PLEASURE

# The secrets behind "reduced-in" pizza

PLEASURE

novel processing approaches for the development of food products low in fat, salt and sugar reduced

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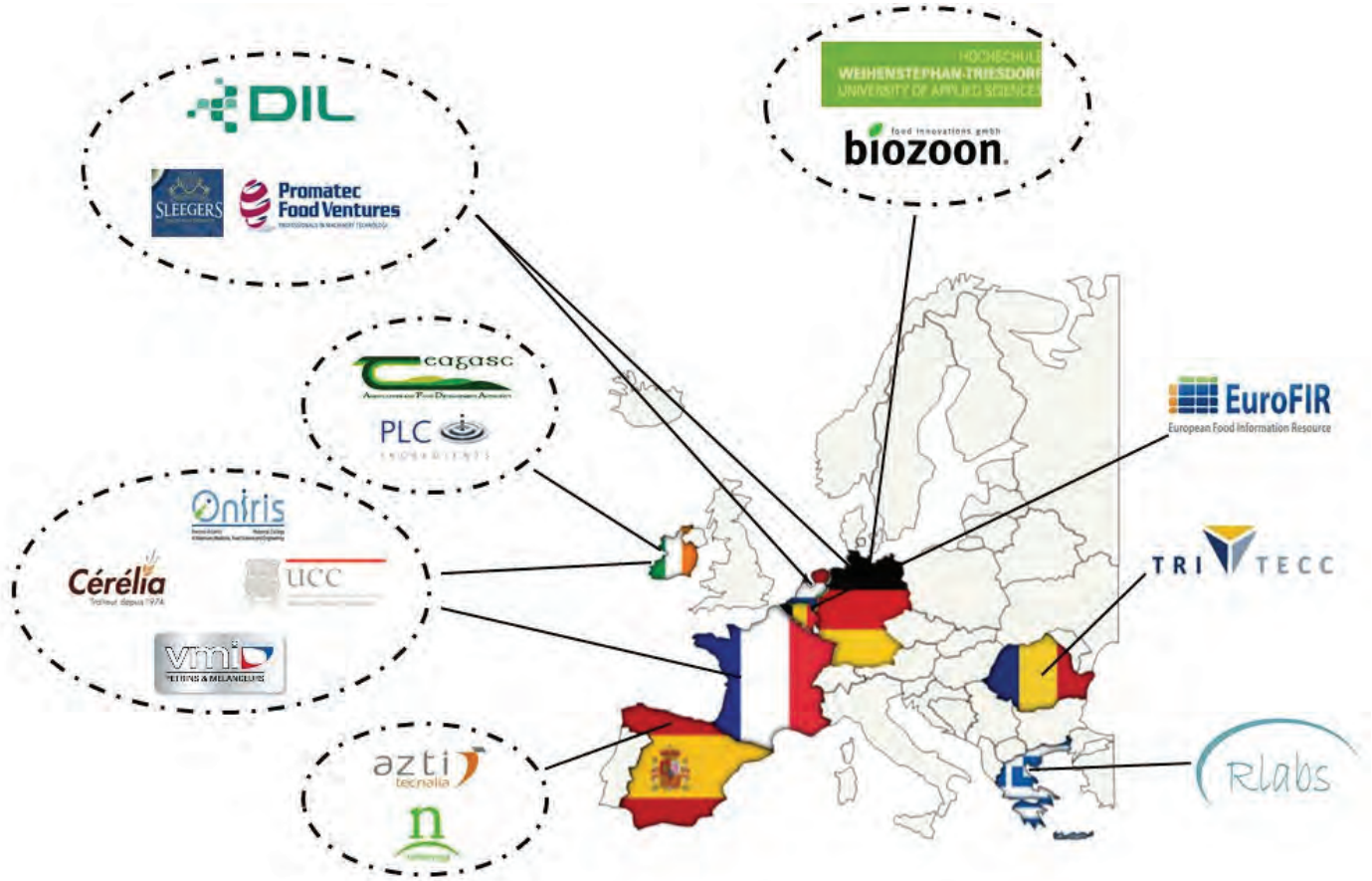
*Prof Carole PROST*
*ONIRIS – GEPEA France*

CommNet
COMMUNICATING THE BIOECONOMY

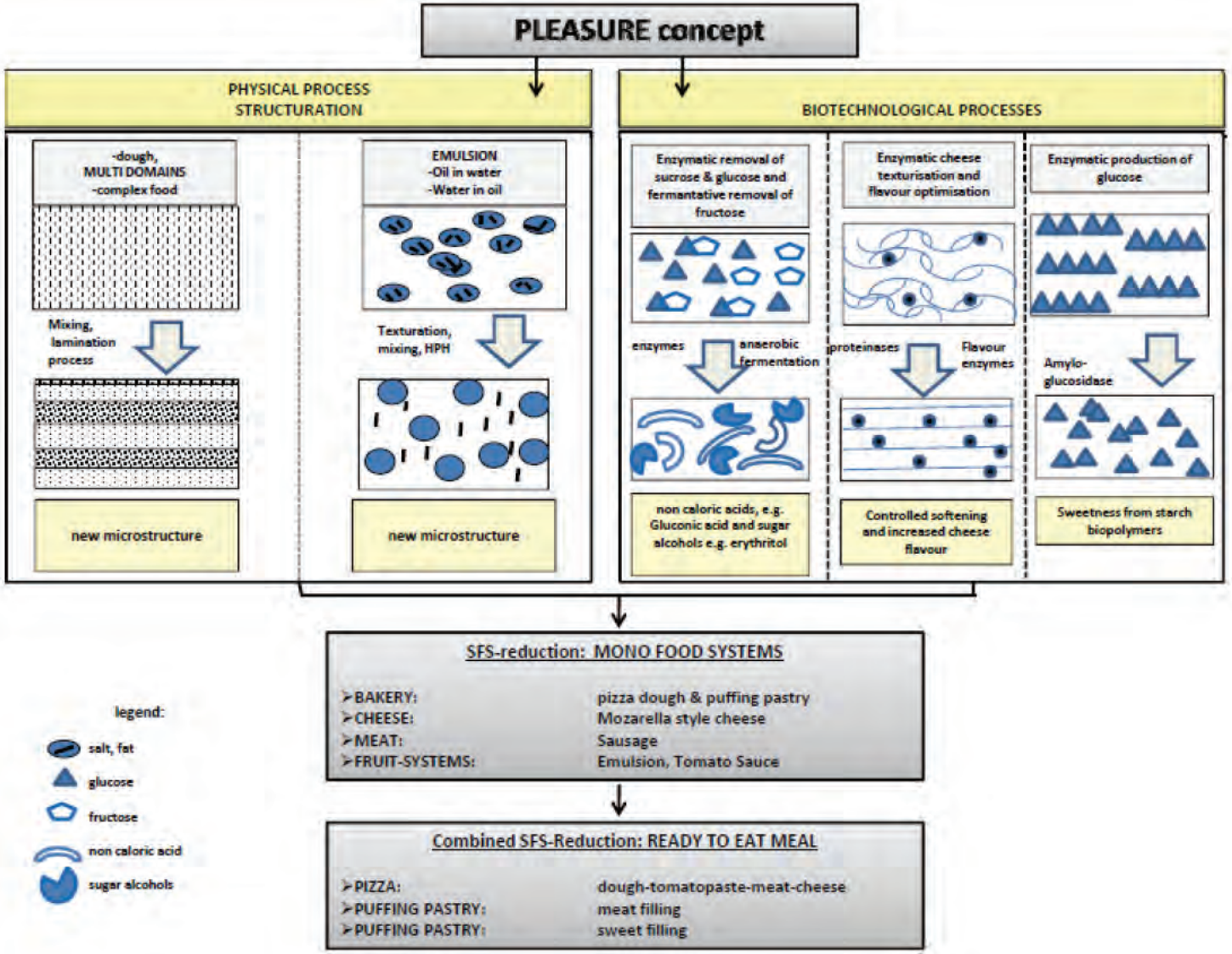
## PLEASURE project

I) PROJECT STRATEGY
II) PIZZA DOUGH
III) PUFFING PASTRY
IV) SWEET: FRUIT AND DOUGH
V) MEAT
VI) CHEESE
VII) PIZZA ; SENSORIAL PERCEPTION
VIII) OUTLOOKS

# How to produce a healthy pizza?
# Can we reduce salt , lipids (saturated), …. thanks to processes?




# PLEASURE project strategy …. Process vs. replacers



PLEASURE

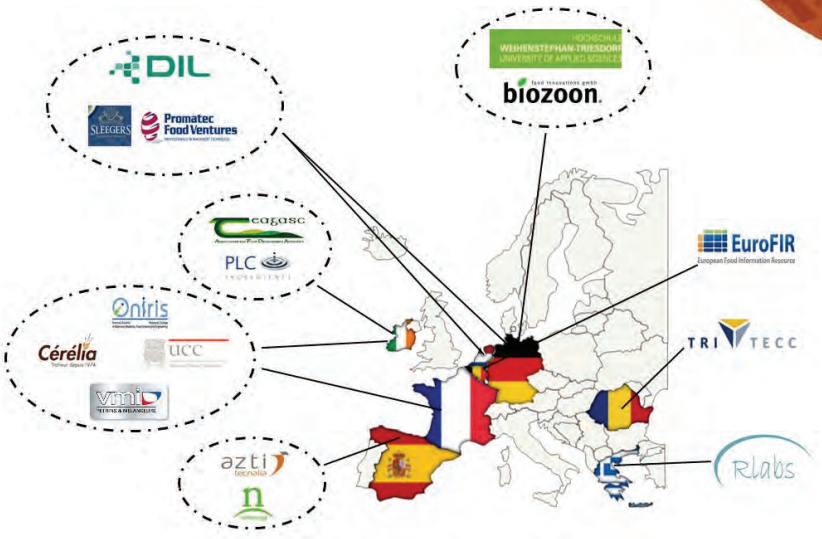
# PLEASURE

novel processing approaches for the development of food products low in fat, salt and sugar reduced

✓**innovative processes and/or novel technologies**

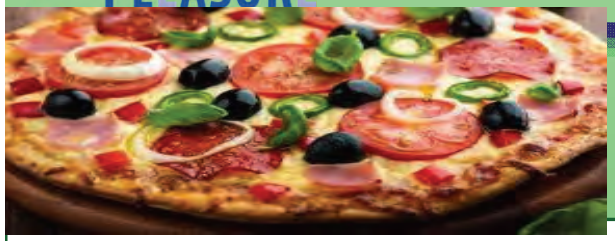
➔ Development and production of food products with "**low content"**

➔ **Low Salt, Low Sugar, Low Fat (saturated and trans-fatty acids)**




| | |
|---|---|
| Proposal full title: | PLeASURe |
| Proposal Acronym: | Novel **P**rocessing approaches for the development of food products **L**ow in f**A**t, **S**alt and s**U**gar **Re**duced |
| Duration: | 36 months |
| Number of participants: | 16 |
| Total cost: | 3,945,226 Euro |
| Total EC contribution: | 2,983,864 Euro |
| Coordinator: | biozoon |

Funded by the 7th Framework Programme of the European Union, Small Collaborative Project.
KBBE.2011.2.3-05 – Processed foods with a lower salt, fat and sugar content.



