Dank St. Galler Tüftler Alfred Bruni (55)

So frisch war Milch vom Hof noch nie

MUOLEN SG - Mit seinen Brunimaten erobert Alfred Bruni derzeit die Welt. 2016 kann er 200 Stück an deutsche Bauern verkaufen – trotz des starken Frankens.

Publiziert am 29.11.2016, aktualisiert am 30.05.2017

Erfolgsgeschichte Milchautomat[1]

Kampf mit den Behörden

Das ruft auch die Veterinärämter auf den Plan, die heimlichen Chefs der Bürokratie. Bruni seufzt. „Bei manchen muss ein DIN A 4 grosses Plakat aufgeklebt sein, auf dem steht, dass die **Milch abgekocht** werden muss. Bei anderen reicht ein deutlich kleinerer Hinweis darauf, dass eine **Erwärmung auf 72 Grad vor dem Verzehr empfohlen** wird.“


Milchautomat

Schweizer Milchautomat auf Erfolgskurs

…**Verglichen mit Deutschland** sei das Aufstellen der Automaten **in der Schweiz ein Spaziergang**...

[1] Landwirtschaftlicher Informationsdienst Nr. 3299, Eveline Dudda (16.11.2016)

Milchshakes

"...feines Milchshake in verschiedenen Varianten, frisch gemischt im Becher… **Schulmilchautomat**… Industriebetriebe, Badeanstalten, Campingplätze…

…kundenfreundlich, **hygienisch**, 24h Betrieb, Self-Service…"

Masterarbeit Milchautomaten

- 61 Milchautomaten beprobt
- Gesamtkeimzahl

CFU/ml	10^2-10^3	10^3-10^4	10^4-10^5	10^5-10^6	10^6-10^7
Brunimat	1	15	24	14	7
%	1.5%	24%	39%	23%	11.5%

- 27% positiv für *S. aureus*
  - 14% davon tragen Enterotoxingene

[1] Masterarbeit Marc Zulauf, 2018

ERNÄHRUNG

Rohmilch – gesund oder gefährlich?

Nutztiere | Donnerstag, 9. Oktober 2014 07:30, Julian Perrenoud

Der Schweizer Publizist Walter Hess fragte sich an einem Seminar, wie das Heilmittel Rohmilch zu einem Produkt wurde, von dessen Konsum gewarnt werden müsse. Ist es also ein gesellschaftliches Problem? Auch Mudrak sagt, die durch die Milch eingenommenen Enzyme seien lebenswichtig, bauten sie im Körper doch Nahrung ab. Sie macht vor allem grosse Industriekonzerne für gefährliche Keime in der Rohmilch verantwortlich.

Laut EFSA Datenlage zu lückenhaft, um mit Rohmilchverzehr einhergehendes Erkrankungsrisiko zu quantifizieren[1]

ABER: In Rohmilch vorkommende Erreger und Ausbrüche bekannt!

[1] EFSA (2014), Scientific Opinion on the public health risks related to the consumption of raw drinking milk

CDC: Raw Milk-Related Outbreaks on the Rise

BY **JAMES ANDREWS** | DECEMBER 12, 2014

During the three years from 2007 to 2009, 30 foodborne illness outbreaks in the U.S. were connected to raw milk consumption. Yet, in the next three years, from 2010 to 2012, that number rose to 51, according to a new study published in the January issue of Emerging Infectious Diseases, a peer-reviewed monthly journal published by the Centers for Disease Control and Prevention (CDC).

In that time, 81 percent of raw milk-related outbreaks occurred in states that allow for the legal sale of raw milk. Retail sale of raw milk is legal in 10 states, on-farm sales are legal in another 16, and seven states have legalized herd-share programs, in which a number of people "buy in" to owning dairy cows from which they receive raw milk.

The leading cause of these illnesses was Campylobacter, which accounted for 62 of the 81 outbreaks. Campylobacter, an infectious bacteria found in some animal feces, causes bouts of diarrhea, vomiting and cramping in most people, but can cause long-lasting arthritis and rare nerve disorders in a small number of those it infects.

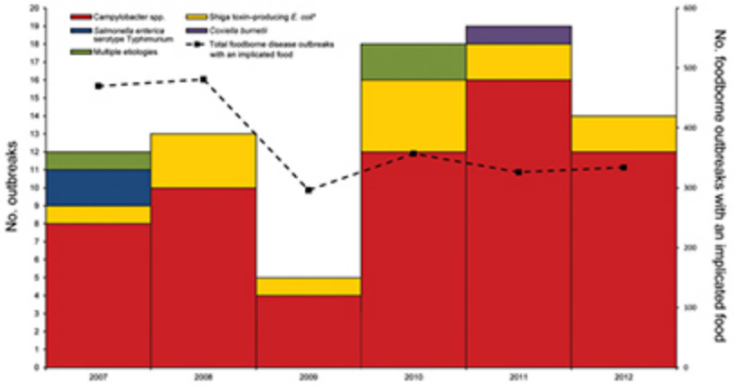

Figure 1. Outbreaks associated with nonpasteurized milk, by etiologic agent and year, United States, 2007–2012. Three outbreaks involved multiple pathogens: Campylobacter spp. and Salmonella enterica serotype Typhimurium; Shiga toxin–producing Escherichia coli O157:H7 and Campylobacter; Campylobacter and Cryptosporidium. E. coli serogroups: O157 (10 outbreaks), O111 (1 outbreak), O26:H11 (1 outbreak), O157:H7 and O121 (1 outbreak).

