



**Vitenskapskomiteen for mat og miljø**

Norwegian Scientific Committee for Food and Environment

**Assessment of *L. monocytogenes* concentrations  
in ready-to-eat foods and the effect of risk  
mitigation strategies for vulnerable and normal  
consumers in Norway**

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## ***Risk assessment of *L. monocytogenes* in ready-to-eat foods for better diet advice to vulnerable consumer groups in Norway***

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# Request from the Norwegian food safety authorities (NFSA) to VKM

- Purpose: Decision support for revision of the advices to pregnant women and vulnerable groups to avoid listeriosis (NFSA task)
- Evaluate the following four food groups:
  - fish products
  - meat products
  - dairy products
  - fresh produce
- Assess the effects of various risk-reducing measures based on new knowledge on growth and survival of *L. monocytogenes* in these foods.

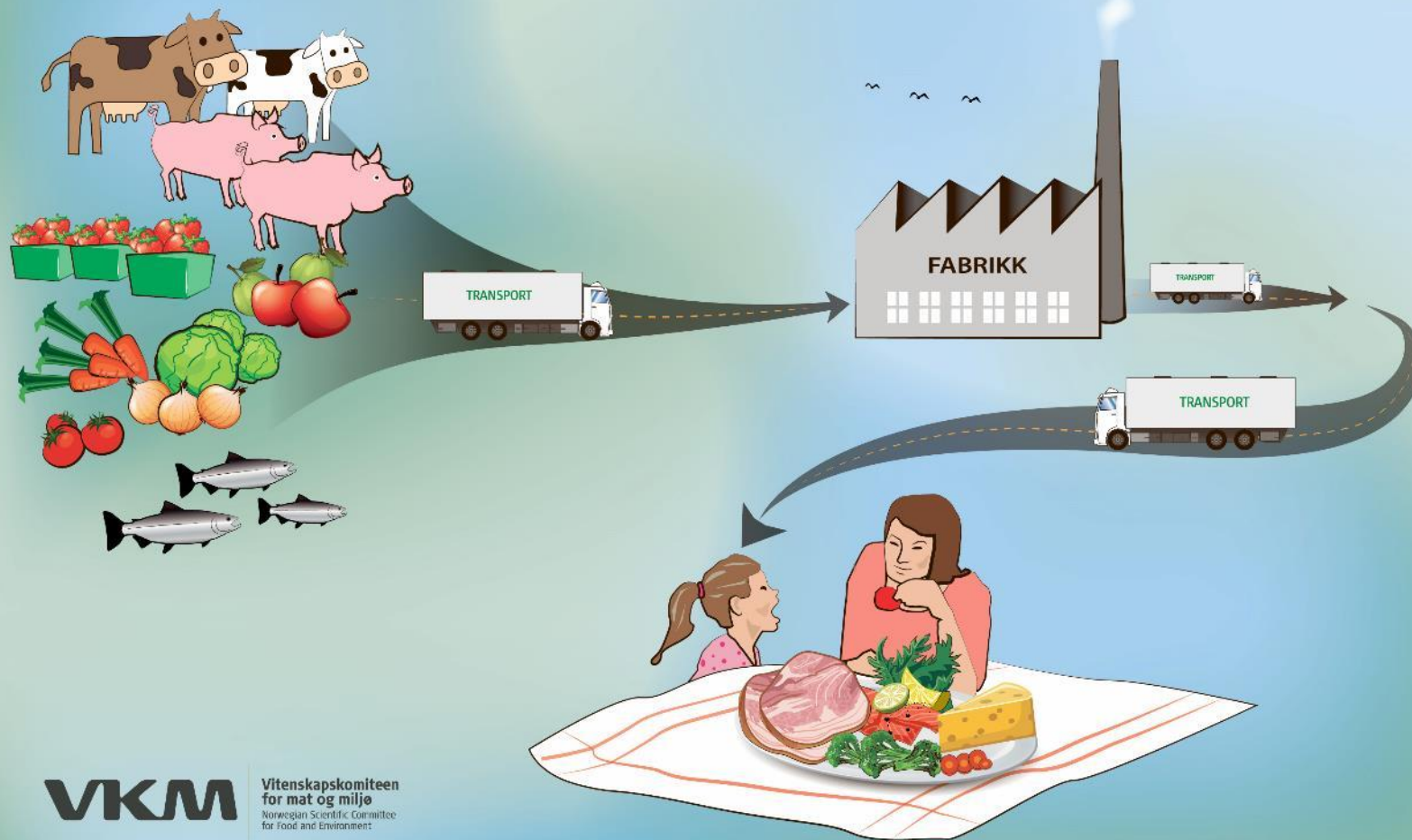
# Effect of risk mitigation measures (1)