PLEASURE

novel processing approaches for the development of food products low in fat, salt and sugar reduced

- Food intakes (g/d) for the UK population

| Total Population | Mean | Mean Error | P95 | P95 Error |
|---|---|---|---|---|
| **Total Diet** | 2779.1 | 29.6 | 4537.5 | 128.7 |
| Tomato sauce → | 20.0 | 1.3 | 103.2 | 3.8 |
| Mozzarella-style cheese → | 12.1 | 1.0 | 87.3 | 6.0 |
| Pizza dough | 12.0 | 0.9 | 87.3 | 5.9 |
| Cooked ham | 5.3 | 0.3 | 25.2 | 2.0 |
| Puff pastry dough | 1.3 | 0.2 | 0 | 0.2 |
| Apple sauce | 0.9 | 0.2 | 0 | 0.9 |
| Dried cured sausage | 0.6 | 0.3 | 0 | 0.7 |
| Bologna type sausage | 0 | 0 | 0 | 0 |

- Food intakes (g/d) for the Dutch population

| Total Population | Mean | Mean Error | P95 | P95 Error |
|---|---|---|---|---|
| **Total Diet** | 3127.2 | 18.3 | 4771.33 | 57.8 |
| Pizza dough → | 6.9 | 0.5 | 63.2 | 4.2 |
| Cooked ham → | 6.6 | 0.3 | 32.0 | 1.5 |
| Dried cured sausage | 5.6 | 0.3 | 33.6 | 2.4 |
| Apple sauce | 4.1 | 0.4 | 28.3 | 2.6 |
| Tomato sauce | 4.0 | 0.3 | 29.8 | 3.6 |
| Puff pastry dough | 2.3 | 0.2 | 23.1 | 3.5 |
| Bologna type sausage | 1.3 | 0.1 | 9.0 | 1.0 |
| Mozzarella-style cheese | 1.13 | 0.1 | 4.7 | 2.1 |

EuroFIR™

European Food Information Resource

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# PLeASURe & the pizza dough


READY TO BAKE PIZZA DOUGH
5 WEEKS SHELF LIFE @ 4°C

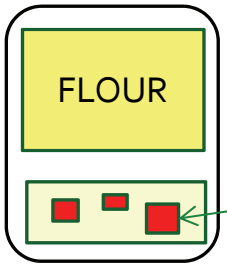
INDUSTRY PARTNER
CERELIA (France)

## SALT & LIPIDS REDUCTION STRATEGY; CEREAL DOUGH

- Laminated dough (pizza & puff pastry)
- Target = - 25% Salt or less + Reduction of saturated fat

### PROCESS STRATEGY :

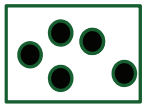
a) LOW SALT MIXING ( - 50 % to - 75%) (↗ STICKINESS)
b) ENCAPSULATED SALT EMBEDDED IN DOUGH DURING SHEETING
c) LIPID MIX REDUCED IN SAT. LIPIDS (↗ STICKINESS)

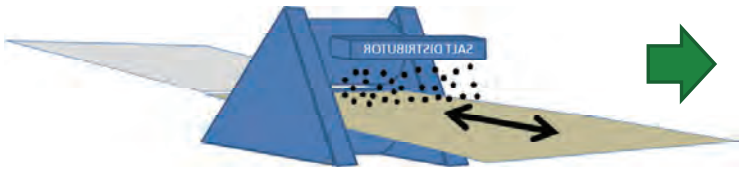



MIXING

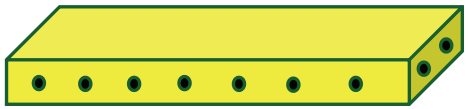
↘ SAT. LIPIDS

ENCAPSULATED
SALT (1.25 / 2 mm)






SHEETING

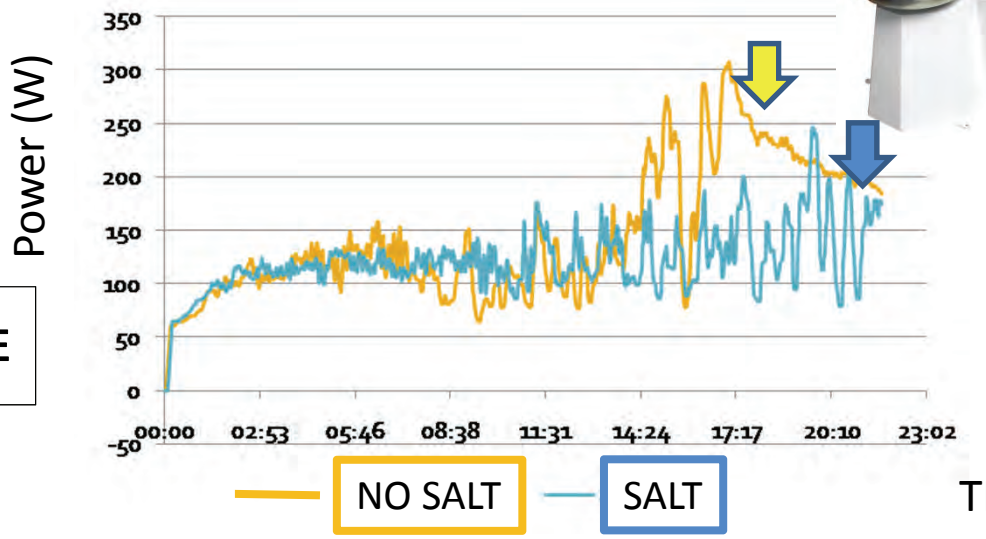


DOUGH with
ENCAPSULATED SALT
↘SALT (-25% to – 50%)
SALTINESS PRESERVED

# SALT REDUCTION & MIXING

- **Mixing in Spiral mixer**

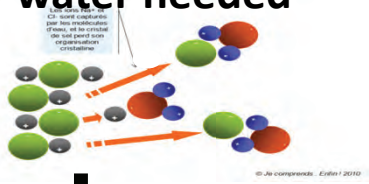
(« SPI11 » - VMI-France)




↘SALT : ↗ TORQUE & ↘ MIXING TIME

**Salt Dissolution : water needed**

NaCl



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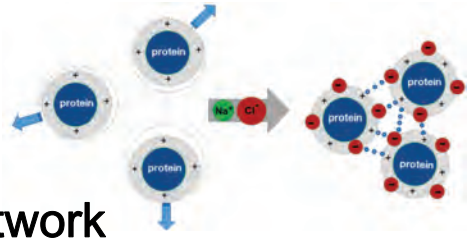



Helps to gluten network

=

NaCl delays dough mixing
Gluten network is more cohesive
STAKE: ↘ NaCl ↗Dough stickiness

Beck, M. – Impact of different sodium replacers on starch re-crystallization kinetics - 19th October 2011 - 7

2012- Beck et *al* – Impact of sodium chloride on wheat flour dough for yeast-leavened products. I. Rheological attributes. Journal of the Science of Food and Agriculture. Vol 92 (3), p 585-592.

# PLEASURE PROJECT and DOUGH PROCESSING PROTOTYPE LOW PRESSURE MIXER

VMI THE MIXING COMPANY

Spiral tool


**VMI SPIRAL MIXER**

**Pressure modulation**

**Range - 0.9 to + 0.5 Atm**

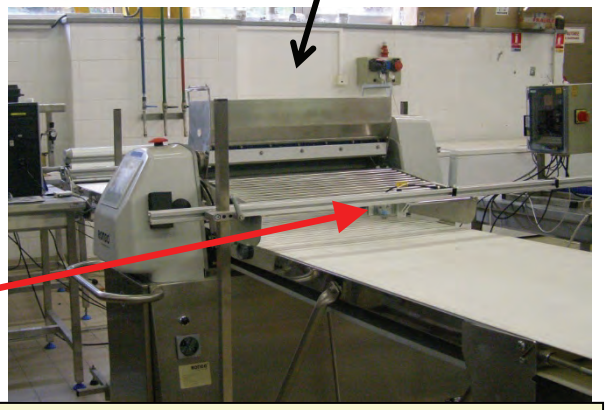
**VACUUM MIXING: ➔ REDUCED OXYDATION OF GLUTEN**
**➔ DOUGH RHEOLOGY: MORE PLASTIC**
**➔ REDUCED DOUGH STICKINESS**

# PLEASURE PROJECT and DOUGH PROCESSING PROTOTYPE DOUGH SHEETER

**PROMATEC** (NL)


**RONDO-DOGE**
**Rondostar ECO**

SALT DUSTER



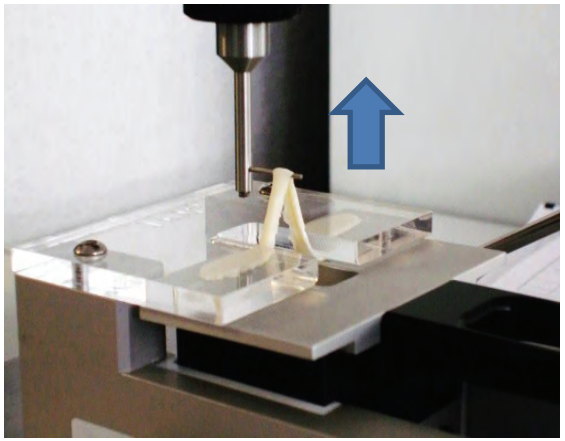
2 temperature sensors
2 Laser thickness sensors

**FUNCTIONALITIES ➔ SALT DISTRIBUTION ON DOUGH**
**➔ TORQUE MEASURMENT**
**➔ THICKNESS & TEMPERATURE SENSORS**

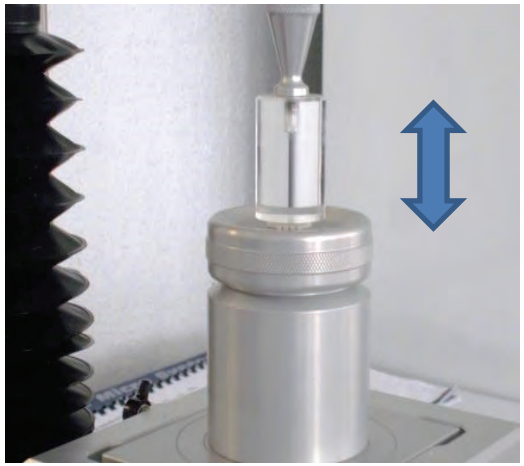
# PIZZA DOUGH RECIPES

| | FLOUR | WATER | SALT | FAT |
|---|---|---|---|---|
| % (based on 100 g Flour) | 100 | 43.6 | 2.1 | 14.8 |
| 1/3 REDUCTION | 100 | 43.6 | 1.4 | 9.87 |
| 2/3 REDUCTION | 100 | 43.60 | 0.70 | 4.93 |
| 100% REDUCTION | 100 | 43.6 | 0 | 0 |