Other leading pathogens included E. coli, with 13 outbreaks, and Salmonella, with two.

The increase in raw milk-related outbreaks could be partially explained by the rising popularity of drinking raw milk, which is milk that has not been pasteurized to eliminate potentially harmful pathogens.

EMERGING INFECTIOUS DISEASES®

ISSN: 1080-6059

CDC > EID journal > Volume 23 > Number 6—June 2017

Volume 23, Number 6—June 2017

Research

Outbreak-Related Disease Burden Associated with Consumption of Unpasteurized Cow's Milk and Cheese, United States, 2009–2014

Solenne Costard, Luis Espejo, Huybert Groenendaal, and Francisco J. Zagmutt

Author affiliations: EpiX Analytics, Boulder, Colorado, USA (S. Costard, H. Groenendaal, F.J. Zagmutt); Consultant, St. Augustine, Florida, USA (L. Espejo)

Cite This Article

Abstract

The growing popularity of unpasteurized milk in the United States raises public health concerns. We estimated outbreak-related illnesses and hospitalizations caused by the consumption of cow's milk and cheese contaminated with Shiga toxin–producing *Escherichia coli*, *Salmonella* spp., *Listeria monocytogenes*, and *Campylobacter* spp. using a model relying on publicly available outbreak data. In the United States, outbreaks associated with dairy consumption cause, on average, 760 illnesses/year and 22 hospitalizations/year, mostly from *Salmonella* spp. and *Campylobacter* spp. Unpasteurized milk, consumed by only 3.2% of the population, and cheese, consumed by only 1.6% of the population, caused 96% of illnesses caused by contaminated dairy products. Unpasteurized dairy products thus cause 840 (95% CrI 611–1,158) times more illnesses and 45 (95% CrI 34–59) times more hospitalizations than pasteurized products. As consumption of unpasteurized dairy products grows, illnesses will increase steadily; a doubling in the consumption of unpasteurized milk or cheese could increase outbreak-related illnesses by 96%.

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Universität Zürich[UZH]

Institut für Lebensmittelsicherheit und -hygiene

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CDC > EID journal > Volume 23 > Number 6—June 2017

Nur 3.2% konsumieren Rohmilch und 1.6% Rohmilchkäse
ABER: **96% der Erkrankungen durch Rohmilchprodukte!**

Volume 23, Number 6—June 2017

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Food Safety News

Breaking news for everyone's consumption

Raw milk test in Pennsylvania prompts Campylobacter warning

BY **CORAL BEACH** | FEBRUARY 27, 2018

Pennsylvania officials warned consumers earlier this month that they should immediately discard all raw milk from Conoco View Dairy because it was contaminated with Campylobacter, which can cause serious infections and is killed by pasteurization.

As of Monday, the Pennsylvania Department of Agriculture, which issued the warning Feb. 15, had not received any reports of confirmed Campylobacter infections in connection with the unpasteurized, raw milk from the Perry County dairy, said a department spokeswoman.

All of the implicated milk was labeled with a sell-by date of Feb. 16.

While it is unlikely people still have any of the unpasteurized milk in their homes, consumers should monitor themselves and children who drank the milk for symptoms of Campylobacter infection. It can take several days after exposure for symptoms to develop.

Salmonella Illnesses Linked to Raw Milk

By Denis Stearns on October 7, 2017

POSTED IN FOODBORNE ILLNESS OUTBREAKS

Lab results confirmed the *Salmonella* strain recently found in Pride & Joy Dairy organic raw milk matches the strain that hospitalized two Washington residents in January. Health officials are urging consumers not to drink Pride & Joy Dairy organic raw milk in any container size or sell-by date.

"Unpasteurized 'raw' milk can carry harmful bacteria and germs. Foodborne illnesses are possible from many different foods; however, raw milk is one of the riskiest," said Dr. Scott Lindquist, Washington state communicable disease epidemiologist.

The unique strain identified in the illnesses and the recent dairy sample, *Salmonella* Dublin, has previously been found among cattle and cattle products, including beef and raw dairy. Symptoms can include fever, diarrhea, nausea, vomiting, and abdominal pain. In severe cases, the infection can be fatal.

Foodborne Illness Outbreak Database

This database provides summaries of significant food and water related outbreaks occurring since 1984 caused by E. coli, Salmonella, Hepatitis A, Campylobacter and other pathogens. READ MORE »

2016 Outbreak of STEC linked to Consumption of Raw Milk, Golden Valley Guernseys

In March 2016 local and state public health, laboratory and agriculture agencies investigated an outbreak of non-O157 Shiga Toxin E. coli (STEC) among members of a herd share. Prior to symptom onset, ill persons consumed raw (unpasteurized) milk produced by Golden Valley Guernseys, a dairy located in Rixeyville, Virginia. As many as 14 persons were ill. The majority were children. Three developed hemolytic uremic syndrome. STEC was not isolated from any environmental or milk specimens collected at the farm. Non-O157 STEC was detected in a sample of milk collected from a private household. The isolate from this specimen was indistinguishable by PFGE to a isolate cultured in a patient's specimen.

