Presentation of the IT tool of STARTEC project

Taran Skjerdal
on behalf of the STARTEC team

The research leading to these results has received funding from the European Union's Seventh Framework Programme for research, technological development and demonstration under **grant agreement n**°289262. Coordinator: Norwegian Veterinary Institute, Oslo, Norway.

Decision support tools for food producers to ensure safe, tasty and nutritious ready-to-eat products for healthy and vulnerable consumers

KBBE.2011.2.4-01: Safety and quality of ready-to-eat foods

Advisory board: Dr Annie Beaufort, ANSES, Dr Knut Framstad, Nortura, Dr Petra Luber, BfR,
External expert: Dr Matthias Filter, Bfr

The research leading to these results has received funding from the European Union's Seventh Framework Programme for research, technological development and demonstration under **grant agreement n**°289262. Coordinator: Norwegian Veterinary Institute, Oslo, Norway.

Project background and idea

- **Ready-to-eat and convenient products are very common**.
- **Some consumers have no other choice**, even though some of them like to cook.
- **Food producing industry must make a lot of choices**, including trade-offs between quality, safety and costs.
  - Difficult and complicated decisions, particularly for combined RTE and convenient products
  - Decisions have to be done quickly
  - Large consequenses of wrong desisions, both for company and consumers

The research leading to these results has received funding from the European Union's Seventh Framework Programme for research, technological development and demonstration under **grant agreement n**°289262. Coordinator: Norwegian Veterinary Institute, Oslo, Norway.

Objectives of STARTEC (summary)

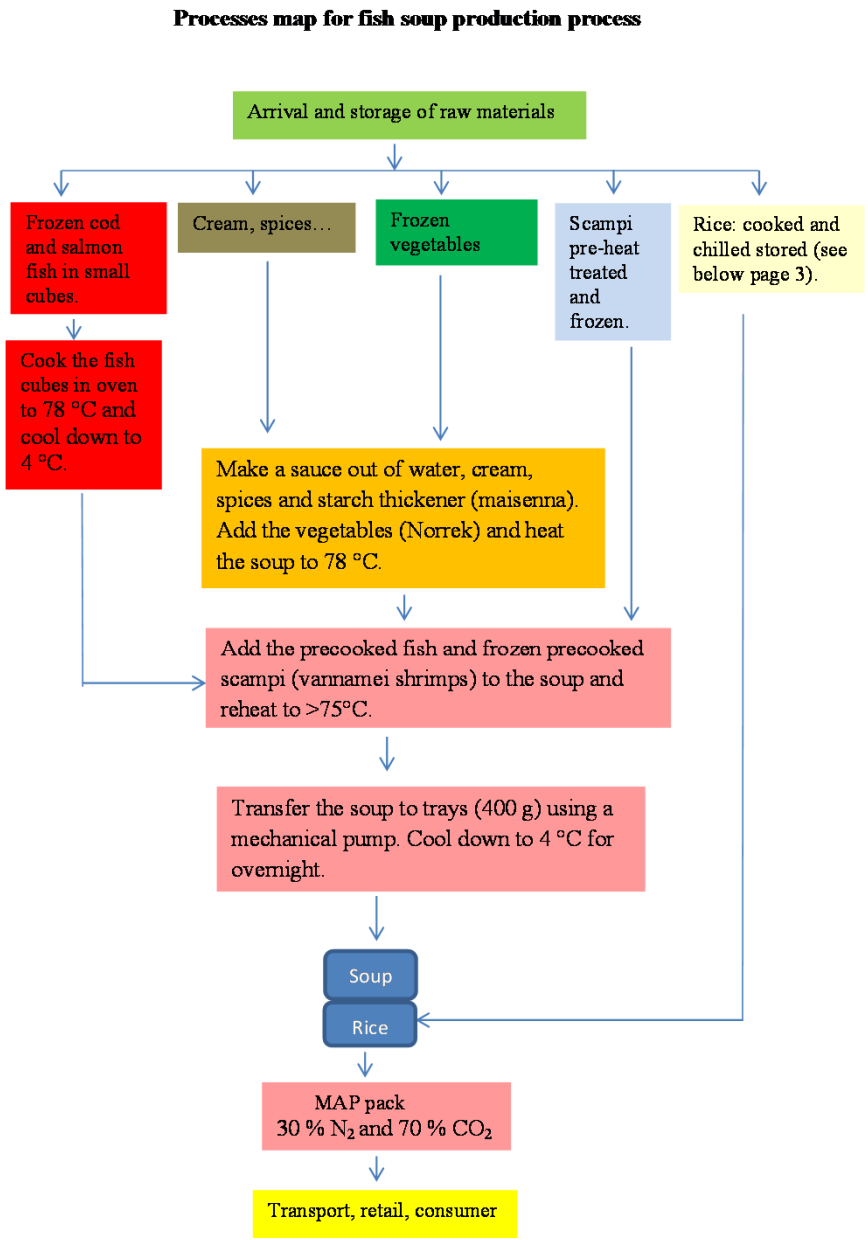
- Develop decision support tools to make relevant trade-offs between food safety, food quality and costs without compromising consumer health.
- Develop processes and strategies for «extra safety level», «extra quality level» and «extra nutrition level» situations

The research leading to these results has received funding from the European Union's Seventh Framework Programme for research, technological development and demonstration under **grant agreement n**°289262. Coordinator: Norwegian Veterinary Institute, Oslo, Norway.

Process maps may be very complex

- *Logistics*
- *Material flow*
- *cross contaminations*

- *New information: learned how industry dealt with the complexity and*
- *when decision support is needed*



The research leading to these results has received funding from the European Union's Seventh Framework Programme for research, technological development and demonstration under **grant agreement n°**289262. Coordinator: Norwegian Veterinary Institute, Oslo, Norway.