# PIZZA DOUGH PROPERTIES



**Extensibility**

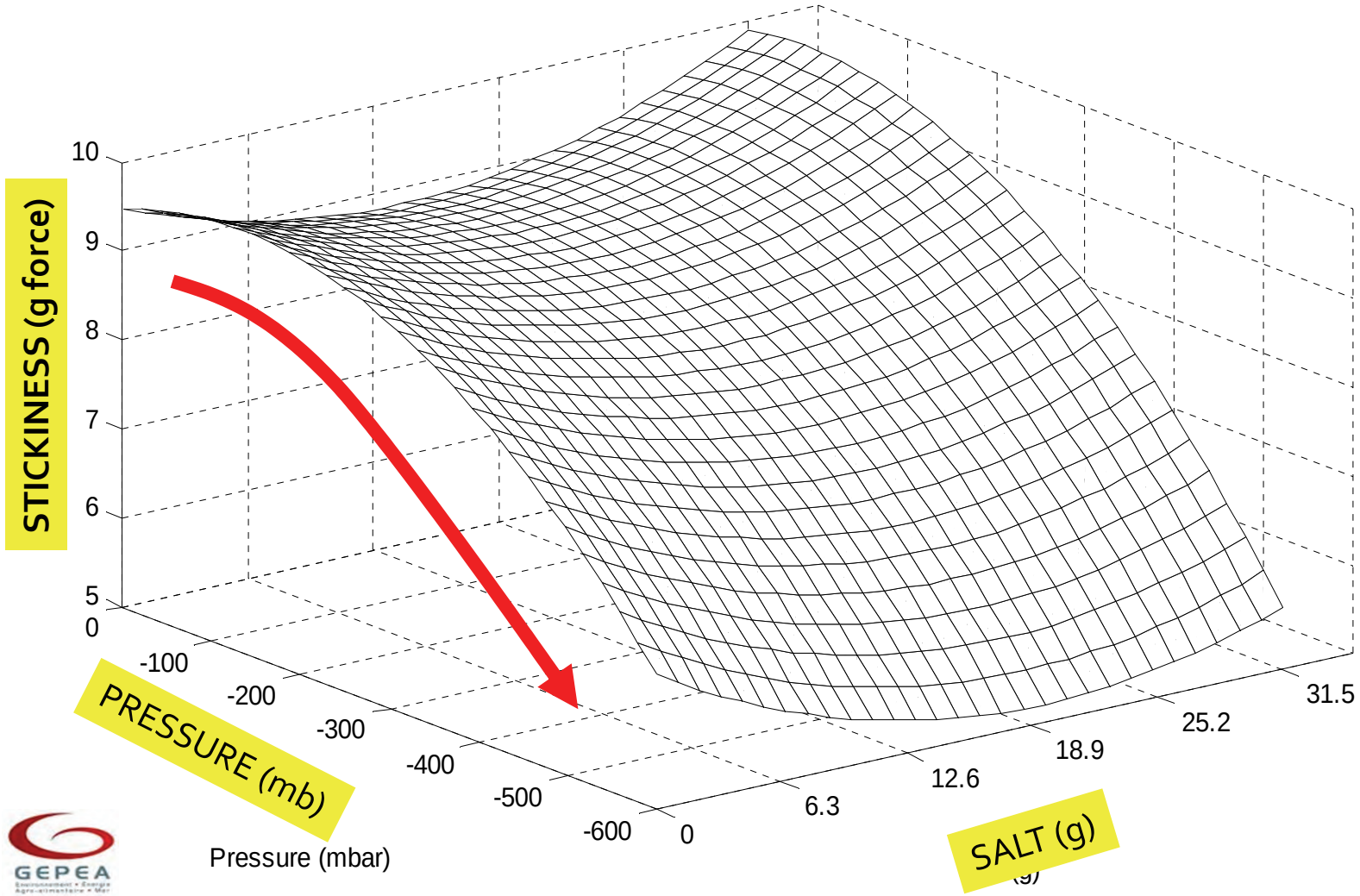


**Stickiness**

# SALT, LIPIDS and MIXING & DOUGH STICKINESS

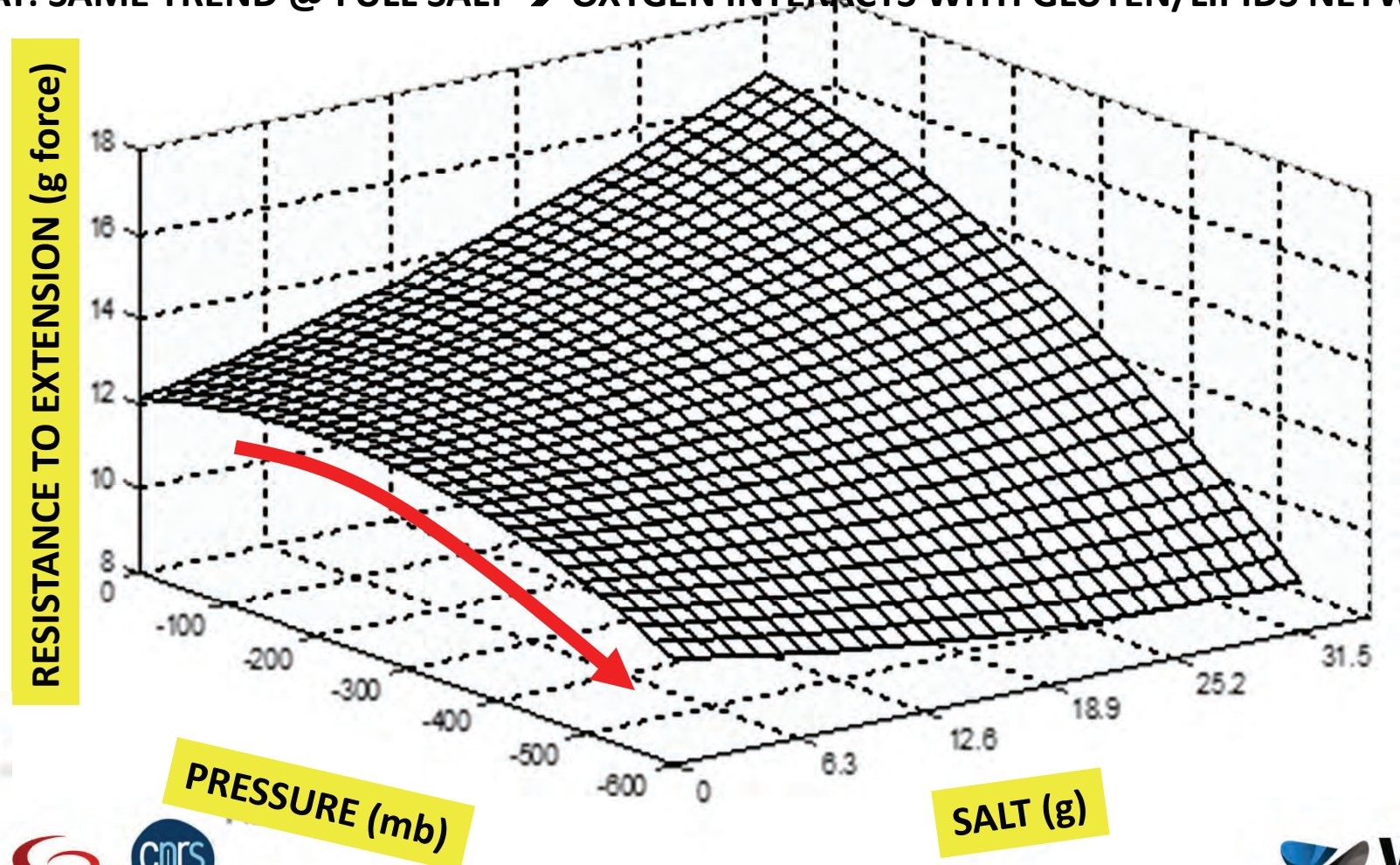
**IMPACT OF PRESSURE and SALT on DOUGH STICKINESS (HALF FAT RECIPE)**

**↘ PRESSURE DURING MIXING = ↘ DOUGH STICKINESS (same trend for all fat levels)**

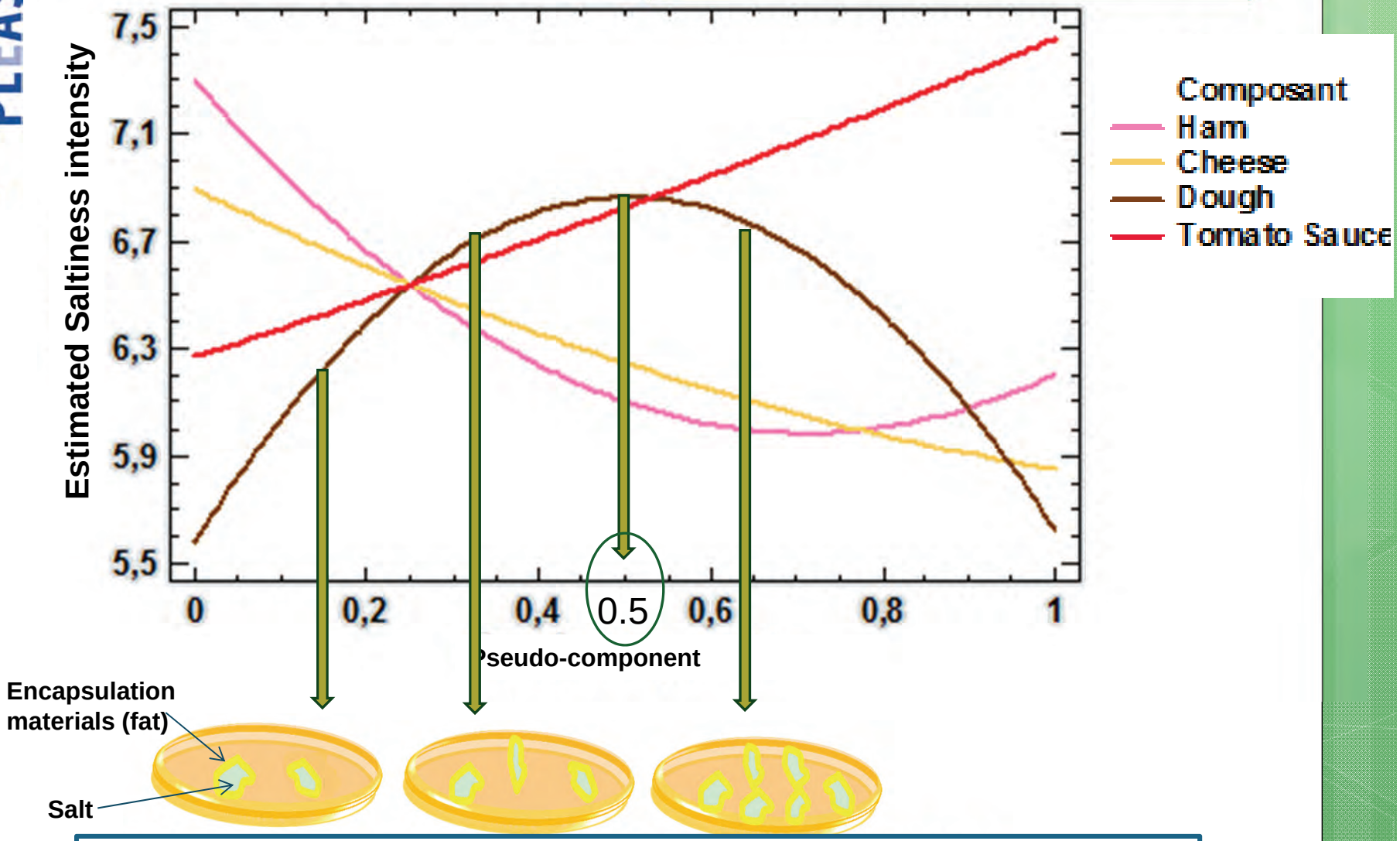


# SALT, LIPIDS and MIXING DOUGH EXTENSIBILITY

**IMPACT OF PRESSURE and SALT on DOUGH EXTENSIBILITY (FULL FAT RECIPE)**
**↘PRESSURE DURING MIXING = ↗ EXTENSIBILITY of DOUGH**
**OTHER FAT: SAME TREND @ FULL SALT ➔ OXYGEN INTERACTS WITH GLUTEN/LIPIDS NETWORK**