Tags: unpasteurized, raw, milk, stec, dairy, shiga toxin e. coli, non-o157, goden valley guernseys, herd share

Outbreak began:	March 2016
Affected Country:	US
Affected States/Territories:	Virginia
Organism(s):	Non-O157 STEC

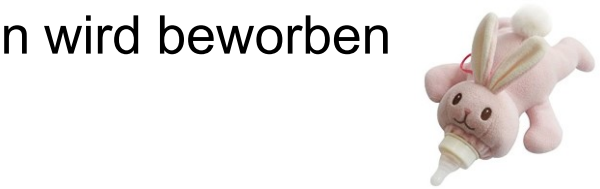
Bakterielle Risiken durch Rohmilchkonsum

- *Campylobacter jejuni*
- *Salmonella* spp.
- Shiga-Toxin bildende *Escherichia coli* (STEC)
- *Staphylococcus aureus*
- *Bacillus cereus*
- *Yersinia enterocolitica/ pseudotuberculosis*
- *Corynebacterium* spp.
- *Streptococcus suis* ssp. *Zooepidemicus*
- *Listeria monocytogenes*
- *Brucella abortus/ melitensis*
- *Mycobacterium bovis*

[1] EFSA (2014), Scientific Opinion on the public health risks related to the consumption of raw drinking milk

Säuglingsanfangsnahrung

- z.T. fälschlicherweise für steril gehalten
  => CAVE: Vitaminquellen werden unerhitzt zugesetzt
- Diverse Babykostwärmer
  => auch Warmhaltefunktion wird beworben
- Bakterielle Risiken
  - *Salmonella* spp.
  - *Cronobacter* spp.



Cronobacter spp.

- Opportunistisches Pathogen
  => v.a. Erkrankungen bei Frühchen
- gehören zu *Enterobacteriaceae*
- Klinik
  - Sepsis
  - Nekrotisierende Enterocolitis
  - Meningitis
- Todesfälle bekannt

Quelle: Roger Stephan

Agenda

- Milch und Säuglingsanfangsnahrung
- **Käse**
- Sonderfall Alpkäse

Vergleich Weichkäse und Hartkäse

	Weichkäse	**Hartkäse**
Haltbarkeit	Kühlung	aw-Wert
Mikrobiologie des Endproduktes	Reifungskultur	Reifungskultur
Produktesicherheit	Pasteurisation	Reifungsdauer

Vergleich Weichkäse und Hartkäse

	Weichkäse	**Hartkäse**
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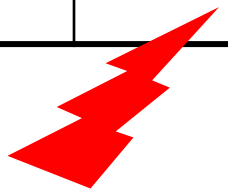

CAVE: Oberflächenkontamination!

Bakterielle Risiken durch Käseverzehr

- Shiga-Toxin bildende *Escherichia coli* (STEC)
- *Listeria monocytogenes*
- *Staphylococcus aureus*

Quelle: H & S Cheese

[1] x

STEC und Milchprodukte

- v.a. *Escherichia coli* **O157:H7** => **MID** von nur **5-50 Zellen**!
- **Wiederkäuer** sind Hauptreservoir für zoonotische STEC
- Klinik: Gastroenteritis, Enterocolitis, blutige Diarrhoe
  => 10% der Patienten entwickeln **Hämolytisch-Urämisches Syndrom**
- Rohmilch: ca. 0-2% positiv für STEC[1]
- i.d.R. Eintrag durch **fäkale Kontamination der Milch**
- einige STEC Serotypen können sich ab 6.5°C in Milch vermehren
- Inaktivierung durch Pasteurisierung der Milch

[1] Farrokh et al. (2013). Review of Shiga-toxin-producing *Escherichia coli* (STEC) and their significance in dairy production. *Internat. J. Food Microbiol.*

J. Dairy Sci. 91:2561–2565
doi:10.3168/jds.2008-1055

Prevalence and Characteristics of Shiga Toxin-Producing *Escherichia coli* in Swiss Raw Milk Cheeses Collected at Producer Level

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†National Reference Laboratory for *Escherichia coli*, Centre for Infectiology and Pathogen Characterization, Federal Institute for Risk Assessment, Berlin, Germany
‡Federal Veterinary Office, Schwarzenburgstrasse 155, 3003 Bern, Switzerland

ABSTRACT

The aim of this study was to describe the prevalence, serotypes, and virulence genes of Shiga toxin-producing *Escherichia coli* (STEC) isolated from raw milk cheese samples collected at the producer level with the purpose of determining whether raw milk cheeses in Switzerland represent a potential source of STEC pathogenic for humans. Raw milk cheese samples (soft cheese, n = 52; semihard and hard cheese, n = 744; all produced

INTRODUCTION

Shiga toxin-producing *Escherichia coli* (**STEC**) are among the most important causes of food-borne diseases (http://www.who.int/mediacentre/factsheets accessed Apr. 25, 2008; Anonymous, 2007). They are responsible for several human gastrointestinal diseases, including watery or bloody diarrhea. In a proportion of individuals, commonly children, these symptoms may be complicated by neurological and renal sequelae, including hemolytic-uremic syndrome (**HUS**). Most out-

=> 3.7-6.3% *stx* positiv

J Dairy Sci. 2013 Feb;96(2):815-23. doi: 10.3168/jds.2012-5865. Epub 2012 Dec 14.