Main output: decision support tool

Based on an overview of the *real options* the industry can use to manage the complexity, food safety, quality, nutrition and cost challenges, it is possible to

- Categorise in good, marginal, poor rather than very detailed results
- Make multidiciplinary tradeoffs based on research based models developed within STARTEC
- Give examples of corrective actions based on research in STARTEC

We have a prototype with high potential for further development

The research leading to these results has received funding from the European Union's Seventh Framework Programme for research, technological development and demonstration under **grant agreement n**°289262. Coordinator: Norwegian Veterinary Institute, Oslo, Norway.

Tool developed for pasta salad

- Cooked pasta, meat, vegetables, two styles
- Growth of *L. monocytogenes*
  - Primary model: Barany no-lag
  - Secondary model: Rosso, gamma concept

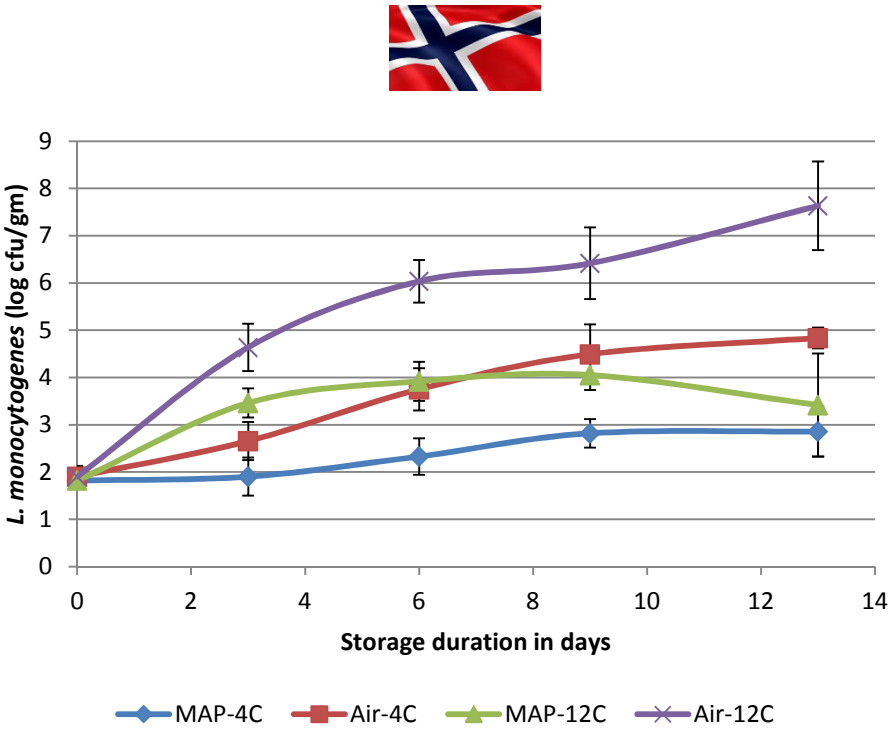
In addition:

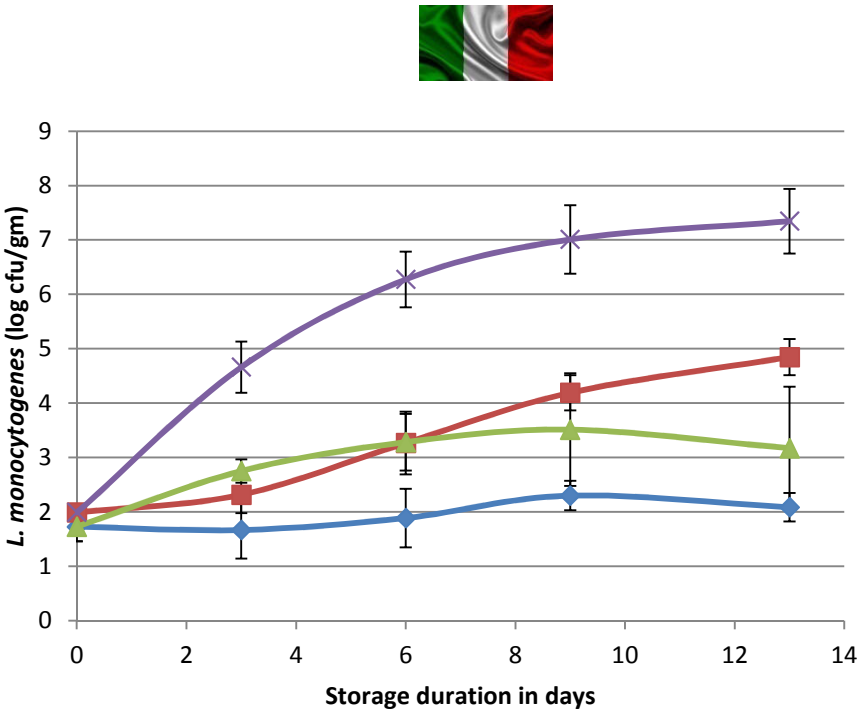
- Guidelines built on growth potentials

Multidisciplinary approach partly implemented, can be further developed

The research leading to these results has received funding from the European Union's Seventh Framework Programme for research, technological development and demonstration under **grant agreement n**°289262. Coordinator: Norwegian Veterinary Institute, Oslo, Norway.

Growth of *L. monocytogenes* in two types of pasta salads under different packaging and storage scenarios





STARTEC

Food producers

Decision Support Tool

Welcome,tskjerdal (1.10.0)
Change password / Log out

Salad ✔
Back ›
‹ Pasta salad Provance style ✔
‹ Spelt Salad ✔
‹ Pasta Salad, Norwegian ✔
‹ Potato Salad ✔
‹ Pasta Salad, Italian ✔