# ENCAPSULATED SALT; SALT DISTRIBUTION vs SALTINESS …




**DISTRIBUTION BETWEEN SALT CRYSTALS IS CRUCIAL ➡**
**↘ SIZE SALT = ↗ NUMBER OF GRAINS = ↘ SALTINESS**

# SALT, LIPIDS & PIZZA DOUGH

- PRESSURE DURING MIXING
  - ✓ ↘ PRESSURE = ↘ Dough stickiness and porosity
  - ✓ ↘ PRESSURE = ↗ Dough extensibility
  - ✓ VACUUM MIXING helps to reduce salt
  - ✓ VACUUM MIXING helps to reduce sat. Fat in dough

## SUCCESFULL PIZZA DOUGH

-SALT REDUCTION -25%

-SATURATED FAT REDUCTION

-SENSORIAL PERCEPTION & SALTINESS PRESERVED

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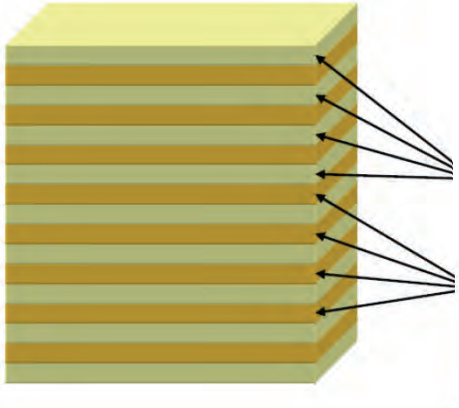
# Puff Pastry dough with layers of dough and margarine/fat



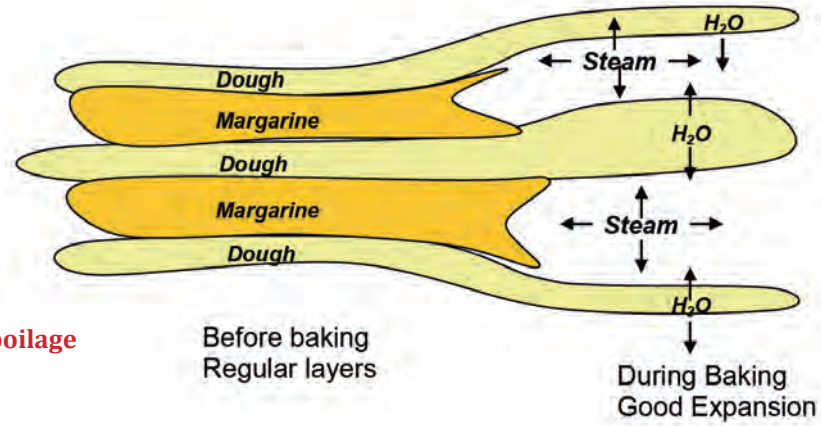

Puff Pastry dough during baking process

## Fat plays key role in puff pastry

- Separation of dough layers during lamination process
- Important for mouth feel, taste, structure of final product

## Salt plays key role in puff pastry

- development of gluten structures
- control of water activity and the development of microbial spoilage
- Flavour enhancement

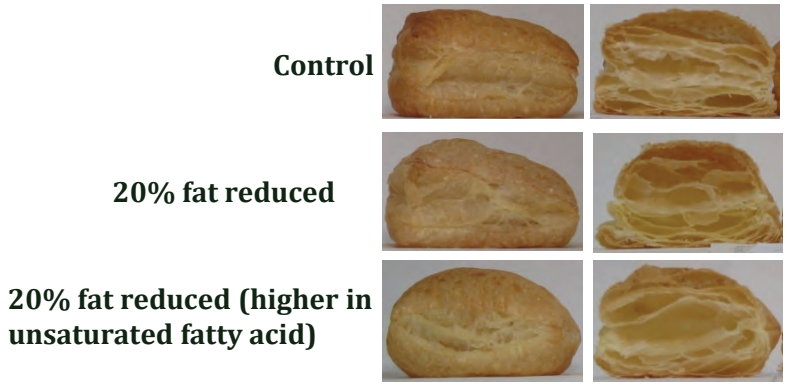



**Project target : reducing fat (20%) and salt content (30%) on Puff Pastry**

# PUFFING PASTRY – CONCLUSION

## Fat reduction

By modulating the no. of layers and the final thinks (roller graduation) it is possible to reduce the fat content by 20% and improving at the same time the concentration of unsaturated fatty acid providing thus an "healthy option"




## Salt reduction

Sensory study of salt reduced (30%) puff pastry (PP) showed no significant differences for all tested attributes and no significant recognition of salt reduction by the panellists.

No relevant impact of salt reduction (30%) and fat reduction (30%) was observed on the microbial shelf-life of PP dough stored for 6 weeks at 5 °C.

| | HEDONIC (Liking of) | | | | | | INTENSITY | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Appearance | Colour | Volume | Flavour | Mouthfeel/ Texture | Overall Acceptability | Saltiness | Fatness | Moisture | Layers | Firmness | Crispness | Off-Flavour |
| | Control PP (fat reduced, normal salt content) | | | | | | | | | | | | |
| AVER | 6.1 | 5.7 | 6.7 | 5.8 | 5.8 | 6.0 | 4.6 | 5.0 | 4.6 | 6.9 | 5.1 | 6.6 | 2.3 |
| STDV | 1.8 | 1.8 | 1.4 | 1.8 | 1.9 | 1.7 | 2.0 | 1.8 | 1.6 | 1.6 | 1.4 | 1.9 | 2.3 |
| | PP (fat red, -30% salt, salt in dough) | | | | | | | | | | | | |
| AVER | 6.6 | 6.3 | 6.8 | 6.2 | 6.2 | 6.6 | 3.3 | 4.7 | 4.4 | 6.5 | 5.3 | 6.5 | 1.5 |
| STDV | 1.3 | 1.6 | 1.3 | 1.5 | 1.6 | 1.4 | 1.8 | 2.0 | 1.6 | 1.3 | 1.4 | 1.4 | 1.8 |
| | PP (fat red, -30% salt, salt in fat) | | | | | | | | | | | | |
| AVER | 6.1 | 6.1 | 6.3 | 6.1 | 5.8 | 6.0 | 3.9 | 4.8 | 4.4 | 5.5 | 5.4 | 6.2 | 1.5 |
| STDV | 1.6 | 1.8 | 5.2 | 1.4 | 1.6 | 1.3 | 1.9 | 1.8 | 1.5 | 1.7 | 1.8 | 1.7 | 1.6 |

## Salt and fat reduction

Physicochemical tests showed that a salt reduction (30%) in fat reduced (20%) PP is possible without significantly affecting total firmness

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# Sugar reduction in fruit and vegetable preparations

Valuable compounds ⟺ High sugar content

**Challenge:** Keep valuable compounds & reduce sugar by 30%

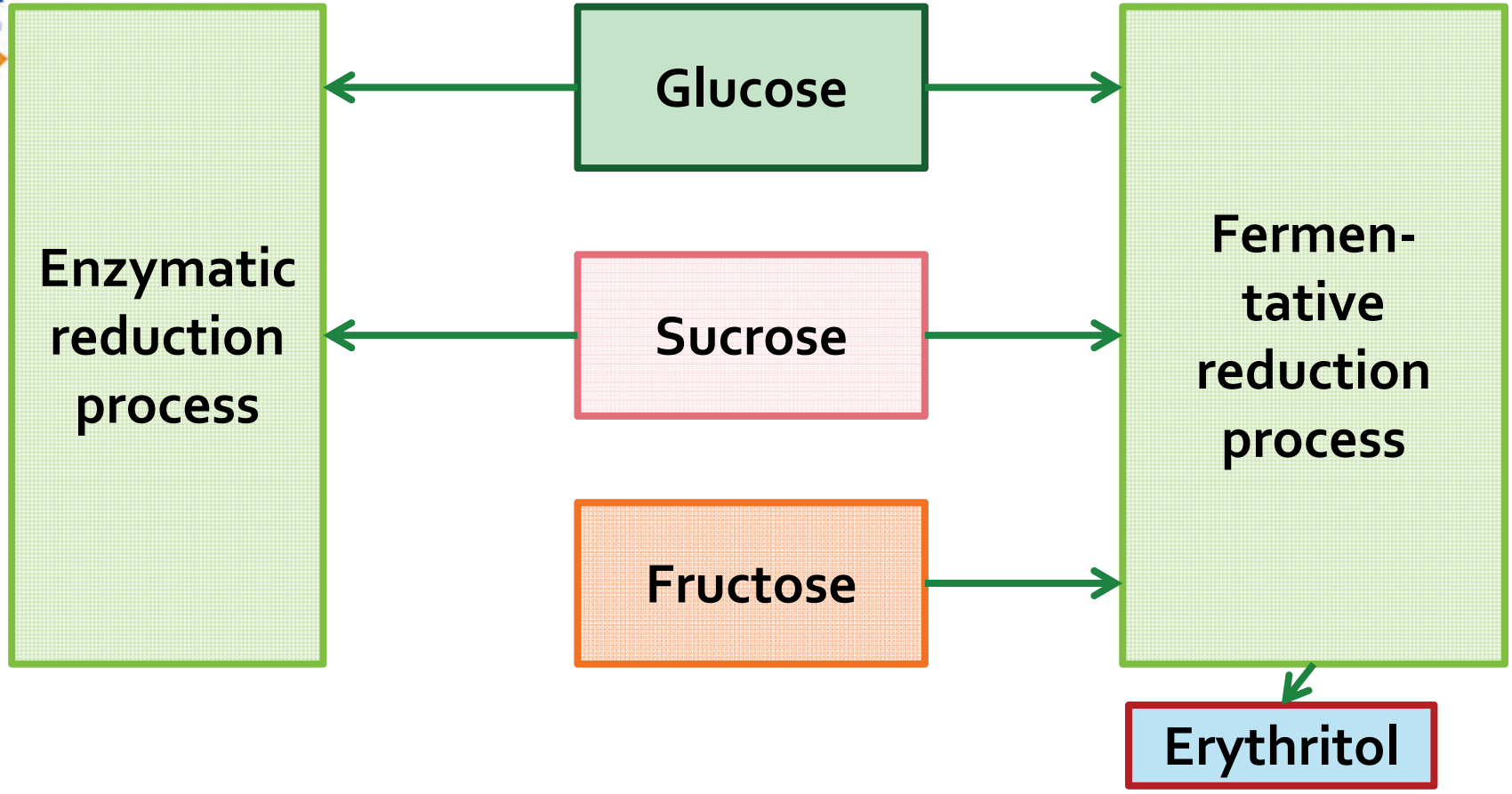
**Approach:** New innovative sugar reduction processes