Fate of Shiga toxin-producing and generic Escherichia coli during production and ripening of semihard raw milk cheese.

Peng S[1], Hoffmann W, Bockelmann W, Hummerjohann J, Stephan R, Hammer P.

Author information

1 Institute for Food Safety and Hygiene, University of Zurich, 8057 Zurich, Switzerland. ils@fsafety.uzh.ch

Abstract

The fate of 5 different Escherichia coli strains, including 3 Shiga toxin-producing E. coli (STEC) strains, was analyzed during the production and ripening of semihard raw milk cheese. The strains, which were previously isolated from raw milk cheese, were spiked into raw milk before cheese production at 2 different levels (approximately 10(1) and 10(3) cfu/mL, respectively). Two cheese types were produced, which differed in cooking temperatures (40 and 46°C). The cheeses were sampled during manufacture and the 16-wk ripening period. An increase in E. coli counts of approximately 3.5 log(10) cfu/g occurred from raw milk to fresh cheese at d 1, which was attributed to a concentration effect during cheese production and growth of the strains. During ripening over 16 wk, a slow, continuous decrease was observed for all strains. However, significant differences were found between the E. coli strains at the applied spiking levels, whereas the inactivation was similar in the 2 different cheese types. The 2 generic E. coli strains survived at higher counts than did the 3 STEC strains. Nevertheless, only 1 of the 3 STEC strains showed significantly weaker survival at both spiking levels and in both cheese types. Six of 16 cheeses made from raw milk at a low spiking level contained more than 10 cfu/g of STEC at the end of the 16-wk ripening process. After enrichment, STEC were detected in almost all cheeses at both spiking levels. Particularly because of the low infectious dose of highly pathogenic STEC, even low colony counts in raw milk cheese are a matter of concern.

=> Auch bei Inokulation mit geringen Keimmengen nach 16 Wochen Reifung STEC >10 KBE/g nachweisbar

Listeria monocytogenes

- Minimale Infektiöse Dosis gering (genaue MID unbekannt)
- Vermehrung bei 4°C & hohe Tenazität!
- Klinik
  - Gastroenteritis
  - Meningitis
  - Listeriensepsis
  - Schwangerenlisteriose

[1] X

Listeria monocytogenes

- Reservoir: Umgebung
- häufige Quellen:
  - Milch und Milchprodukte
  - verzehrsfertige Speisen
  - Früchte und Gemüse

[1] x

SWI swissinfo.ch

Listeria outbreak under control

JUN 7, 2005 - 16:45

Two people have died from listeria bacteria after eating a local speciality soft cheese, according to Swiss health officials.

A total of ten people have been admitted to hospital over the past two weeks, but the authorities say the outbreak is now under control.

Test results about the contaminated cheese are due on Thursday

(Keystone)

Officials said that listeria had also been linked to two miscarriages.

Daphné Berner, a senior health official in canton Neuchâtel in northwestern Switzerland, said that traces of listeria – which can cause serious and sometimes fatal infections – had been found in both the elderly victims.

She added that both the victims and the miscarriages had been linked to the consumption of locally-made Tomme cheese.

Five people are still in hospital, officials said on Tuesday.

Tomme Käse:

10 Hospitalisierte
2 Aborte

Euro Surveill. 2006;11(6):91-3.

Outbreak of human listeriosis associated with tomme cheese in northwest Switzerland, 2005.

Bille J, Blanc DS, Schmid H, Boubaker K, Baumgartner A, Siegrist HH, Tritten ML, Lienhard R, Berner D, Anderau R, Treboux M, Ducommun JM, Malinverni R, Genné D, Erard PH, Waespi U.

National Reference Center for Listeriosis (CNRL), Lausanne, Switzerland.

AMERICAN SOCIETY FOR MICROBIOLOGY | genomeAnnouncements

CrossMark click for updates

Genome Sequences of *Listeria monocytogenes* Strains Responsible for Cheese- and Cooked Ham Product-Associated Swiss Listeriosis Outbreaks in 2005 and 2011

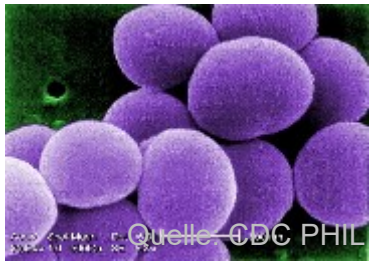
Taurai Tasara,[a] Jochen Klumpp,[b] Jacques Bille,[c] Roger Stephan[a]

Vetsuisse Faculty, Institute for Food Safety and Hygiene, University of Zurich, Zurich, Switzerland[a]; Institute of Food, Nutrition and Health, ETH Zurich, Zurich, Switzerland[b]; Institute of Microbiology, University of Lausanne, Lausanne, Switzerland[c]

The complete genome sequences of three *Listeria monocytogenes* serotype 1/2a strains, Lm 3136, Lm 3163, and Lm N1546, which were responsible for listeriosis outbreaks in 2005 and 2011 in Switzerland, are presented here.