Pasta Salad, Italian — Italian 4C

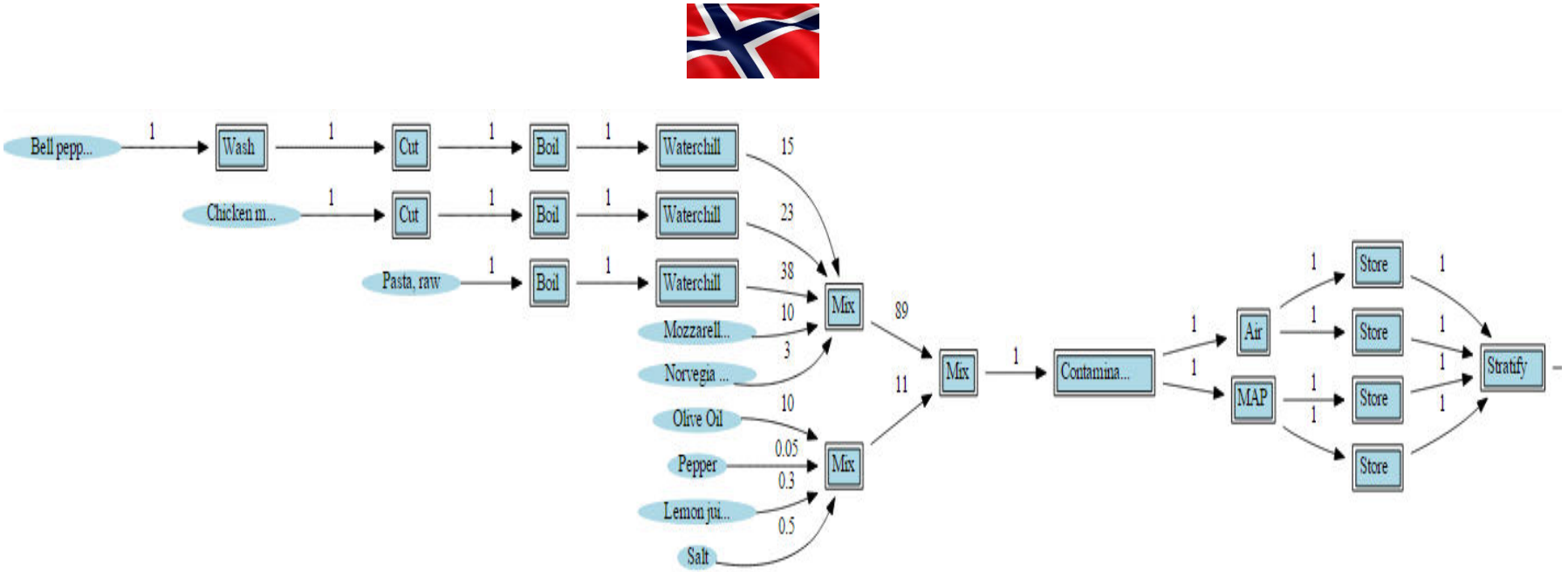
Product Image

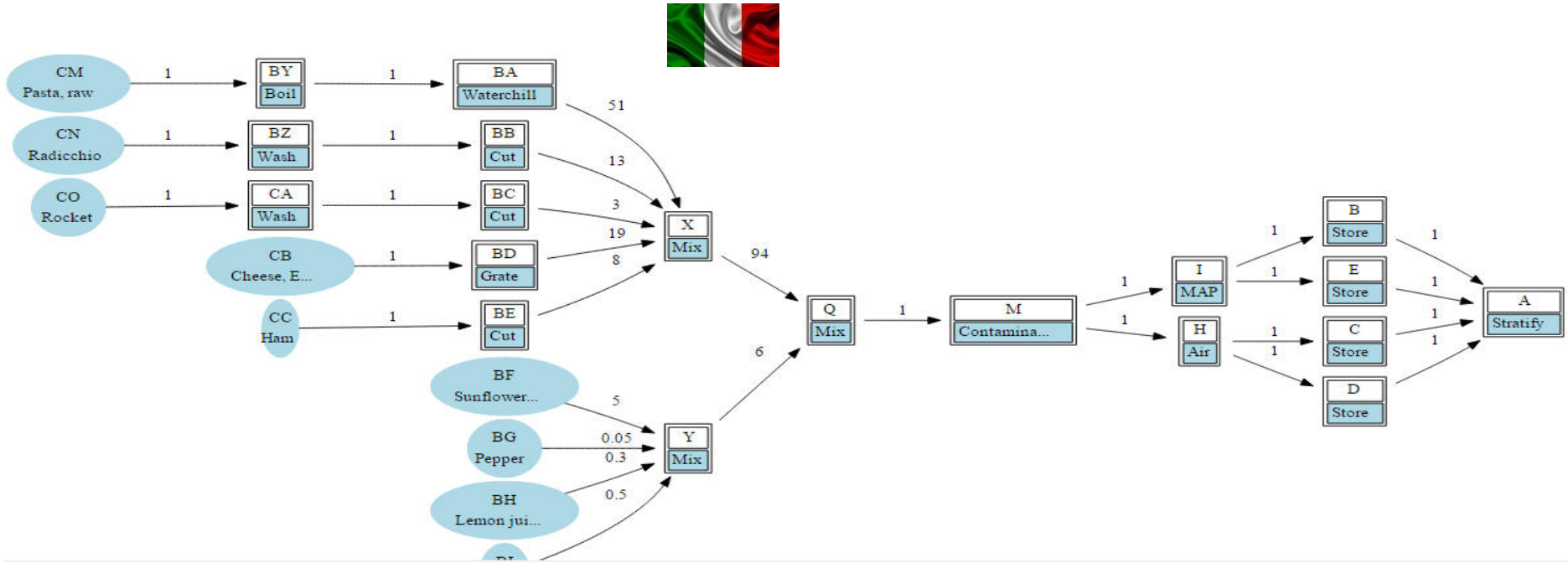
Nutrition Facts

Product Description

Shelf Life: 35 days
Handling & Storage: Shipping Temperature: 4-6 °C
Storage Temperature: 4-6 °C
Once opened, product should be used within 4 days.