1) Enzymatic sugar reduction

2) Fermentative sugar reduction

# Developed technology platform

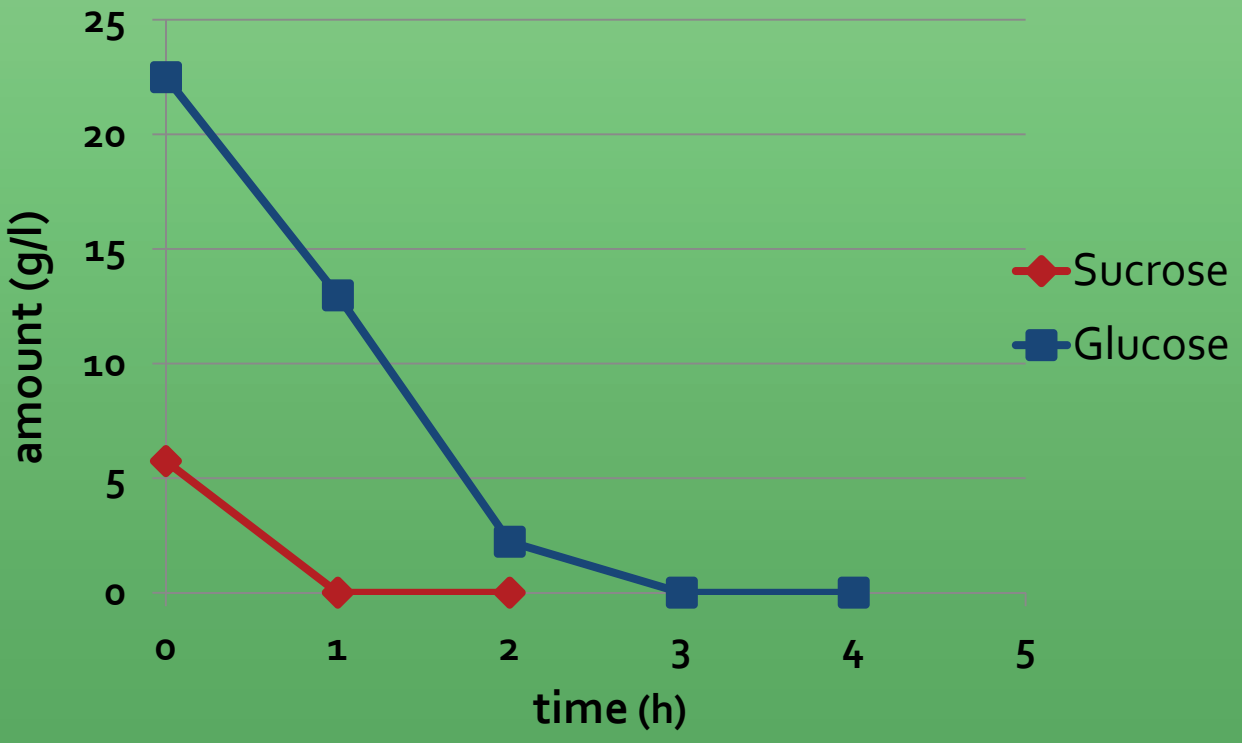
Sugars in fruits:




HOCHSCHULE WEIHENSTEPHAN-TRIESDORF UNIVERSITY OF APPLIED SCIENCES

# Enzymatic sugar reduction

## Enzymatic sugar reduction in strawberry puree:




**45 % reduction of total sugar**

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# Fermentative sugar reduction

**Objective**: remove high caloric sugar and keep sweetness

FRUCTOSE/GLUCOSE —microorganisms→ ERYTHRITOL

Sugar reduced

Sweetness

HOCHSCHULE WEIHENSTEPHAN-TRIESDORF UNIVERSITY OF APPLIED SCIENCES

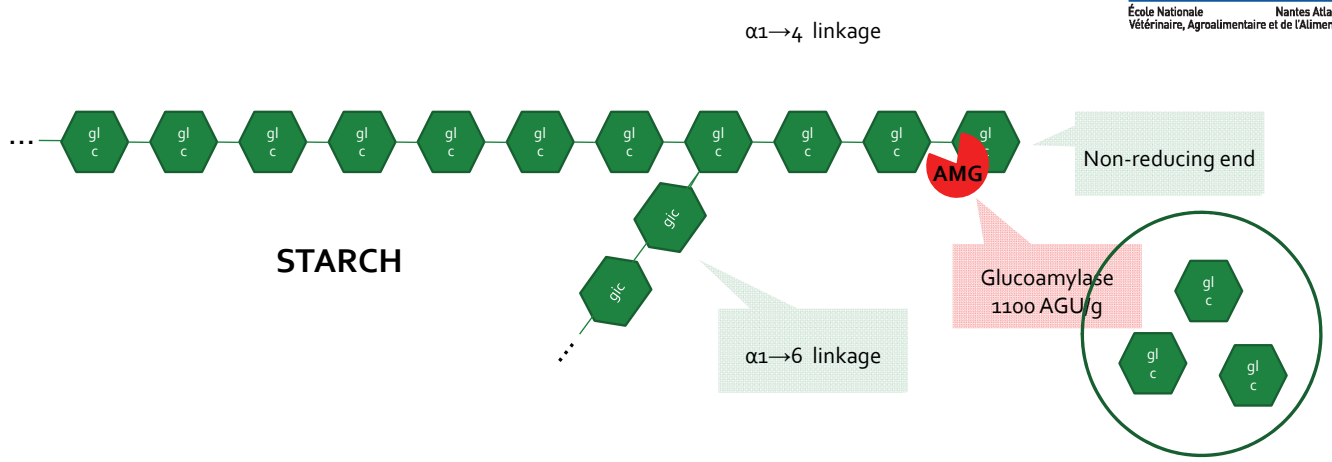
# Sugar reduction in fruit and vegetable preparations

## Results:

- New sugar reduction platform technology successfully developed
- Both processes applicable for juices & purees
- Sugar reduction by min. 30% possible
- Labelling of product "sugar reduced"
- 100% fruit content in product
- Both processes patent pending

# SWEET DOUGH & NO ADDED SUGAR

➡ AMULOGLUCOSIDASE




AMG IN DOUGH:

- SUGAR MIX

➡

- **SENSORY ISSUE:**

0,75 g /100 g FLOUR ⇔: 17g SUGAR in 100 g Flour

- **TECHNICAL ISSUES :**

AMG effect < sucrose effect

1.5% AMG; ↘ G', ↗stickiness,

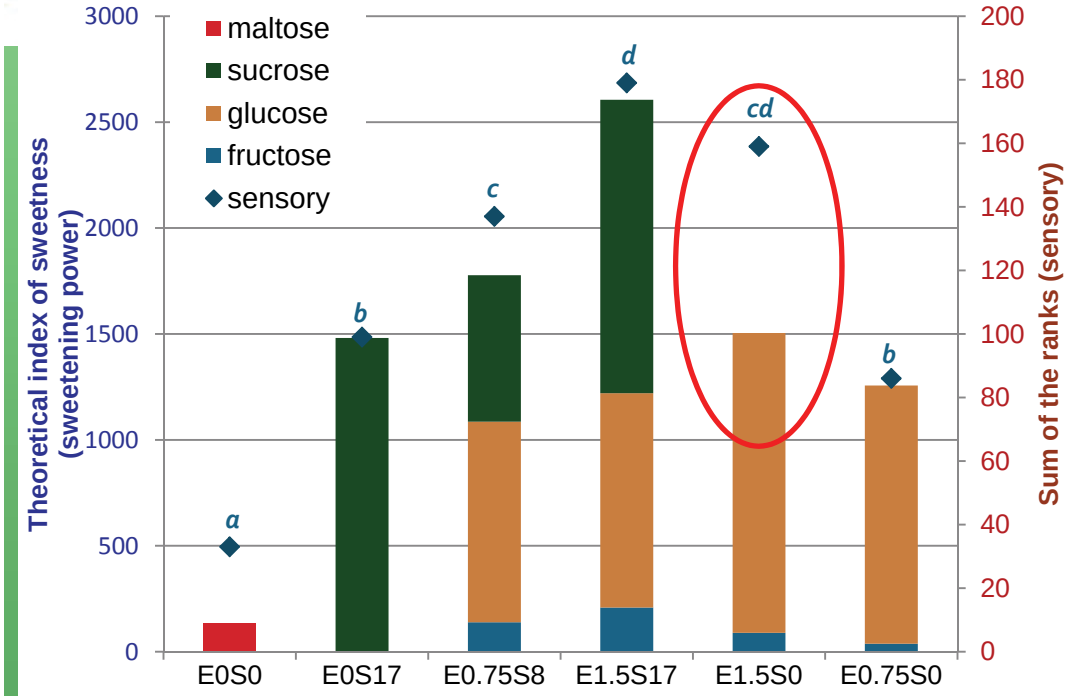
↘ resistance to extension

# Sweet dough

## Theoretical index of sweetness (TS)

HPLC: glucose (G), fructose (F), maltose (M) and sucrose (S )

$$\text{Theo Sweet} = TS = \sum \text{SWEET} - \text{POWER}_i \text{.MASS FRACTION SUGAR}_i$$




**TS = G*75 + S*100 + F*140 + M*40**

## Sensory perception

- AMG = significant sweet taste
- $E_{0.75}S_0$ no different from $E_0S_{17}$
- $E_{1.5}S_0$ no different from $E_{1.5}S_{17}$

## SENSORY vs TS

- sensory perception of $E_{1.5}S_0$ is higher than its theoretical index

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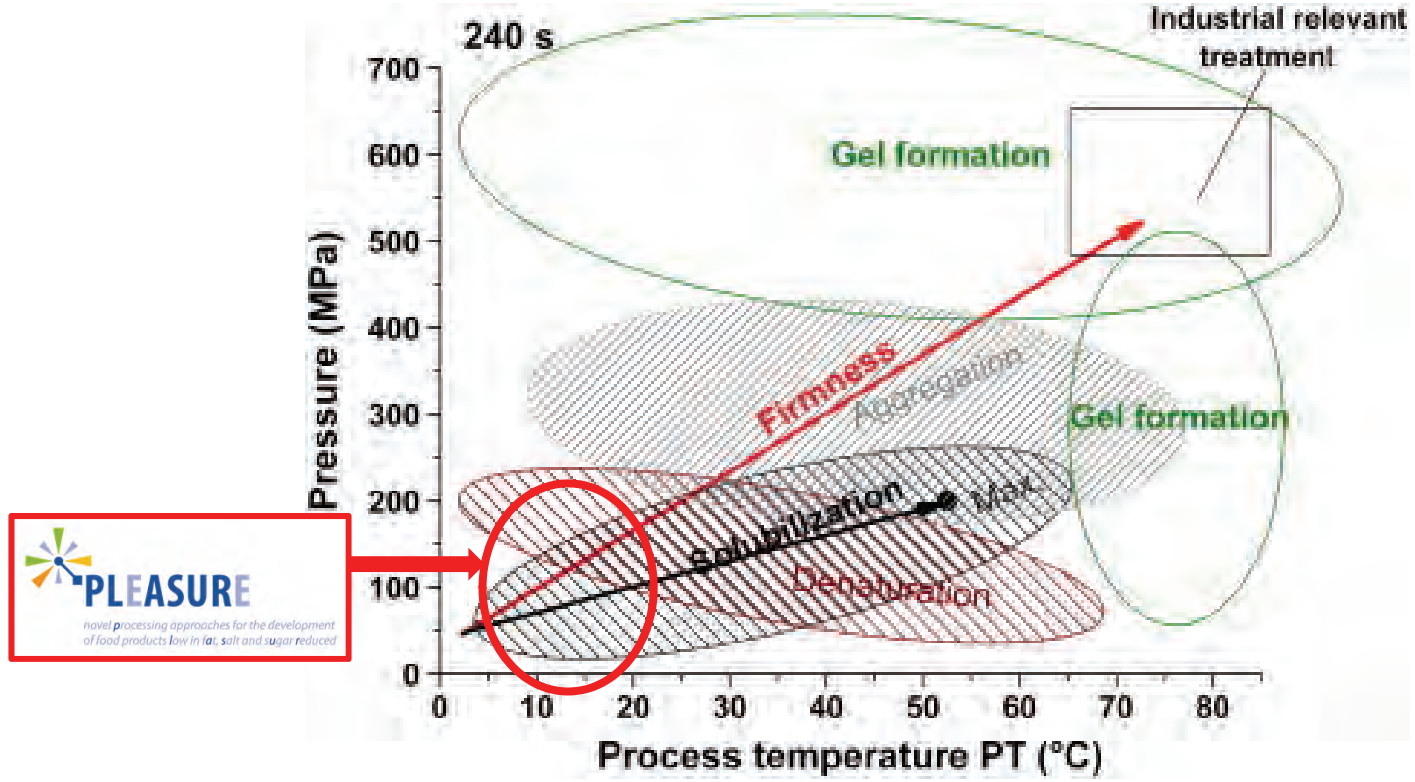
# MEAT PROCESSING: HPP

Hypothetic P–T ranges of myosin solubilisation, aggregation and gelation after HPP treatment of 240 s.