CAVE: Oberflächenkontamination!

Staphylococcus aureus



- Gram-positive Kokken
- Vermehrung und Enterotoxinbildung im Lebensmittel
- Staphylococcal Food Poisoning (SFP) ist **häufigste Lebensmittelintoxikation weltweit!**
  - EU: 434 gemeldete Ausbrüche für 2015 (Dunkelziffer hoch)[1]
- **Enterotoxine** sind sehr **stabil**
  - Keine Inaktivierung durch Erhitzen oder proteolytische Enzyme
    => Abtöten des Erregers inaktiviert Toxine nicht
    => Bildung der Toxine muss verhindert werden

[1] EFSA (2016). The European Union Summary report on trends and sources of zoonoses EFSA Journal

Intoxikation ≠ Infektion

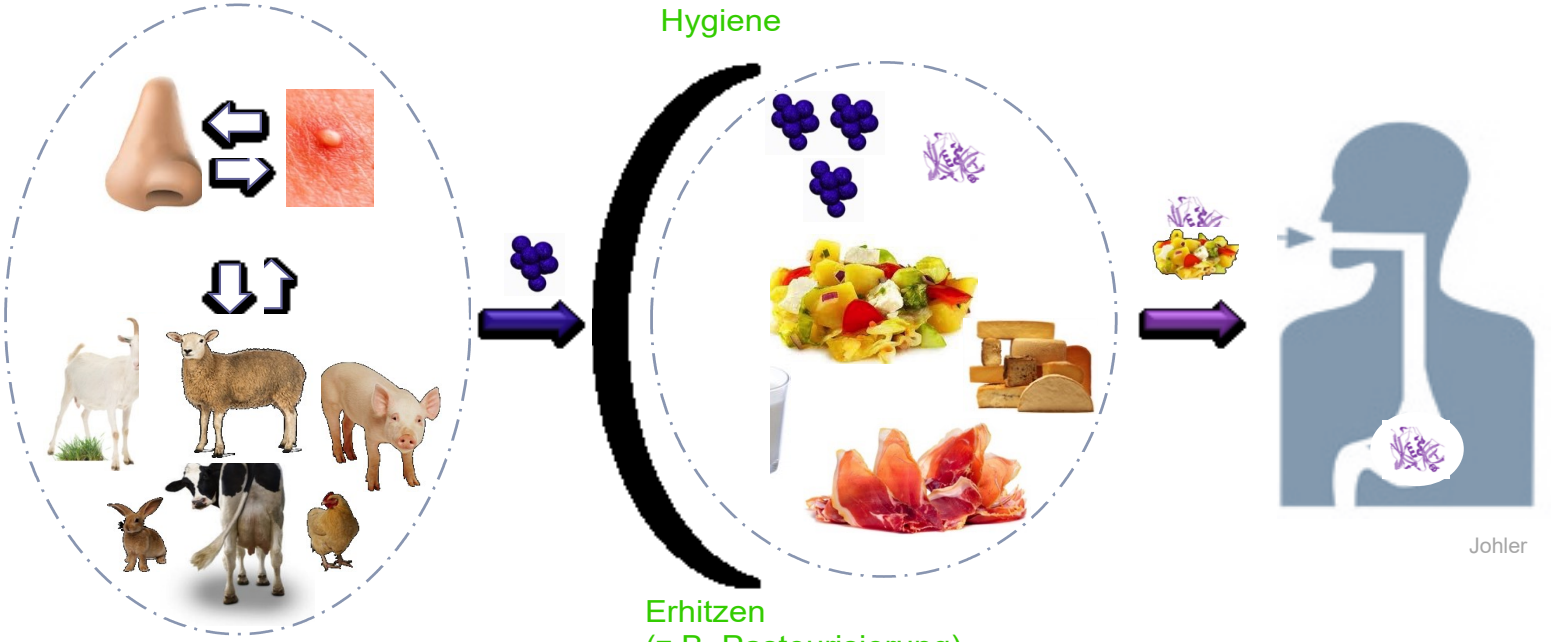
Orale Aufnahme des **Toxins** führt zur Lebensmittelvergiftung

Eindringen des **Erregers** (Haut-/Schleimhautdefekte...)