Product flowchart


Bell pepp...
Wash
Cut
Boil
Waterchill
Chicken m...
Pasta, raw
Mozzarell...
Norvegia ...
Olive Oil
Pepper
Lemon jui...
Salt
Mix
Contamina...
Air
MAP
Store
Stratify

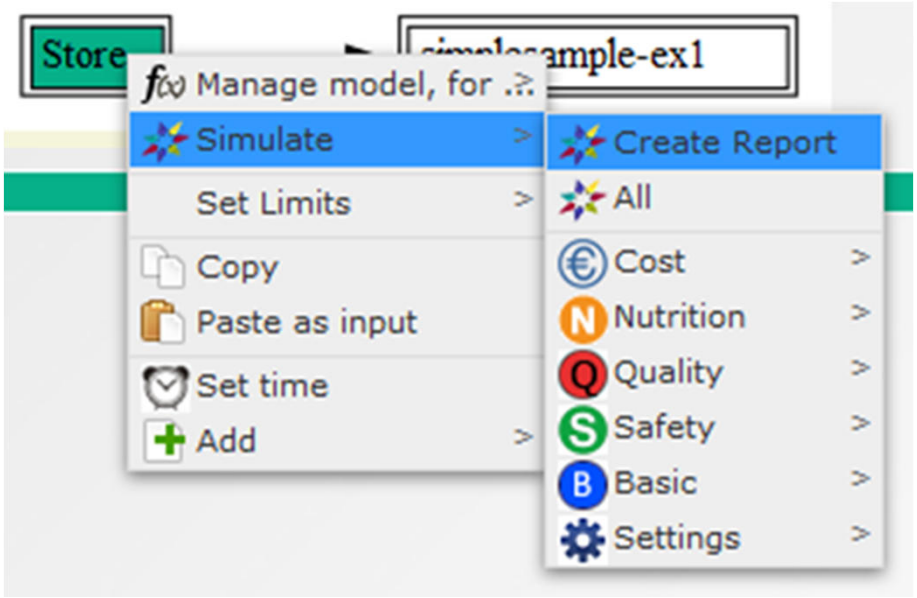

CM
Pasta, raw
CN
Radicchio
CO
Rocket
CB
Cheese, E...
CC
Ham
BF
Sunflower...
BG
Pepper
BH
Lemon jui...
BY
Boil
BZ
Wash
CA
Wash
BB
Cut
BC
Cut
BD
Grate
BE
Cut
BA
Waterchill
X
Mix
Y
Mix
Q
Mix
M
Contamina...
I
MAP
H
Air
B
Store
E
Store
C
Store
D
Store
A
Stratify

Data, models and categories can be inserted bu the user

	name	formula	Author
1	Constant	OUTPUT = c	Unknown
2	baranyi_no_lag	m=1 ; b = log(1+(e**(m*mu_max*time)-1)/(e**(m*(x_max-INPUT)))) ; OUTPUT = INPUT + mu_max*time -1/m*b	Silvia Vitali
3	gamma_T_pH	num = (T-Tmax)*((T-Tmin)**2) ; den = (Topt-Tmin)*((Topt-Tmin)*(T-Topt)-(Topt-Tmax)*(Topt+Tmin-2*T)) ; gamma_T = num/den ; num_pH = (pH-pH_min)*(pH-pH_max) ; den_pH = (pH-pH_min)*(pH-pH_max)-(pH-pH_opt)**2 ; gamma_pH = num_pH/den_pH ; OUTPUT = mu_opt*gamma_T*gamma_pH	Silvia Vitali
4	gamma_0	num=(X-X_max)*((X-X_min)**n) ; den = ((X_opt-X_min)**(n-1))*((X_opt-X_min)*(X-X_opt)-(X_opt-X_max)*((n-1)*X_opt+X_min-n*X)) ; gamma = num/den ; OUTPUT = gamma * (X>X_min) * (X< X_max)	Silvia Vitali
5	gamma_m	OUTPUT = mu_opt*gamma_T*gamma_pH	Silvia Vitali
6	linear	OUTPUT = INPUT +c*time	Silvia Vitali
7	LAB-LM stop	OUTPUT = mu*(LAB < limit)	Taran Skjerdal
8	lower_better	OUTPUT = 'GREEN' if (X	Andras Gefferth
9	Energy (kcal)	OUTPUT=4*P+4*C+9*F	Gonzalo Delgado
10	Quality Index - Pasta Salad, I - noMAP 12C	OUTPUT=-0.0002*time0**2-0.0137*time0+5	Konstantia Georgouli
11	Quality Index - Pasta Salad, I - MAP 12C	OUTPUT=-6*10**-5*time0**2-0.0013*time0+5	Konstantia Georgouli
12	quadratic	OUTPUT = maximum(1,A* time0**2 + B * time0 + C)	Andras Gefferth
13	higher_better	OUTPUT = 'GREEN' if (X>GREEN_LIMIT) else 'YELLOW' if (X>YELLOW_LIMIT) else 'RED'	Andras Gefferth
14	gamma_X	OUTPUT = mu_opt * gamma_T * gamma_pH * gamma_LAB * gamma_CO2	Andras Gefferth
15	gamma_LAB	OUTPUT = maximum(0,(1-LAB/LAB_max))	Andras Gefferth
16	Product	OUTPUT = A*B	Andras Gefferth
17	Product2	OUTPUT = INPUT * c	Andras Gefferth
18	Store	OUTPUT = cost_DAYstore * time	Marco Boeri
19	fixed increase	OUTPUT = INPUT0 + c	Marco Boeri
20	TimeTemp	OUTPUT = Temp1 if time0 < t1 else Temp2 if time0 < t2 else Temp3 if time0 < t3 else Temp4	Andras Gefferth
21	Sine	OUTPUT = c1 + c2 * sin(time0*2*pi*freq)	Andras Gefferth
22	sum_of_5	OUTPUT = A+B+C+D+E	Marco Boeri
23	Vit C Retention	k=18533.907*e**(-3221/(273.15+T)) ; OUTPUT=100-k*time0	Gonzalo Delgado