Tintchev et al. 2013

# MEAT PROCESSING

High fat and salt consumption may induced high blood pressure and other cardiovascular diseases.

Prevention: Salt and fat reduction in meat products

**Chosen meat products are:**

- *Cooked ham*
- *Cooked sausage*
- *Dry cured fermented sausage*

**Challenges:**

- Quality attributes and taste should be similar to the standard product
- Might be problems with structure (no binding etc.)

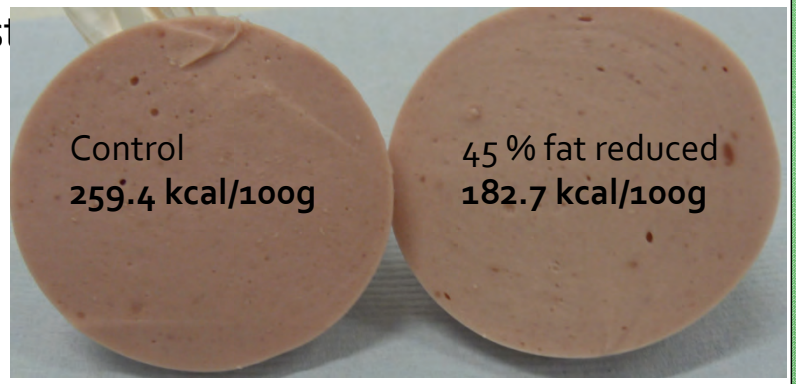
# MEAT PROCESSING

Different levels of salt and fat reduction were produced and compared to the standard product.

**Solutions = Little KCl + Much less phosphate + moderate HPP (100 Mpa)**

The best result in terms of quality and tast

**- Cooked ham: 45 % salt reduction**




**- Cooked sausage: 45 % fat reduction**

**- Dry cured sausage: 35 % fat reduction**
(including HPP treatment of the meat)

Similar appearance = good acceptance by the consumer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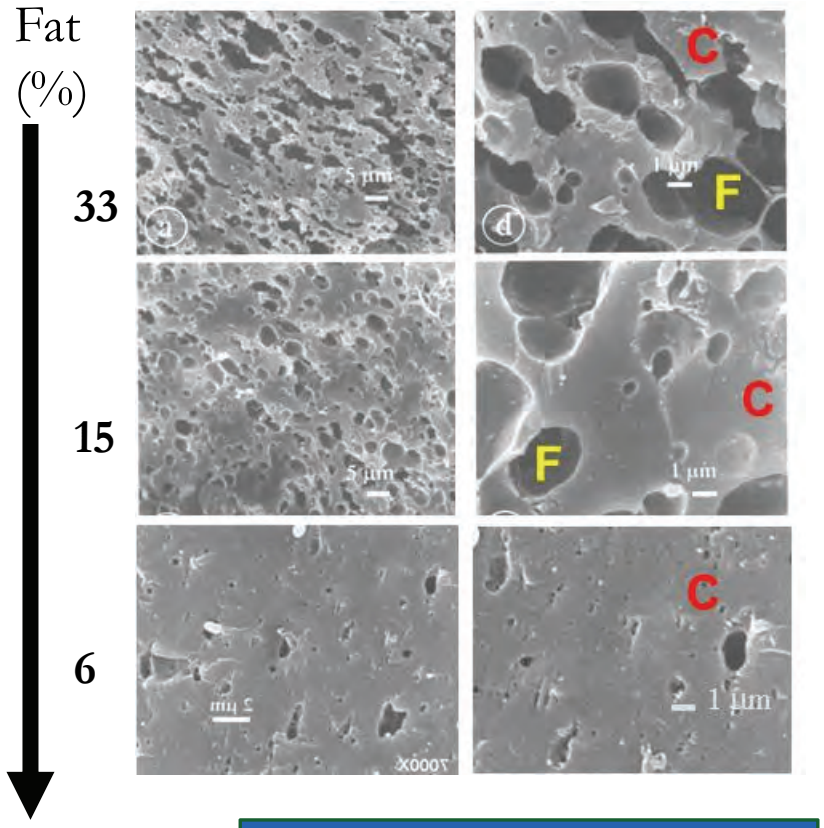
# What are the consequences of reducing fat and salt content of cheese?

Changes to cheese microstructure




F = fat globules/pools
C = casein network

## FAT reduction

- Higher protein content
- Higher volume fraction of casein network
- More difficult to deform and fracture
- Harder, more rubbery, and chewy
- Less succulent
- Flows poorly – becomes less fluid on cooking
- Altered biochemical changes during ageing
- Inferior Quality

## SALT reduction

- Increased flowability - reduced work to stretch
- Reduced, firmness, chewiness, gumminess

**FAT reduction effects generally much larger than those of SALT!**

SEVENTH FRAMEWORK PROGRAMME

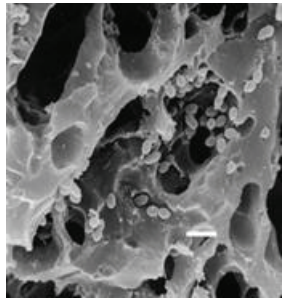
## PLEASURE Outcome 1:

Reduced calcium phosphate cross-linking as a strategy to remedy defects in reduced fat, reduced salt cheese

**Significant step towards the development of a reduced-fat, reduced-salt cheese (RFRS) with some of the key quality attributes of full-fat, full-salt cheese (FFFS)**

## Limitations:

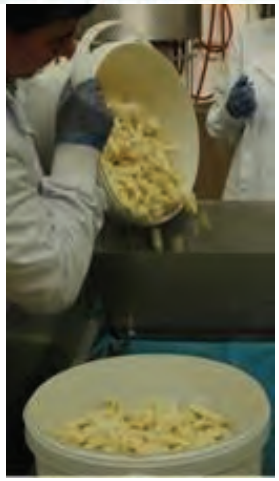
**Does not counteract certain defects associated with fat reduction, especially lack of aroma, flavour, oiling-off, succulence, and fluidity of melted cheese**



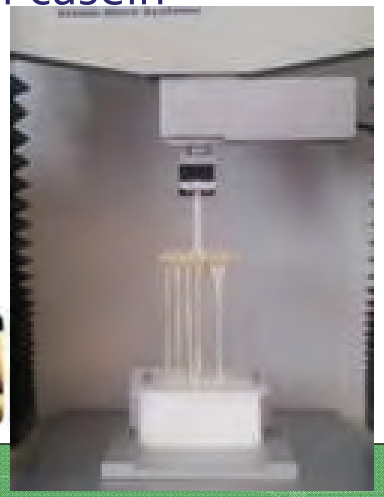
## PLEASURE Outcome 2:

addressing RFRS cheese Quality deficits:

- (a) **Aroma and Flavour**
  - New method of cheese manufacture developed (prototype cheeses in maturation)
    - Curd plasticisation step omitted
    - Natural concentrated cheese flavours added prior to moulding and pressing



- (b) **Melt and Fluidity**
  - Use of exogenous enzymes to increase the hydrolysis of casein

## PLEASURE project

I) PROJECT STRATEGY

II) PIZZA DOUGH

III) PUFFING PASTRY

IV) SWEET: FRUIT AND DOUGH

V) MEAT

VI) CHEESE

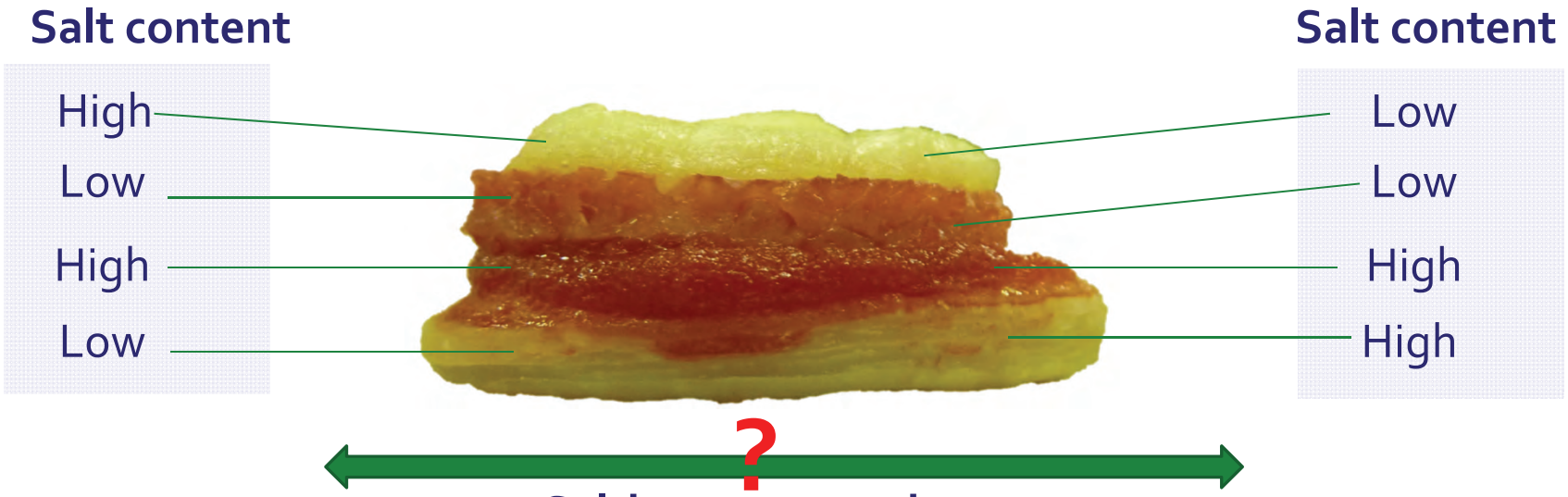
**VII) PIZZA ; SENSORIAL PERCEPTION**

VIII) OUTLOOKS

## ➔ ASSEMBLED PRODUCT: THE PLEASURE'S PIZZA

**Is it possible to increase saltiness perception by inducing Taste Sensory Contrast by varying salt location between ingredients of assembled salt reduced pizza?**

**Where is it suitable to put high and low salt content between ingredients?**



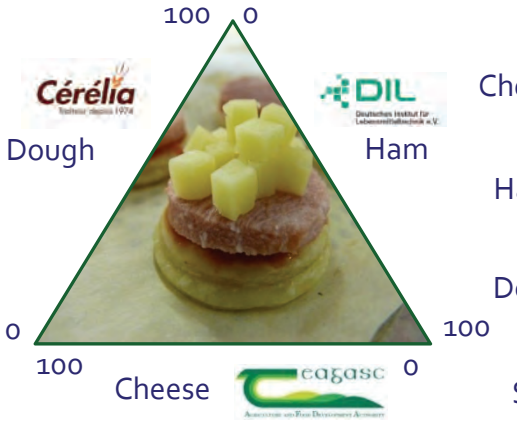

**Total salt content is unchanged**

# ➔ ASSEMBLED PRODCUT: THE PLEASURE'S PIZZA

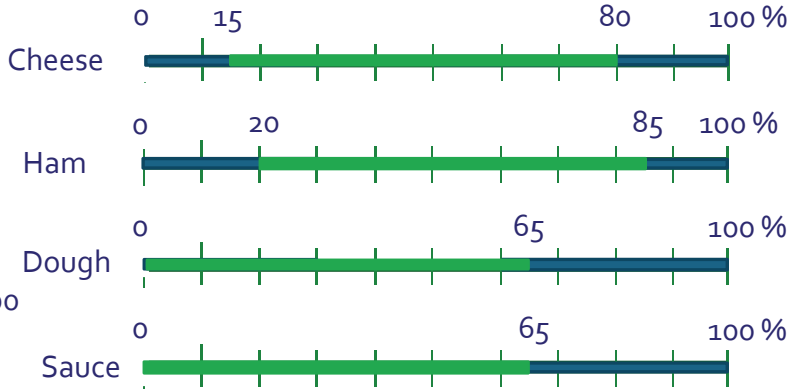
## How can we modify salt distribution between ingredients + preserving their proportions?