- Refrigeration temperature 4°C or colder
- Eat food early during the shelf life period
- Avoid food leftovers that have been in the refrigerator for several days
- Only eat small quantities

# Effect of risk mitigation measures (2)

- Choose products with additives/atmosphere that reduce *L.m.* growth
- Heat the food prior to consumption
- Reduce the storage time for leftovers in the refrigerator
- Treatment with vinegar for 10 minutes (0.5 dl 7% household vinegar per liter of water), with a view to reducing the amount of *L.m.* and other pathogenic bacteria in fresh vegetables

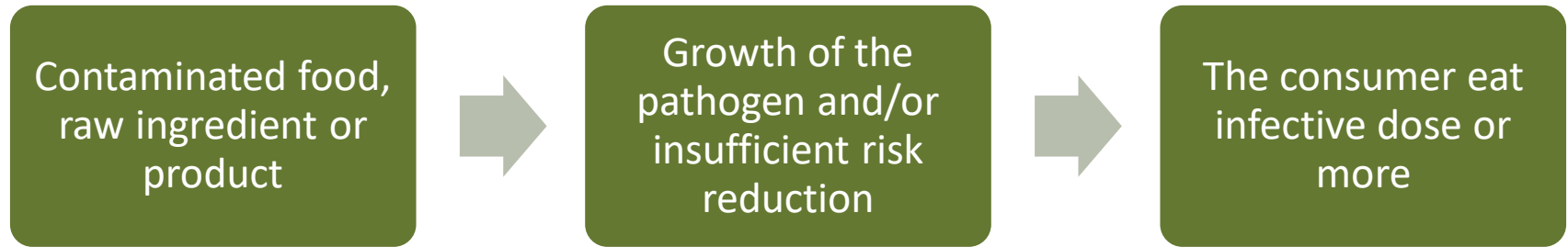
Fra jord og fjord til bord: det er mange muligheter  
for forurensning med *Listeria monocytogenes*.



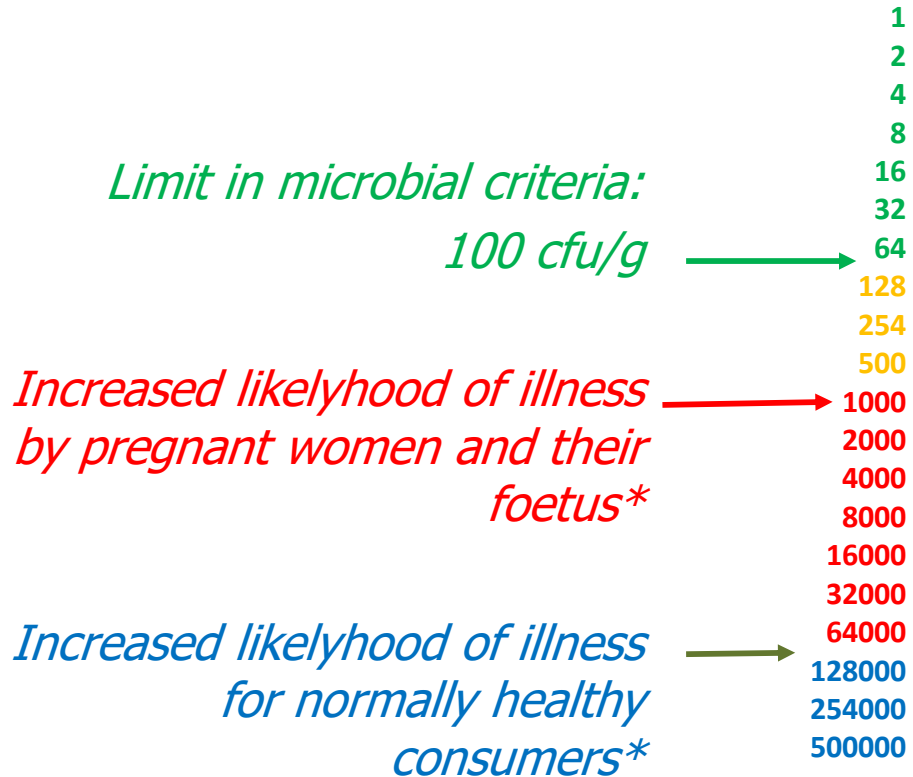
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# Illness occurs when unfortunate conditions come together.