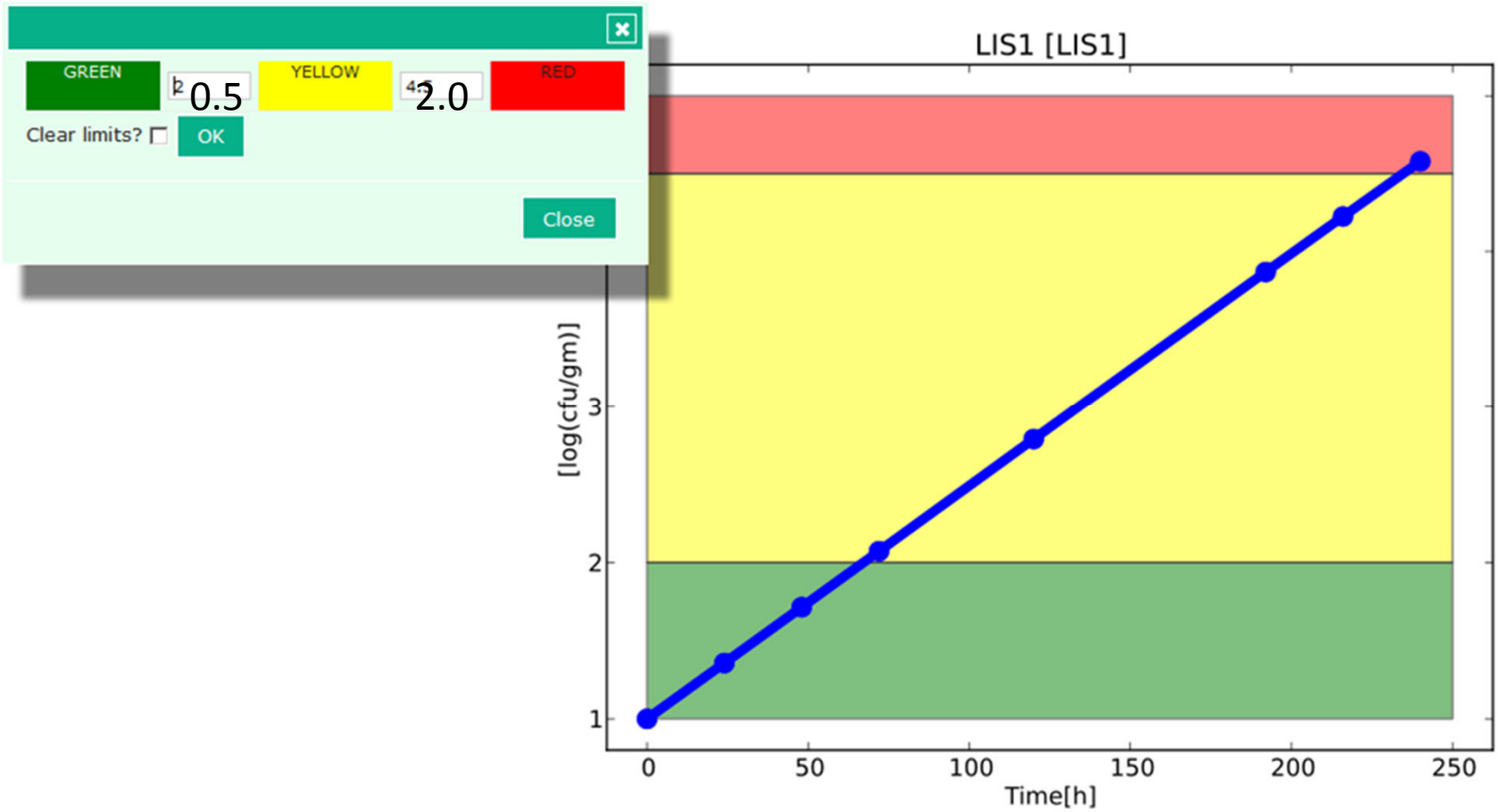
The research leading to these results has received funding from the European Union's Seventh Framework Programme for research, technological development and demonstration under **grant agreement n**°289262. Coordinator: Norwegian Veterinary Institute, Oslo, Norway.