- Haut-/Wundinfektionen, Abszesse, Endocarditis...
- „Staph. Scalded Skin“
- Toxisches Schock Syndrom
- **Euterentzündung**

MRSA

Entstehung des SFP



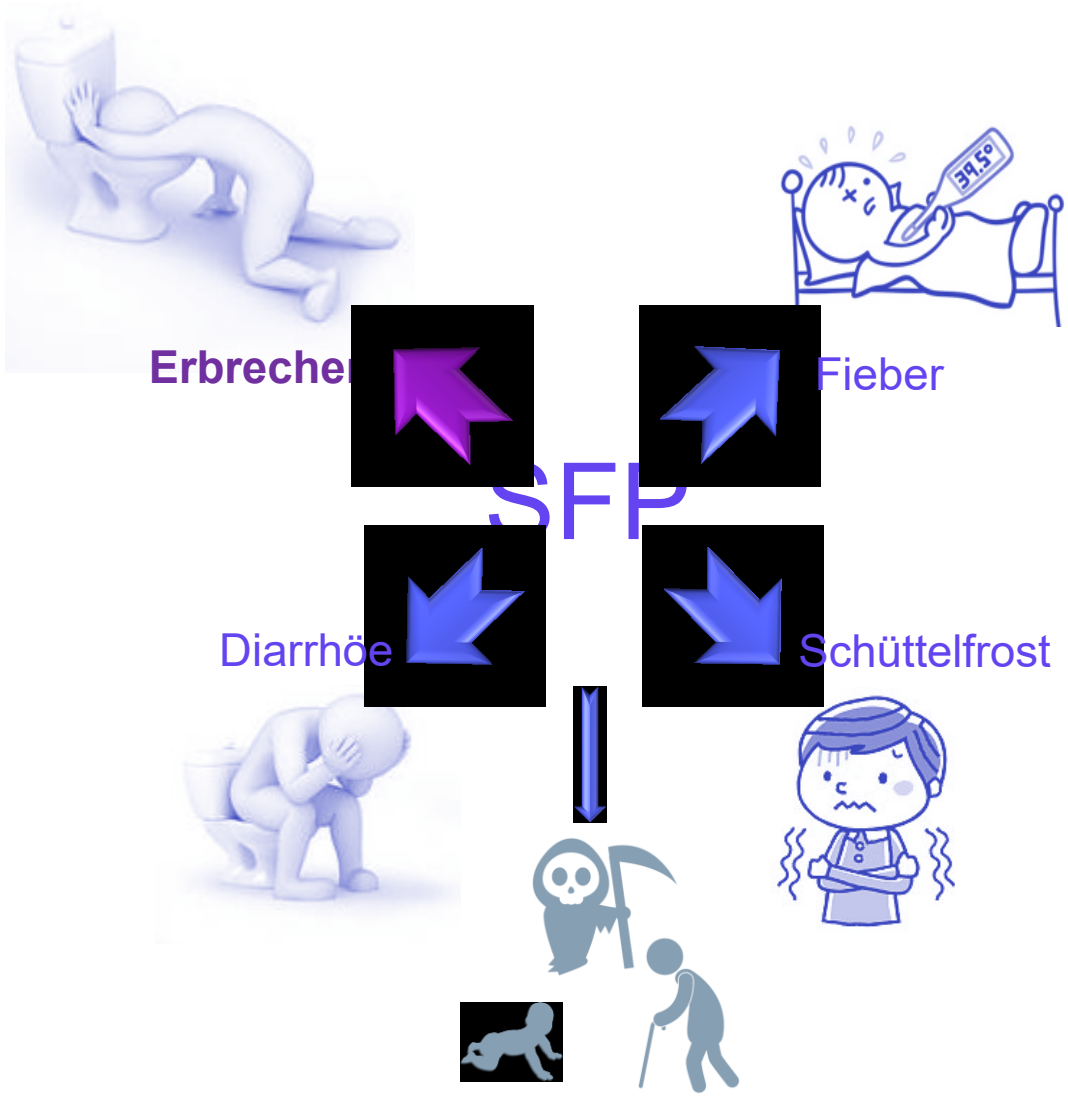
Mögliche ***S. aureus*** Quellen

Vermehrung von ***S. aureus*** im Lebensmittel und Bildung von **Enterotoxinen**

Vergiftung durch orale Aufnahme der **Enterotoxine**

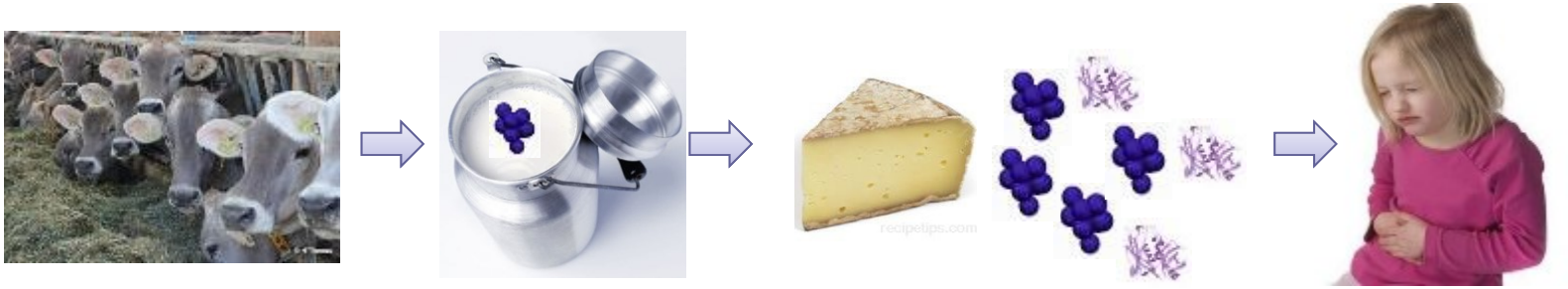
Symptome

- 30 min – 7 h nach Toxinaufnahme
- selbstlimitierend innerhalb von 24 h



SFP Ausbruch in Internat[1]