# Growth and infective dose of *Listeria monocytogenes*



## Assumptions

- Initial concentration of *Listeria* immediately after contamination vary from 1 cfu per kg to 10 cfu per gram.
- Exponential growth: each doubling time equally long
- The time for each doubling depends on
  - The food matrix
  - Packing method and preservatives
  - Storage time and temperature

\*Pouillot et al (2016): Provided a portion size of approximately 100 grams



# Methodology (1)

- Prepared farm-to-fork flow charts for each relevant product (lest given by NFSA)
  - Pointed out possible places for contamination
- Assumed initial concentrations
  - 1 Lm per 25 gram/1 Lm per gram/10 Lm per gram
- Did not take prevalence into account
- Collected information about each product in order to define realistic conditions (additives, packing, temperatures) which gave the
  - Lowest/Most likely/Highest growth of Lm

# Methodology (2)

- Applied model (FSSP), literature data or own data to estimated the growth rate of Listeria in the food in case of
  - Sealed package until the consumer open it for the first time
  - Thereafter in opened package, temperature as in consumer refridges
- Foods who supported growth to limit values for increased likelihood of listeriosis for vulnerable and healthy consumers were classified as risk products



Fish and seafood products

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# Fish and seafood products

- Cold-smoked and hot-smoked fish,
- Gravad and cured fish,
- Cooked shrimps with shell (in certain cases),
- processed fish, including cold cuts, packed after cooling
- Minced fish products, heat treated and preserved:
- Shrimps in salt brine and modified atmosphere
- Salt cured herring

Concentrations above limit value for increased probability of listerioses for vulnerable consumers reached under reasonably foreseeable conditions

# Time for a 100 fold increase at selected conditions

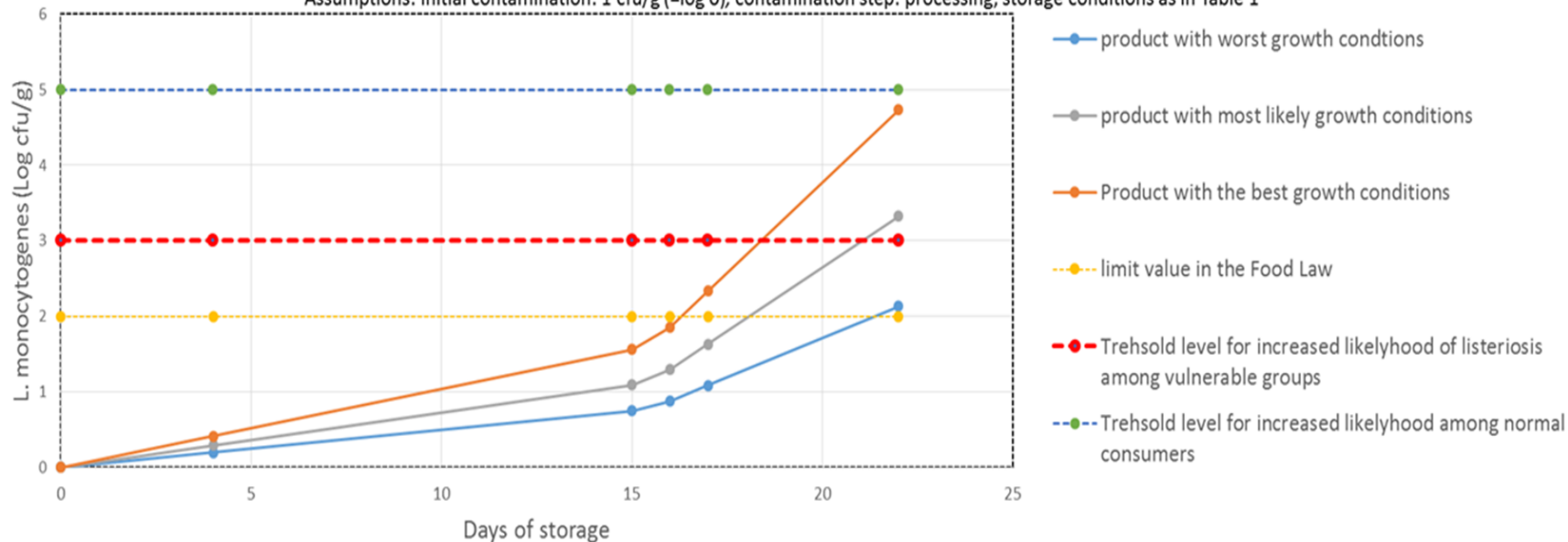
	worst growth conditions	medium growth conditions	best growth conditions
time for 100 doubling (days)			
air 4C	24,2	14,9	10,36
MAP 4C	40	27,5	19,2
air 8C	9,55	5,9	4,17
MAP 8C	16	9,87	6,87