Customised models and support information

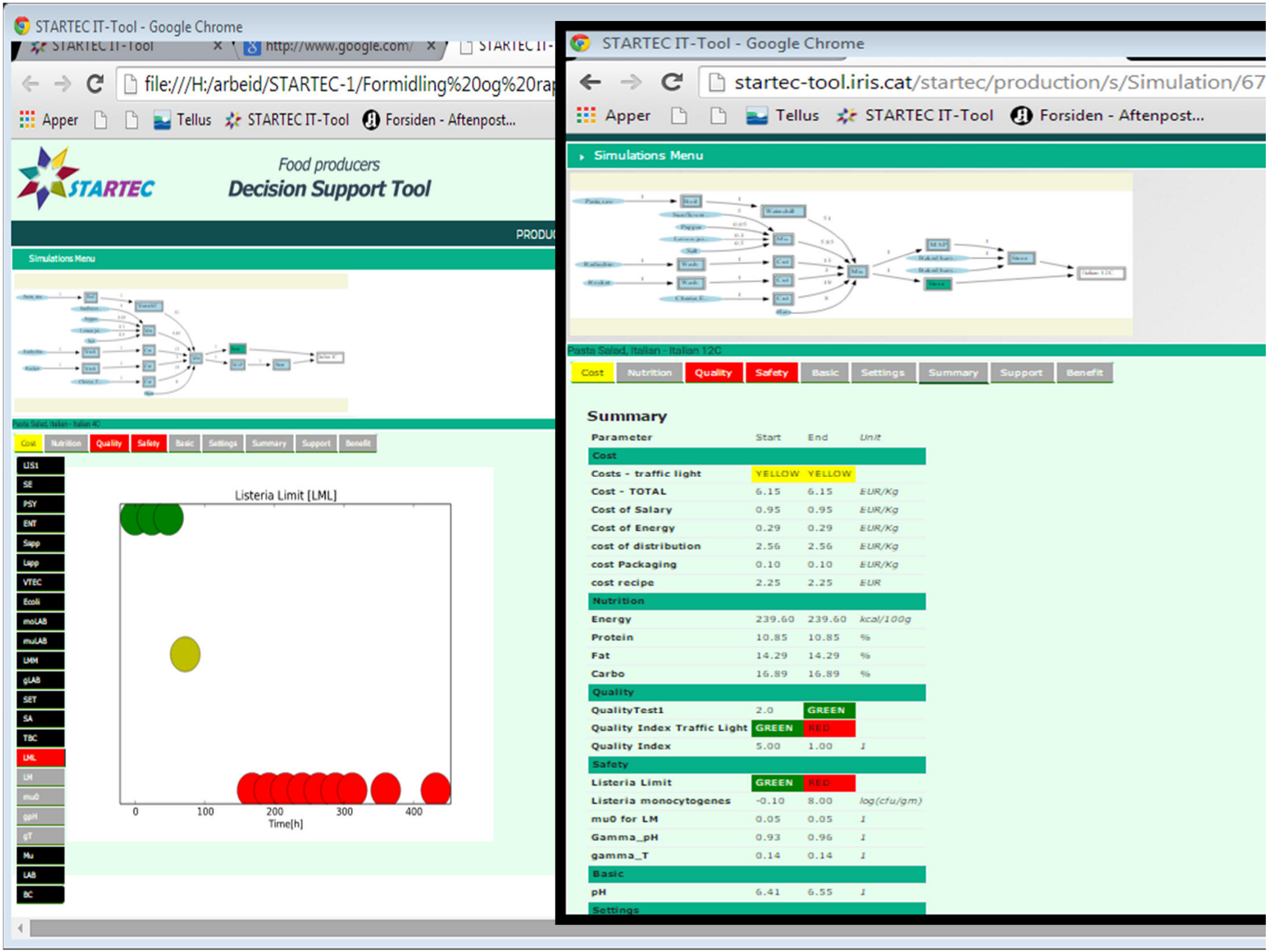


The research leading to these results has received funding from the European Union's Seventh Framework Programme for research, technological development and demonstration under **grant agreement n**°289262. Coordinator: Norwegian Veterinary Institute, Oslo, Norway.

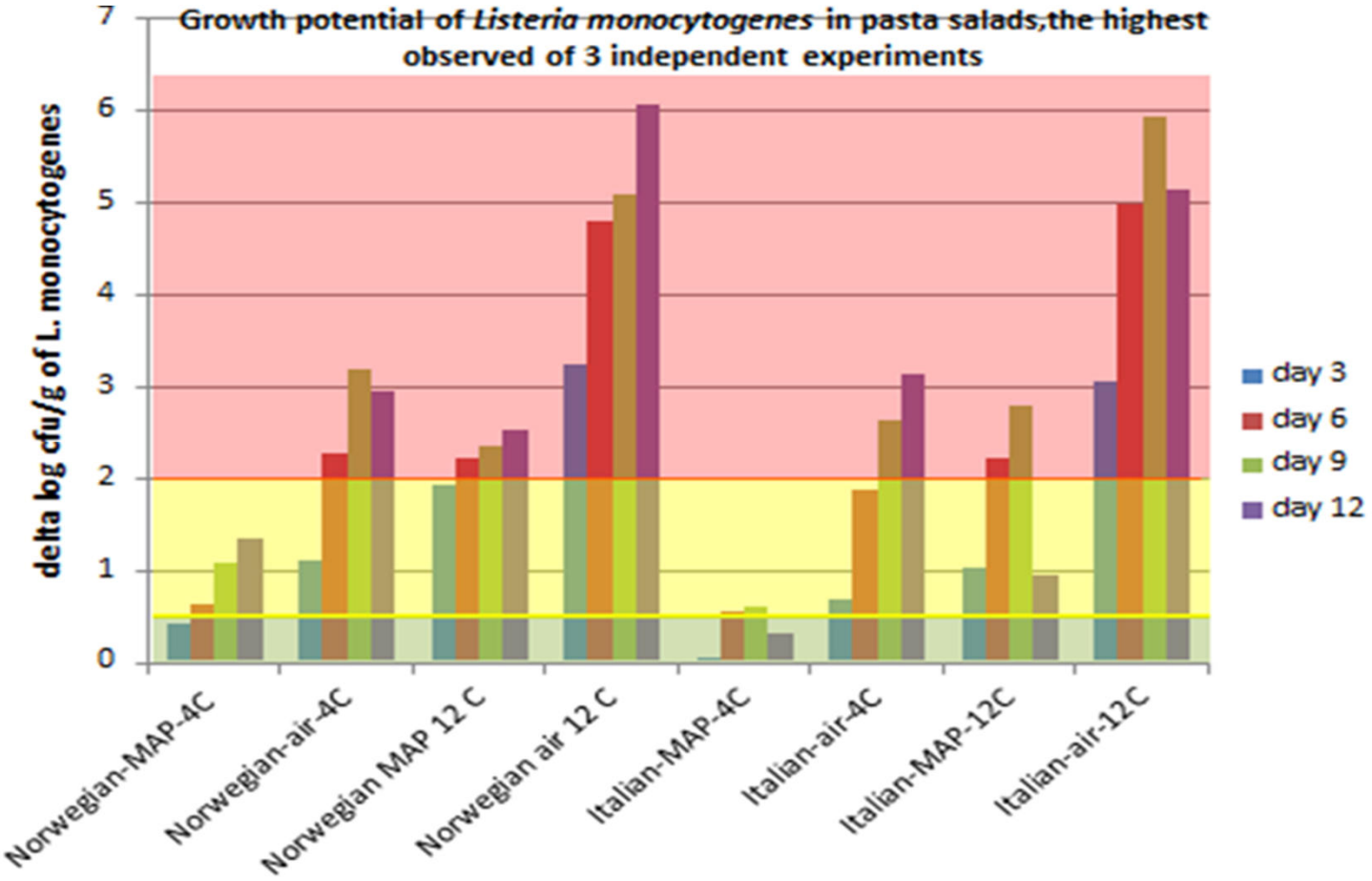
Simulation outputs



The research leading to these results has received funding from the European Union's Seventh Framework Programme for research, technological development and demonstration under **grant agreement n**°289262. Coordinator: Norwegian Veterinary Institute, Oslo, Norway.