- 10 Kinder und 4 Erzieher erkrankt nach Verzehr von “Tomme” **Rohmilchkäse**
- Nachweis *S. aureus* und SEs im Käse
- *S. aureus* **Genotyp B**
  => Milch vieler infizierter Kühe im Tank gepoolt
  => Erregervermehrung/Konzentration beim Käsen + SE Bildung



1) Johler et al. (2015). Outbreak of staphylococcal food poisoning among children and staff at a Swiss boarding school due to soft cheese made from raw milk. *J. Dairy Sci.*

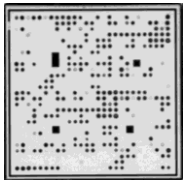
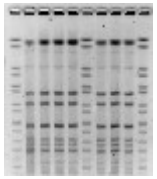
Grillkäserückruf

- Detektion von SEs in Grillkäse
  - Rückruf & Produktionsstopp
- Limitationen:
  - ✓ Traditioneller Produktionsprozess
    (nur Milch/ Starterkultur/ Lab/ Salz; manueller Produktionsprozess)
  - ✓ pH > 6.0 aus technologischen Gründen

pH!

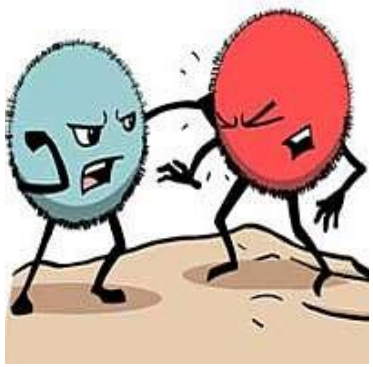
Step-wise tracing

- Stufenweises Verfolgung von *S. aureus* im Produktionsprozess
  - PFGE, DNA Microarray, *spa* typing

- Alle beprobten Endprodukte positiv für einen oder mehrere *S. aureus*
- Quelle sind besiedelte Käser!

Neue Strategie



Starterkultur optimieren!

=> Erfolgreicher Test der Starterkultur im Challenge Assay

Batch	Coagulase-positive staphylococci (CPS)		CNS
	Artificial contamination in milk (cfu/mL)	After 24 h (cfu/g)	After 24 h (cfu/g)
C	10^6	2.0×10^7	2.4×10^8
D	10^5	6.0×10^5	2.1×10^8

S. Johler et al., J. Dairy Sci., 2016

Agenda

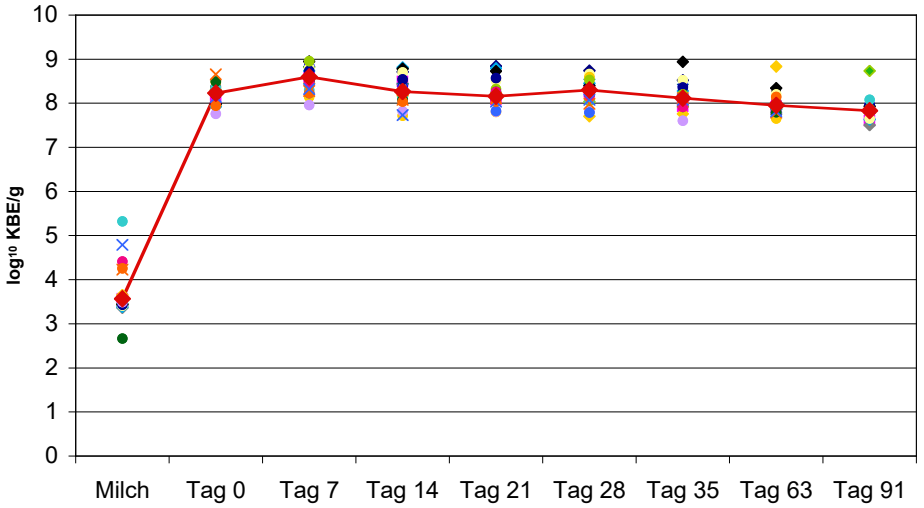
- Milch und Säuglingsanfangsnahrung
- Käse
- **Sonderfall Alpkäse**

