



# Sampling Strategies

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## Consequences of collecting a sample



### Testing

- is expensive
- needs time budget
- can have severe consequences (e.g. product recall)
- can be ineffective (e.g. wrong testing method, low contamination)



## The purpose of collecting a sample

The producer has first to be clear why he collects a sample. Sampling can be done because he wants to

- verify the functioning of his FSMS (see tool 7.1)
- determine the adherence to Good Manufacturing Practices (e.g. cleaning test, see section cleaning and disinfection)
- determine the utility of ingredients for a particular purpose (e.g. raw milk soft cheese, fresh herbs for fresh cheese)
- predict product stability
- establish an early warning systems to warn of the development of food safety hazards

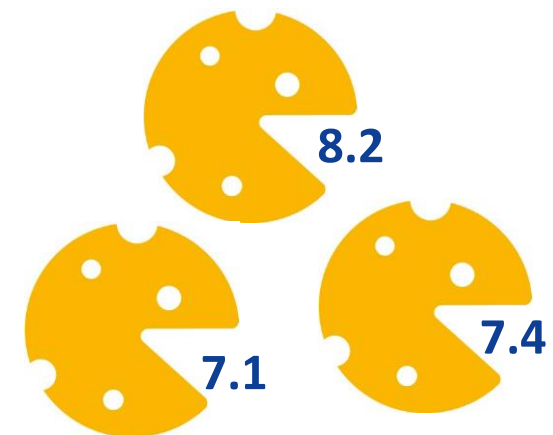
According to his purpose the producers has to find an appropriate sampling method and strategy.



## Important!

### Before sampling, be sure that:

- You can interpret the outcome of the analysis correctly
  - type of sample (product, environment, method, ...)
  - limits (legal requirements, own target value, ...)
- You know what you need to do when there is a positive finding:
  - non conformity management
  - corrective actions
  - preventive actions





## Effectiveness of testing

Numbers of sample units analysed (n)	Proportion of cheeses in lot which contain contaminant							
	50%	20%	10%	5%	2%	1%	0,50%	0,20%
n=1	50%	20%	10%	5%	2%	1%	0%	0%
n=2	75%	36%	19%	10%	4%	2%	0%	0%
n=3	88%	49%	27%	14%	6%	3%	0%	0%
n=4	94%	60%	35%	19%	8%	4%	0%	0%
n=5	97%	68%	41%	23%	10%	5%	0%	0%
n=10	100%	90%	67%	42%	19%	10%	0%	0%
n=20	100%	99%	90%	68%	36%	20%	0%	0%
n=40	100%	100%	100%	93%	64%	40%	0%	0%
n=60	100%	100%	100%	99%	84%	60%	0%	0%
n=80	100%	100%	100%	100%	96%	80%	0%	0%
n=100	100%	100%	100%	100%	100%	100%	0%	0%

Probability of detecting a lot with a specified rate of non-conforming units depending on the numbers of sample units analysed (n), and when no sample unit is permitted to be positive (c = 0).



## Probability of detecting a contaminant

Numbers of sample units analysed (n)	Proportion of cheeses in lot which contain contaminant							
	50%	20%	10%	5%	2%	1%	0,50%	0,20%
n=1	50%	20%	10%	5%	2%	1%	0%	0%
n=2	75%	36%	19%	10%	4%	2%	0%	0%
n=3	88%	49%	27%	14%	6%	3%	0%	0%
n=4	94%	60%	35%	19%	8%	4%	0%	0%
n=5	97%	68%	41%	23%	10%	5%	0%	0%
n=10	100%	90%	67%	42%	19%	10%	0%	0%
n=20	100%	99%	90%	68%	36%	20%	0%	0%
n=40	100%	100%	100%	93%	64%	40%	0%	0%
n=60	100%	100%	100%	99%	84%	60%	0%	0%
n=80	100%	100%	100%	100%	96%	80%	0%	0%
n=100	100%	100%	100%	100%	100%	100%	0%	0%

A sampling plan with 40 sample units has quite a low probability of detecting contamination rates of 1 or 2% as the probabilities of detection are only 40 and 64%, respectively.



## Probability of detecting a contaminant

Numbers of sample units analysed (n)	Proportion of cheeses in lot which contain contaminant							
	50%	20%	10%	5%	2%	1%	0,50%	0,20%
n=1	50%	20%	10%	5%	2%	1%	0%	0%
n=2	75%	36%	19%	10%	4%	2%	0%	0%
n=3	88%	49%	27%	14%	6%	3%	0%	0%
n=4	94%	60%	35%	19%	8%	4%	0%	0%
n=5	97%	68%	41%	23%	10%	5%	0%	0%
n=10	100%	90%	67%	42%	19%	10%	0%	0%
n=20	100%	99%	90%	68%	36%	20%	0%	0%
n=40	100%	100%	100%	93%	64%	40%	0%	0%
n=60	100%	100%	100%	99%	84%	60%	0%	0%
n=80	100%	100%	100%	100%	96%	80%	0%	0%
n=100	100%	100%	100%	100%	100%	100%	0%	0%

### Conclusion:

Assurance of food safety cannot be based on end-product testing.



## Purpose of a good sampling strategy



### Testing should

- be part of a FSMS but not the only measure/action
- be not too expensive
- avoid severe consequences
- be effective





## Sampling strategies – not too expensive

A clever sampling strategy can reduce the number of samples

Producers have the following options to reduce the number of samples:

- **Increase the significance level of the findings**  
*Focus on testing methods covering more than one batch (pooling samples, bottleneck management) but not by increasing the sample size*
- **Pooling samples**  
Can be used to have one sample with 125g instead of 5 samples of 25g (Useful if n=5 is mandatory). The legal requirement for food safety criteria is reached if it is not detected in 125g. If it is detected you have to return to the regulation 2073/2005 with n=5.
- **Definition of what is a batch (daily, weekly, monthly)**  
Legislation doesn't define a daily production as a batch. The producer can decide to expand the batch on more than one production



## Sampling strategies – be effective

Establish an early warning systems to warn of the development of food safety hazards

- **Take samples where higher level of contamination can be expected**  
To achieve a reasonable certainty it can make sense to favour testing during the process or environmental testing. End-product testing is an ineffective way of detecting low level contamination. (e.g. when rind washing, analysis of smear water for presence of L.M. can be more effective at detecting a sporadic, low-level of contamination than end-product testing)
- **Bottleneck Management**  
Each hazard has his most important sources of contamination. It can be more effective to develop and put in place target-oriented process monitoring steps than unspecific end-product-testing (e.g. analysis of stool samples of the employees for presence of Salmonella can be more effective at detecting a sporadic contamination than end-product testing).



## Effective and not too expensive self monitoring measures

Hazard	Main source	Self monitoring measure	End-product testing
<i>Listeria monocytogenes</i>	Red smear	Analysis of smear water after rind washing of the whole stock	Only if a new product is produced or if there was a loss of control
	Raw milk	Milk or swabs from milk receiver or milk pump after milking	
<i>Salmonella</i>	Staff	Stool samples of the employees are tested	Only if a new product is produced or if there was a loss of control
<i>Staphylococcus aureus</i>	Raw milk	Bulk milk somatic cell count  (In case of increased somatic cell count or <b>frequent high levels in milk products</b> check for <i>staphylococcus aureus</i> in bulk milk)	yes
	Staff	Training of milking staff	
<i>Escherichia coli</i>	Cleaning	Surface sampling (cheese vat, equipment, tubes, etc.)	yes
	Raw milk	Milk is tested for E. coli	