STARTEC IT-Tool - Google Chrome
file:///H:/arbeid/STARTEC-1/Formidling%20og%20ra
Apper
Tellus
STARTEC IT-Tool
Forsiden - Aftenpost...
Food producers
Decision Support Tool
Simulations Menu
Cost
Nutrition
Quality
Safety
Basic
Settings
Summary
Support
Benefit
US1
SE
PSY
ENT
Sspp
Lspp
VTEC
Ecoli
moLAB
muLAB
LMM
gLAB
SET
SA
TBC
LML
LM
mu0
gpH
qT
Mu
LAB
BC
Listeria Limit [LML]
0
100
200
300
400
Time[h]
STARTEC IT-Tool - Google Chrome
startec-tool.iris.cat/startec/production/s/Simulation/67
Apper
Tellus
STARTEC IT-Tool
Forsiden - Aftenpost...
Simulations Menu
Pasta Salad, Italian - Italian 12C
Cost
Nutrition
Quality
Safety
Basic
Settings
Summary
Support
Benefit
Summary
Parameter
Start
End
Unit
Cost
Costs - traffic light
YELLOW
YELLOW
Cost - TOTAL
6.15
6.15
EUR/Kg
Cost of Salary
0.95
0.95
EUR/Kg
Cost of Energy
0.29
0.29
EUR/Kg
cost of distribution
2.56
2.56
EUR/Kg
cost Packaging
0.10
0.10
EUR/Kg
cost recipe
2.25
2.25
EUR
Nutrition
Energy
239.60
239.60
kcal/100g
Protein
10.85
10.85
%
Fat
14.29
14.29
%
Carbo
16.89
16.89
%
Quality
QualityTest1
2.0
GREEN
Quality Index Traffic Light
GREEN
RED
Quality Index
5.00
1.00
1
Safety
Listeria Limit
GREEN
RED
Listeria monocytogenes
-0.10
8.00
log(cfu/gm)
mu0 for LM
0.05
0.05
1
Gamma_pH
0.93
0.96
1
gamma_T
0.14
0.14
1
Basic
pH
6.41
6.55
1
Settings

Simpler approach based on growth potentials included in the guideline documents



The research leading to these results has received funding from the European Union's Seventh Framework Programme for research, technological development and demonstration under **grant agreement n**°289262. Coordinator: Norwegian Veterinary Institute, Oslo, Norway.

Maximum initial limit values to avoid 100 cfu/g during shelf life

Maximum initial *L. monocytogenes* level (cfu/g) to avoid levels above 100 cfu/g on the last day of shelf life				
salad formulation, packing and storage condition	shelf life on label			
	3 days	6 days	9 days	12 days
Norwegian-MAP-4C	37	23	8	5
Norwegian-air-4C	8	0,5	0,06	
Norwegian MAP 12 C	1	0,6	0,4	0,3
Norwegian air 12 C	0,06	absence	absence	absence
Italian-MAP-4C	85	28	24	
Italian-air-4C	20	1	0,2	0,07
Italian-MAP-12C	9	0,6	0,2	
Italian-air-12C	0,085	absence	absence	absence

The research leading to these results has received funding from the European Union's Seventh Framework Programme for research, technological development and demonstration under **grant agreement n**°289262. Coordinator: Norwegian Veterinary Institute, Oslo, Norway.

Possible corrective actions to improve the food safety (I)

- Small changes:
  - Shorter shelf life, lower storage temperature, pack in modified atmosphere
- Change processes and formulations:
  - Additives like lactate and acetate
  - Additional preservation techniques, High pressure treatment and lactic acid bacteria. Some dairy products can be used instead of protective cultures

The research leading to these results has received funding from the European Union's Seventh Framework Programme for research, technological development and demonstration under **grant agreement n**°289262. Coordinator: Norwegian Veterinary Institute, Oslo, Norway.

Possible corrective actions to improve the food safety (II)

- Internal control system: Sample where it is likely to find *Listeria*.
- Recalls may not be needed if the growth potential under reasonable foreseeable conditions is low and the initial *L. monocytogenes* level below the one in the performance objective