# Storage times at different conditions, processing to consume

<b>Storage time (days) and conditions (packing and temperature)</b>	<b>From food provider to shop</b>	<b>In shop</b>	<b>In refridge by the consumer, unopened package</b>	<b>By consumer, after first serving</b>	<b>By consumer, after second serving</b>
air 4C					
MAP 4C	4	11			
air 8C				1	5
MAP 8C			1		

## Predicted growth of *L. monocytogenes* in smoked salmon from processing to consumer

Assumptions: Initial contamination: 1 cfu/g (=log 0), contamination step: processing, storage conditions as in Table 1



[D:\presentasjonsversjon estimation best-medium-worst case scenario smoked salmon.xlsx](#)



Meat products

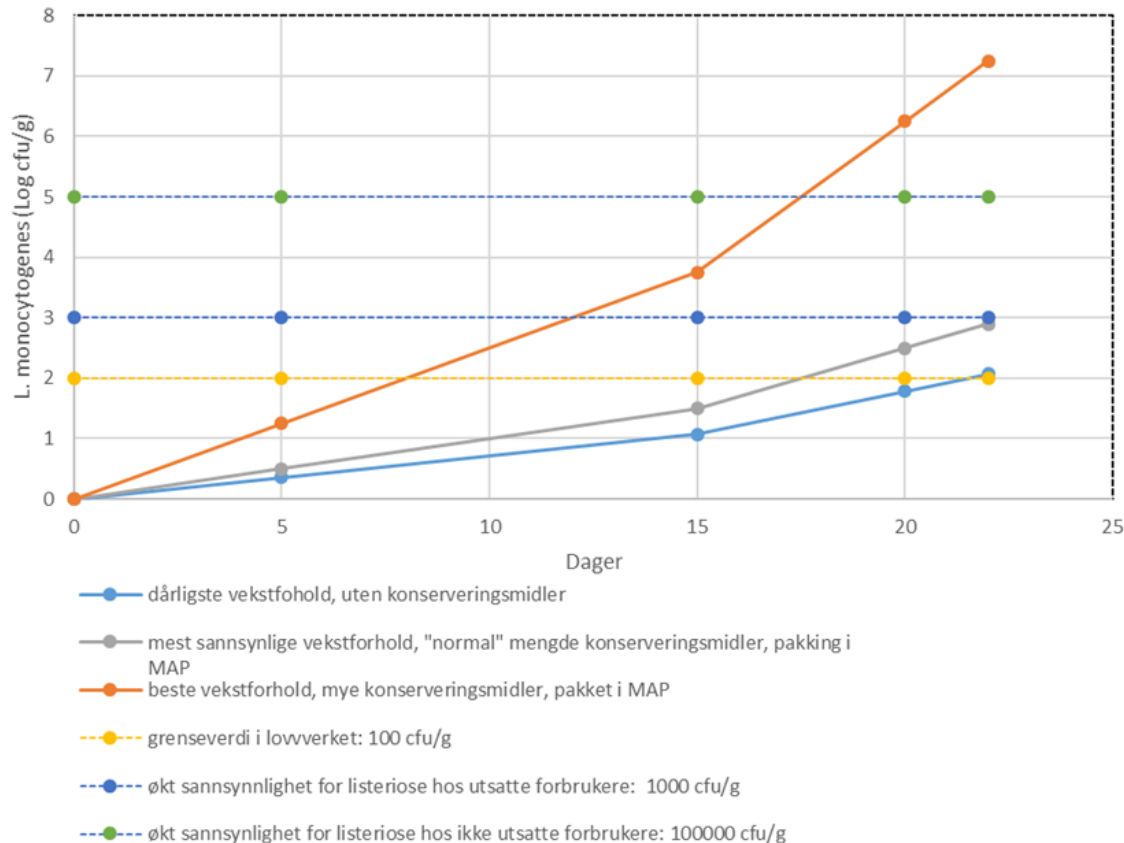


# Risk products of meat – for vulnerable consumers

- Heat-treated, sliced meat products without effective preservatives,
- Raw, cured meat
- raw meat that is smoked without curing or use of preservatives or heat treatment,
- chicken salad meat,
- heat-treated meat products that the manufacturer intends for further heat-treatment prior to consumption but is often not heat treated by the consumer (e.g., patties, meatballs, sausages, etc.).