Sonderfall Alpkäse

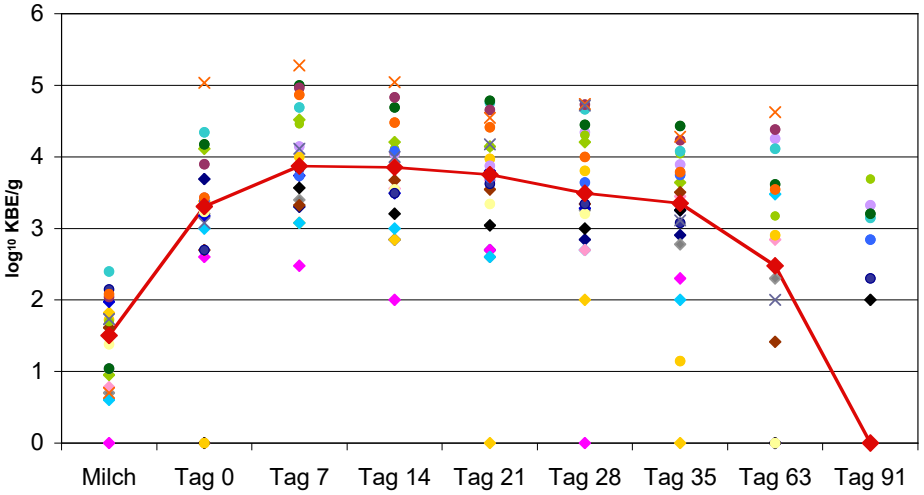
- Rohmilchkäse hergestellt während Sömmerung auf der Alp
- Durchmischung von Tieren aus verschiedenen Herden
- **Problem:** *Staphylococcus aureus*

Keimzahlverlauf

Gesamtkeimzahl

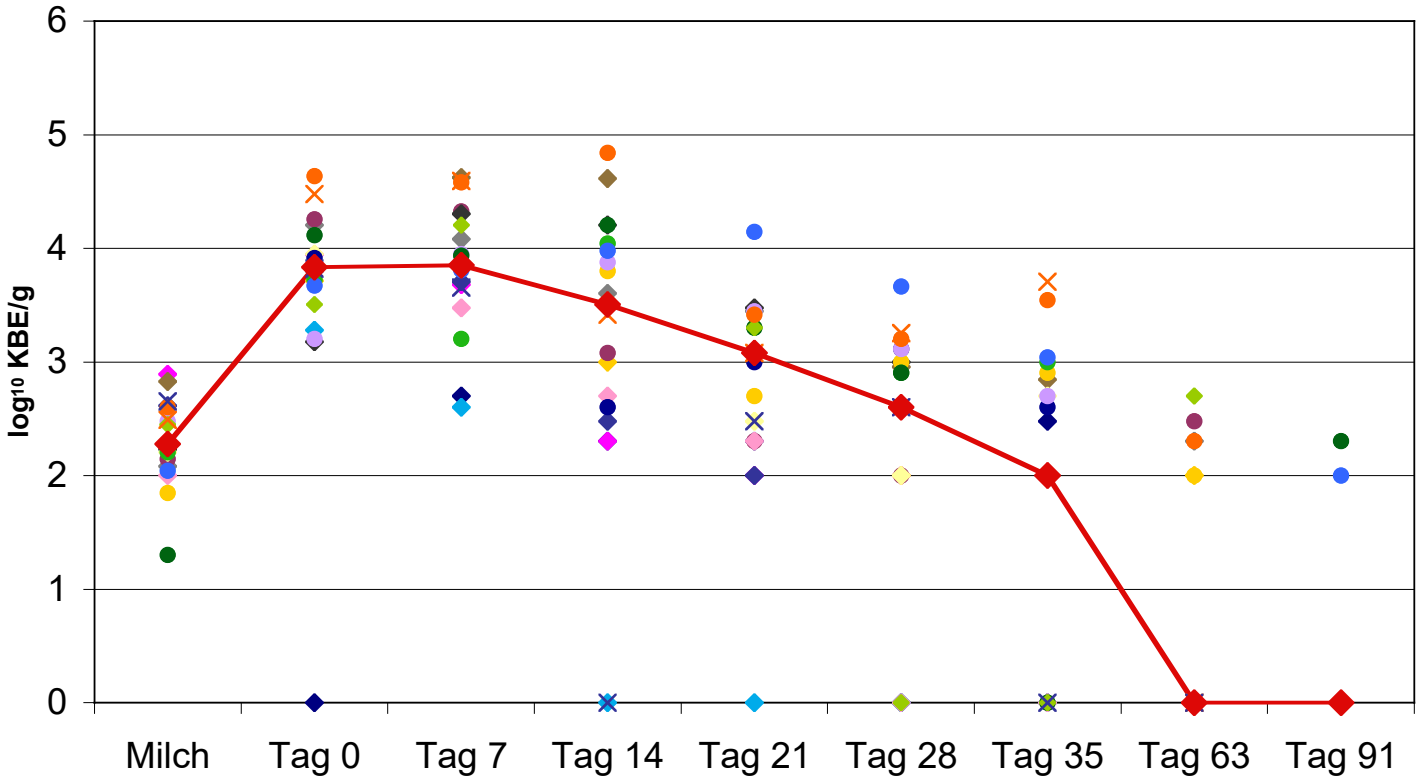


Enterobacteriaceae



Bsp. Rohmilchhalbhartkäse: Dissertation Rusch 2005

Keimzahlverlauf *S. aureus*



Beispiel Rohmilchhalbhartkäse: Dissertation Rusch 2005

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