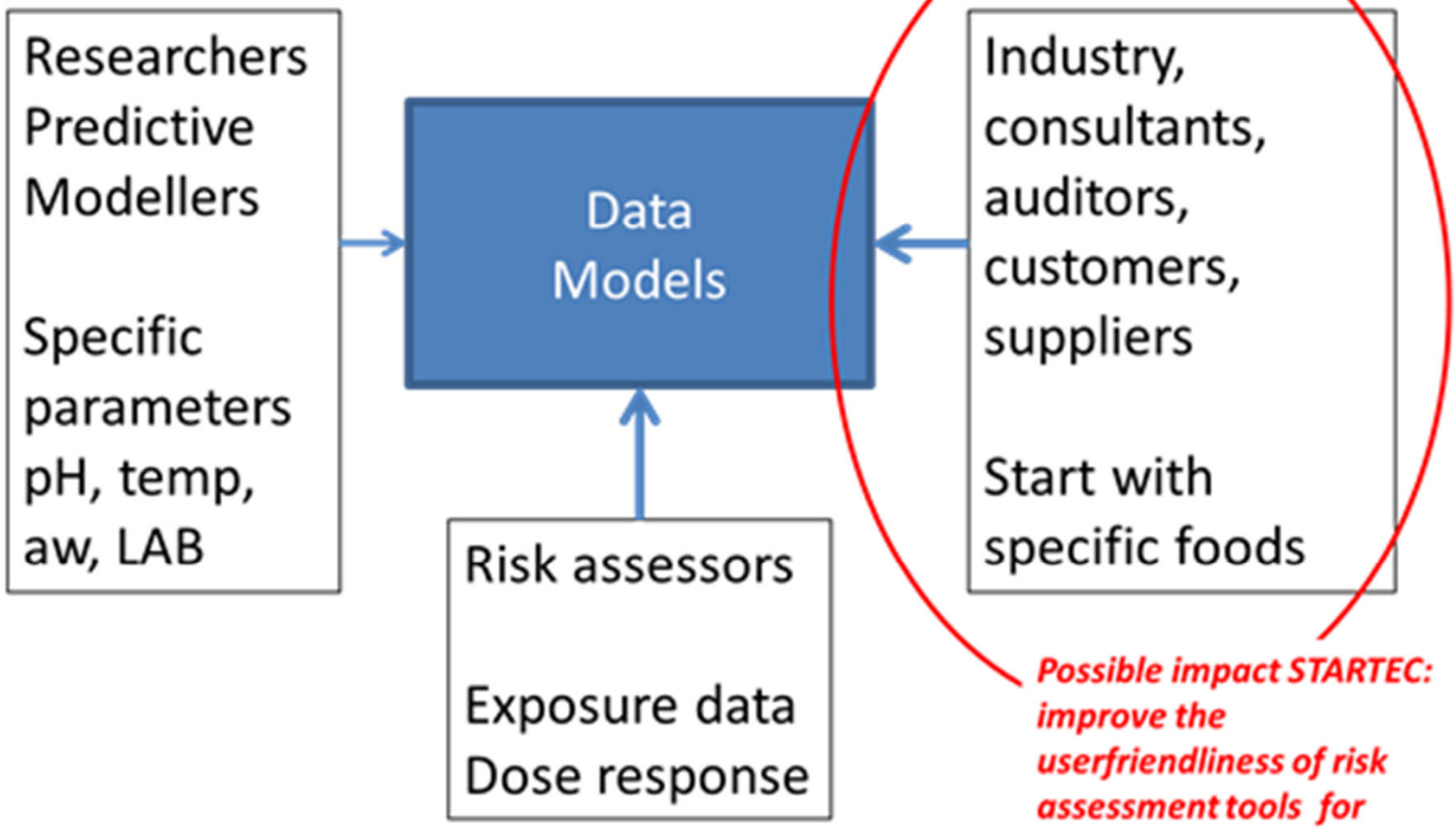
The research leading to these results has received funding from the European Union's Seventh Framework Programme for research, technological development and demonstration under **grant agreement n**°289262. Coordinator: Norwegian Veterinary Institute, Oslo, Norway.

Possible ways forward to obtain a really useful tool

The research leading to these results has received funding from the European Union's Seventh Framework Programme for research, technological development and demonstration under **grant agreement n**°289262. Coordinator: Norwegian Veterinary Institute, Oslo, Norway.

Relevance of STARTEC tool (I)

User interface



The research leading to these results has received funding from the European Union's Seven... ...ological development and demonstration under **grant agreement n°**289262. Coordinator: Norwegian Veterinary Institute, Oslo, Norway.

Relevance of the STARTEC tool (II)

Multidiciplinarity – specific functionalities

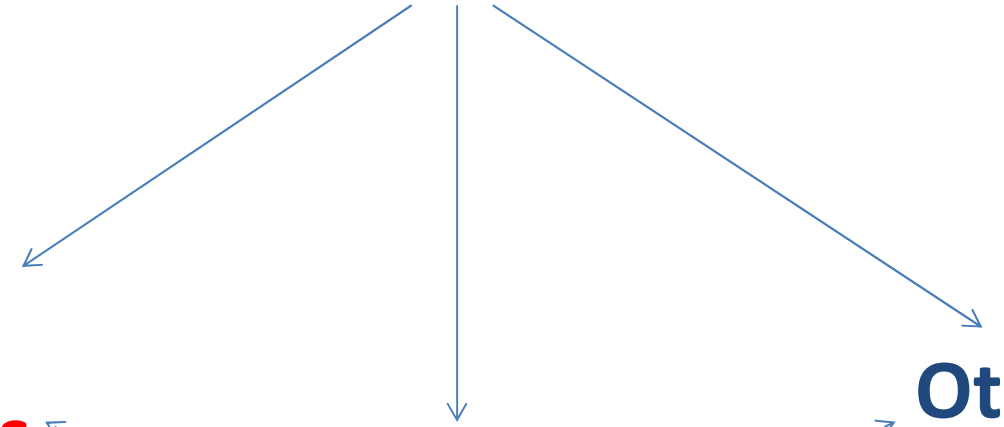
Customised flow charts
Conditions
Specific models
…
…

Tradeoffs for specific foods and scenarios based on categorisation, trendanalyses etc

The research leading to these results has received funding from the European Union's Seventh Framework Programme for research, technological development and demonstration under **grant agreement n**°289262. Coordinator: Norwegian Veterinary Institute, Oslo, Norway.

More ways forward

Prototype
STARTEC Tool and guidelines



Improved STARTEC tool and guidelines

Functions and models

Other tools

The research leading to these results has received funding from the European Union's Seventh Framework Programme for research, technological development and demonstration under **grant agreement n**°289262. Coordinator: Norwegian Veterinary Institute, Oslo, Norway.

In NRL/EURL challenge study context

Question from industry: How different must a sausage be from another before a new challenge test is needed?

1. Data for single and mixed products can be collected in the database in the STARTEC tool, and new data be compared
2. Two suitable test products found in STARTEC: secondary models valid in one, but not the other. Sausages are different if they overrule the known growth pattern in mixed products

Good ideas or not?

The research leading to these results has received funding from the European Union's Seventh Framework Programme for research, technological development and demonstration under **grant agreement n**°289262. Coordinator: Norwegian Veterinary Institute, Oslo, Norway.

Our web site: www.STARTEC-net.info

The tool: www.startec-tool.iris.cat

If you want to try it, ask for a password

taran.skjerdal@vetinst.no

The research leading to these results has received funding from the European Union's Seventh Framework Programme for research, technological development and demonstration under **grant agreement n**°289262. Coordinator: Norwegian Veterinary Institute, Oslo, Norway.