High growth potential for *Listeria* in many meat products, but the growth can be limited with additives and modified atmosphere.

# Results for heat treated chicken, intended ready-to-use in mixed salads, wraps, etc



Data for growth potential from Skjerdal et al 2014

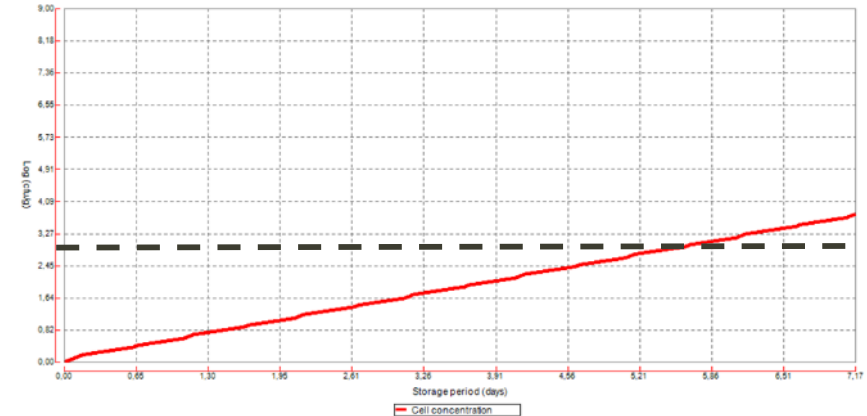


Dairy products

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# Initial concentration of Listeria

- The milk can be contaminated, but Listeria dies in pasteurisation
  - Unpasteurised products may have a high start concentration.
- Listeria can grow in the initial curing period (days)
  - Contamination may occur from equipment, both for pasteurised and unpasteurised products
- May be contaminated by the consumer
  - Cheeses may be stored for a long time by the consumer, and be taken in and out of the fridge every day.



Vekst av *L.m.* ved gitte tid-temperaturforhold i smelteost kontaminert med 1 log cfu/g gjennom 1 uke ved 8 °C.

# Risk dairy products

- All kinds of unpasteurized dairy products (high initial concentration)
- sliced/grated cheese products
- mozzarella for use in salad
- cheese spread
- soft cheeses



Vegetabilier

# Vegetable risk products

- Some cut fresh produce, especially melons
- sprouted seeds; freshly processed mixed products with several ingredients
- home-canned and home-fermented foods for which production has not been carried out properly



# Effect of risk mitigation measures (1)

- Refrigeration temperature 4°C or colder: + + + +
- Eat food early during the shelf life period: + + + +
- Avoid food leftovers that have been in the refrigerator for several days: + + + +
- Only eat small quantities: + / -



# Effect of risk mitigation measures (2)

- Choose products with additives/atmosphere that reduce *L.m.* growth: ++
- Heat the food prior to consumption: ++++
- Reduce the storage time for leftovers in the refrigerator: ++++
- Treatment with vinegar for 10 minutes (0.5 dl 7% household vinegar per liter of water), with a view to reducing the amount of *L.m.* and other pathogenic bacteria in fresh vegetables: -

# Limitations and gaps in the assessment

- Not assessed
  - Prevalence
  - How often abuse temperature occur
  - How often vulnerable consumers eat the foods.
  - Serving portions variations
- Validity of models not assessed for all the foods we have assessed
- Lagphase, stationary phase ignored
- Limited number of scenarios for consumer habits, temperatures and cross contamination

# Thanks for your attention

*Listeria monocytogenes* – vurdering av helseråd  
til gravide og andre utsatte grupper

Further questions: [taran.skjerdal@vetinst.no](mailto:taran.skjerdal@vetinst.no)

Download full report from [vkm.no](https://vkm.no):

<https://vkm.no/download/18.4c35160163e59b88af4eb5b/1529408385432/Listeria%20monocytogenes%20-%20vurdering%20av%20helseråd%20til%20gravide%20og%20andre%20utsatte%20grupper.pdf>