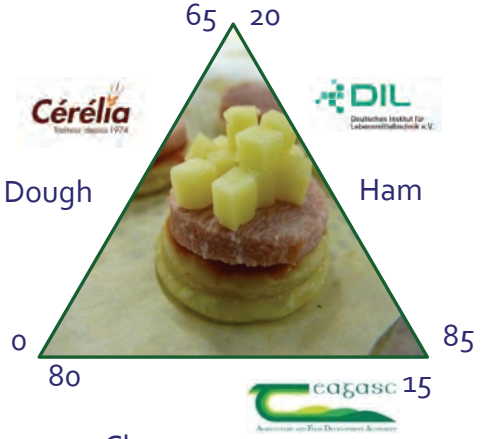
To use ingredients with different salt content with mixture experimental design

Industrial constraints




Sauce: [0-100%]



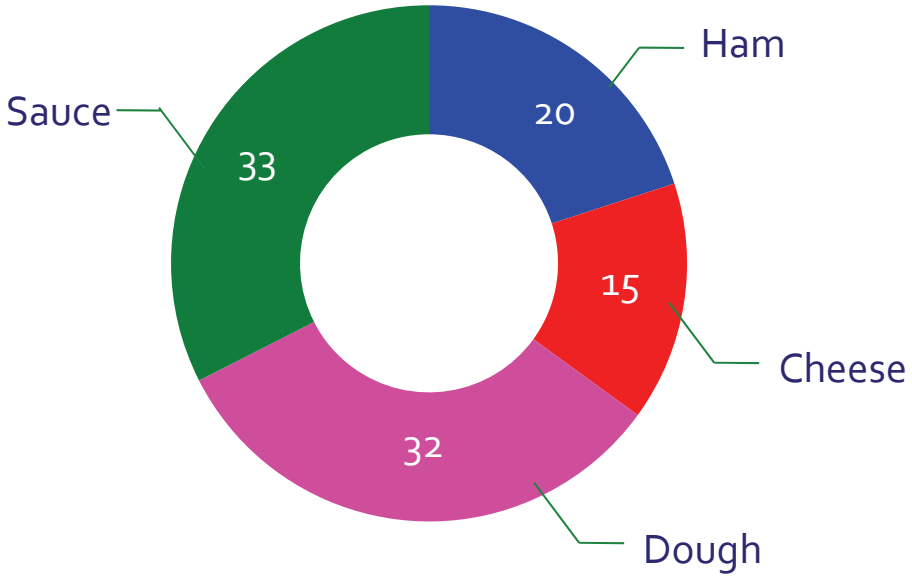

Sauce: [0-65%]

Sauce is at 0%

Mixture experimental design: 13 points

All pizzas have a 30% Salt reduction vs reference pizza

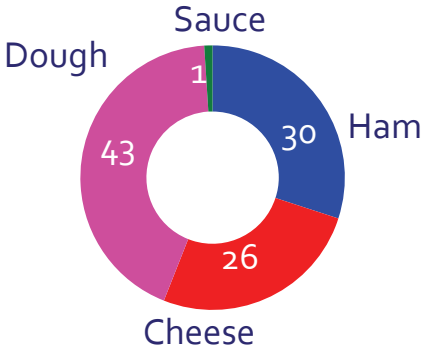
| Ingredients \ Points | |
|---|---|
| Ham | 12 |
| Cheese | 20 |
| Dough | 15 |
| Sauce | 32 |
| Total | 33 |
| | 100 |

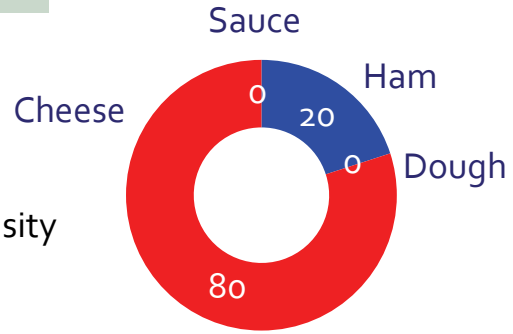


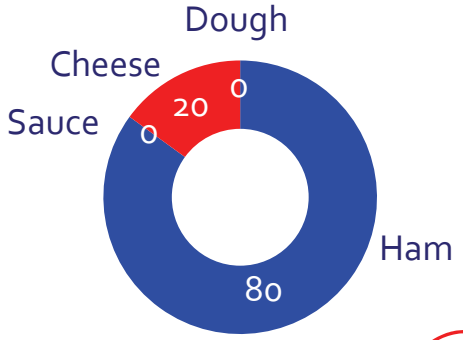

# % OF THE TOTAL SALT FROM EACH INGREDIENT

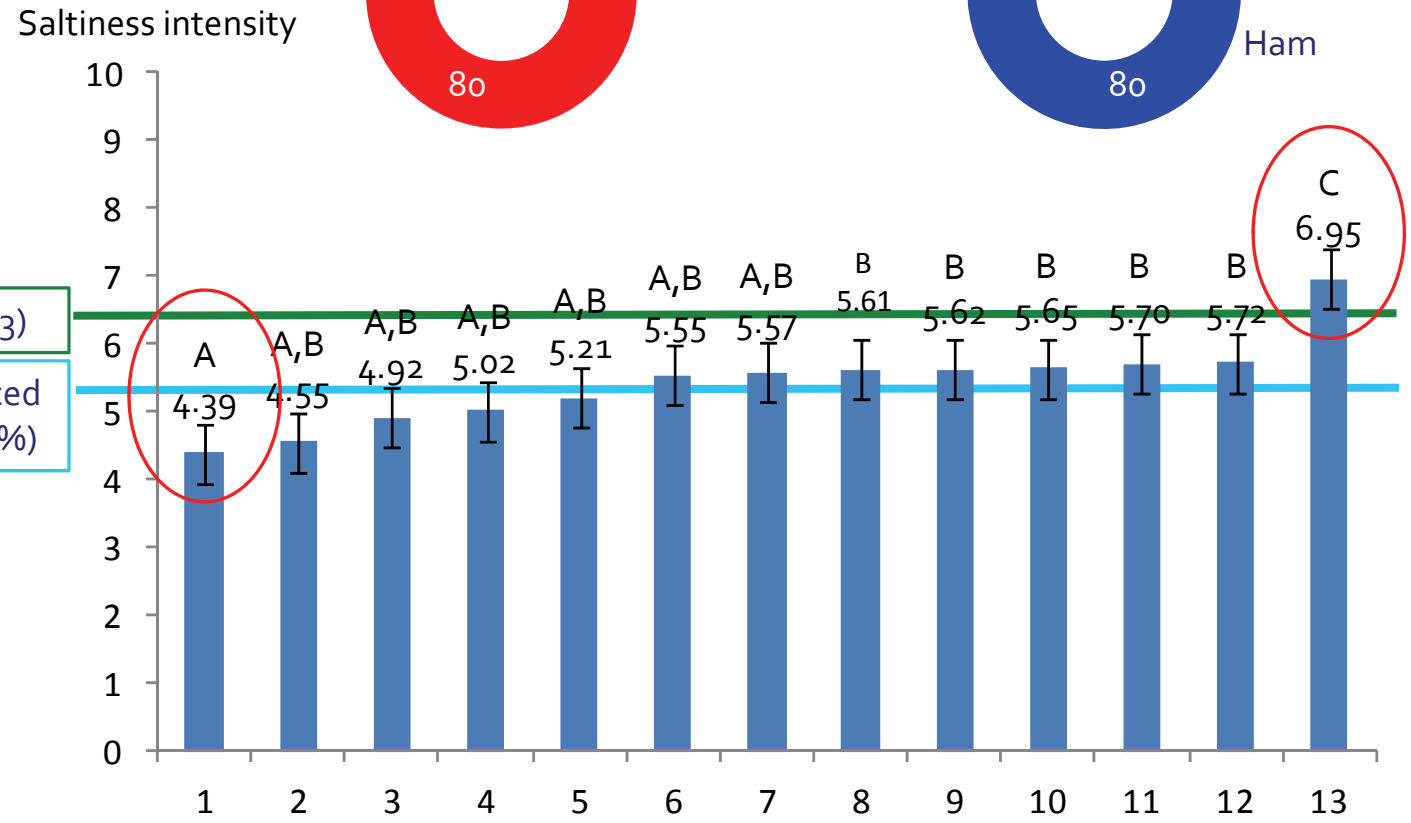
| ANOVA | p-value |
|---|---|
| Product | 0.0161* |

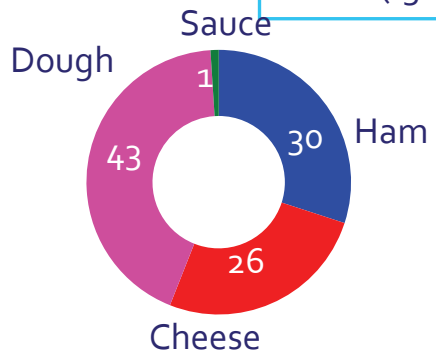
*(* : significant at 5% level)*



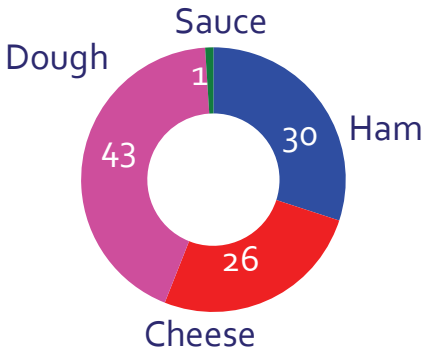

TRAINED JURY (14) - QDA

% OF THE TOTAL SALT FROM EACH INGREDIENT

www.commnet.eu

Oniris
École Nationale Vétérinaire, Agroalimentaire et de l'Alimentation
Nantes Atlantique
Santé et alimentation au cœur de la vie

## Regular Pizza

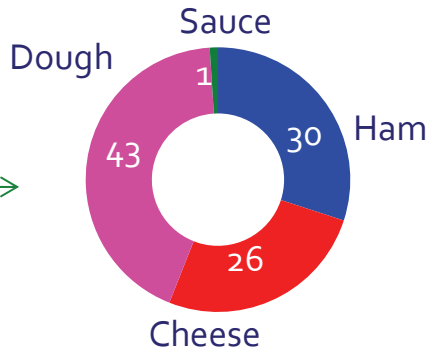



Saltiness intensity:

6.3

« -22% » saltiness

## Salt-reduced Pizza (-30%)



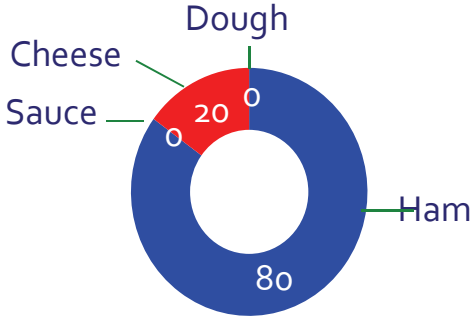

Saltiness intensity:

5.2

« +34% »

« +10% »

## Optimal Salt-reduced Pizza (-30%)




Saltiness intensity:

7.0

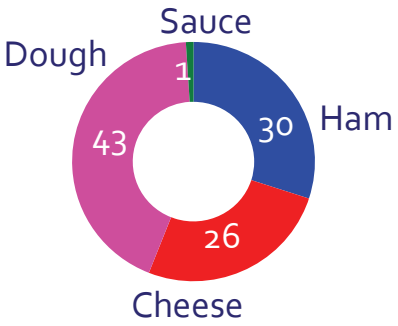
# ONIRIS: development of dough optimum

Salt incorporation during mixing → Homogeneous salt distribution

Salt incorporation by sprinkling after laminating → Inhomogeneous salt distribution

*Preservation of salt crystal by using encapsulated salt (ES)*

Regular Pizza

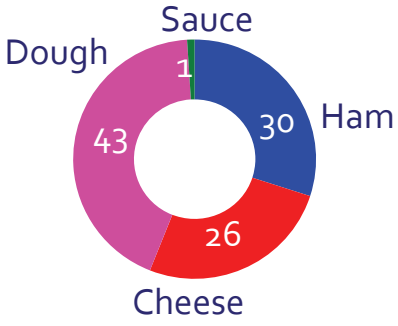



Saltiness intensity:

6.3

+ 20%

Regular Pizza ES




Saltiness intensity:

7.6

ES: encapsulated salt

-22%

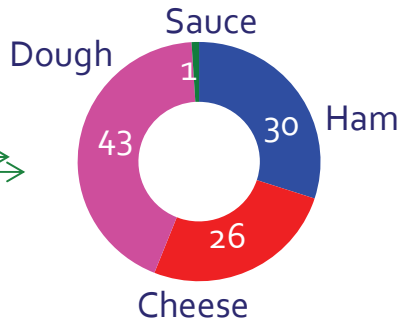
=

+ 27%

+10%

+6%

Salt-reduced Pizza ES (-30%)

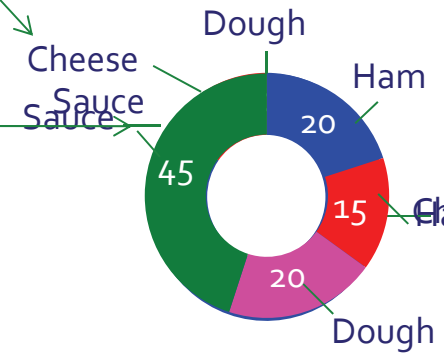



Saltiness intensity:

7.5

+34%

Optimal Salt-reduced Pizza ES (-30%)




Saltiness intensity:

8.0

Hypothesis: better salt mobility within sauce

- Taste Sensory Contrast increases overall saltiness perception within salt-reduced pizza when salt is located within ingredients with better salt mobility : ham and sauce

- The use of encapsulated salt strengthens Taste Sensory Contrast by an inhomogeneous salt repartition within dough

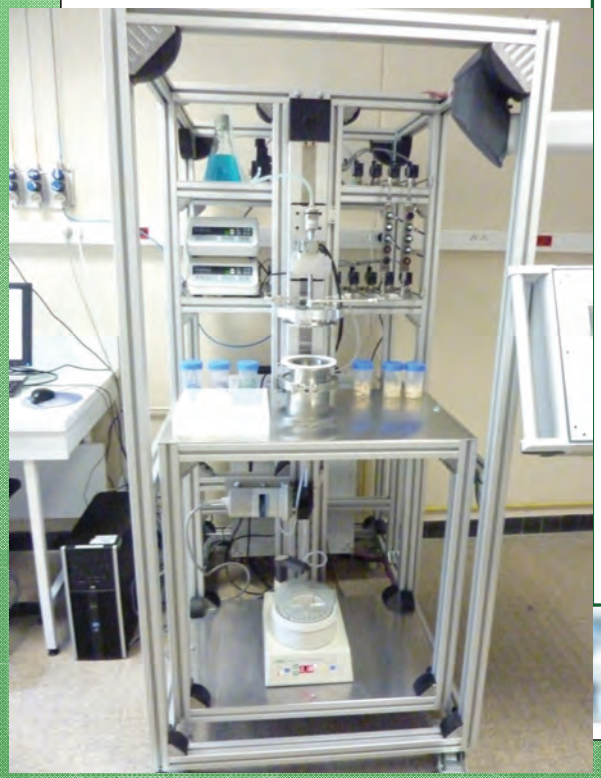
- These results were confirmed with Time-Intensity methodology

- Taste Sensory Contrast between ingredients and within pizza dough allows compensating salt reduction within pizza without altering overall and dynamic saltiness perception

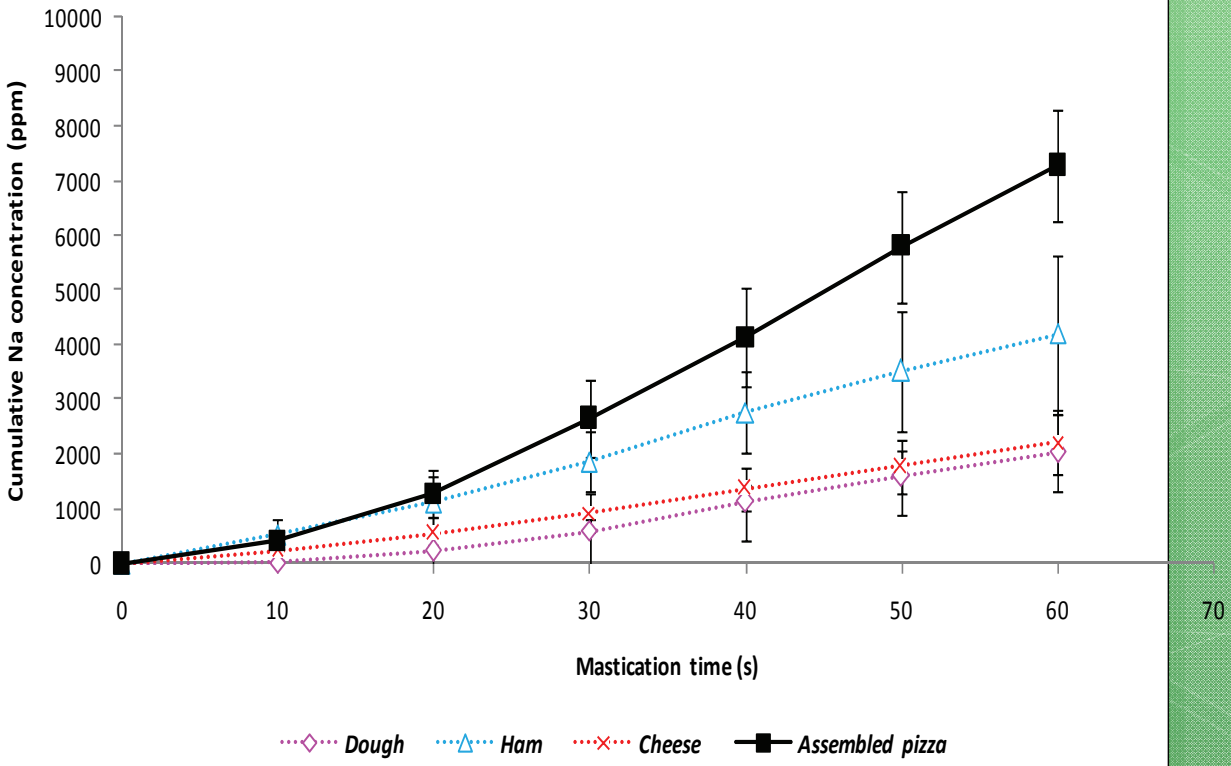
# Design & optimisation of a new in vitro masticator

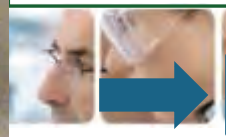
***(1 patent : 2013)***

**AMADEUS**



An exemple of first results on pizza ….



Better salt release towards saliva from ham

# DEMONSTRATION STEP:

SEVENTH FRAMEWORK PROGRAMME

PLEASURE

novel processing approaches for the development of food products low in fat, salt and sugar reduced

DIL German Institute of Food Technologies

- 30% SALT
- 30% FAT

eagasc

- 30% SALT
- - 48% FAT

Cérélia

Oniris

- 25% SALT
- 30% FAT

azti tecnalia

naturvega

- 30% SALT

naturvega

- 30% SUGAR

500 EU CONSUMERS
3 PRODUCTS
+ CHEESE & APPLE SAUCE
➡REFERENCE vs CONTROL

SIAL PARIS 19-23 OCT 2014

PIZZA

PUFFING DOUGH + MEAT

PUFFING DOUGH + APPLE SAUCE

## PLEASURE project

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# OUTCOMES FROM PLEASURE

-CONSUMER TESTS:

- CARRIED OUT IN FIVE EUROPEAN COUNTRIES (F, SP, D, RO, IRL)
- 500 CONSUMERS TETS; COMPARISON CONTROL/REDUCED :
  - PIZZA REDUCED IN SALT
  - PUFF DOUGH WITH HAM (Salty)
  - PUFF DOUGH WITH APPLE SAUCE (Sweet)

➔ SUCCESSFULL TESTS: NO DIFFERENCES DETECTED

ASSEMBLED PRODUCTS STRATEGY:

-RESULTS AVAILABLE FREELY TO THE FOOD INDUSTRY

-EQUIPMENT AND PROCESS

-VMI :CONTINUOUS MIXER TECHNOLOGY (2PATENTS)

-PROMATEC : PROTOTYPE DOUGH SHEETER

-HSWT :ERYTHRITOL PRODUCTION (2 PATENTS)


# DRAWBACK IN SALT & SUGAR REDUCTION

## -MICROBIAL STABILITY

- REMAINS AN ISSUE ….
- DOUGH; SALT IS USED TO ADJUST WATER ACTIVITY
- CHEESE REDUCED IN SALT WERE EPOSED TO MOULD GROWTH
- MEAT SYSTEMS; WAS QUITE OK

→ RESEARCH IS STILL NEEDED TO OVERCOME THIS STAKE
→ FROZEN CHANNEL BETTER
→ FREEZING MAY AFFECT SALTINESS
→ …. STILL A LOT TO DO !!


# PLEASURE PROJECT and DOUGH PROCESSING
## Low pressure Kneading


**VMI PROTOTYPE SPIRAL MIXER**

**Pressure modulation**

**Range - 0.9 to + 0.5 Atm**

**VACUUM MIXING:**
- ↘ GLUTEN OXYDATION
- ↗ DOUGH RHEOLOGY

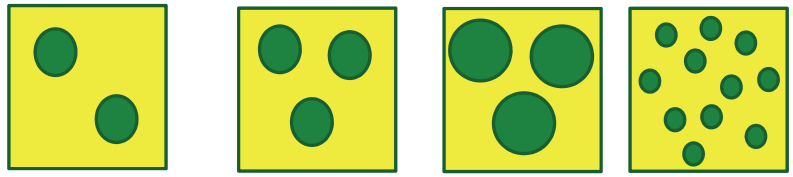
**PIZZA DOUGH**
- ↗ DOUGH RHEOLOGY
- ↘ DOUGH STICKINESS

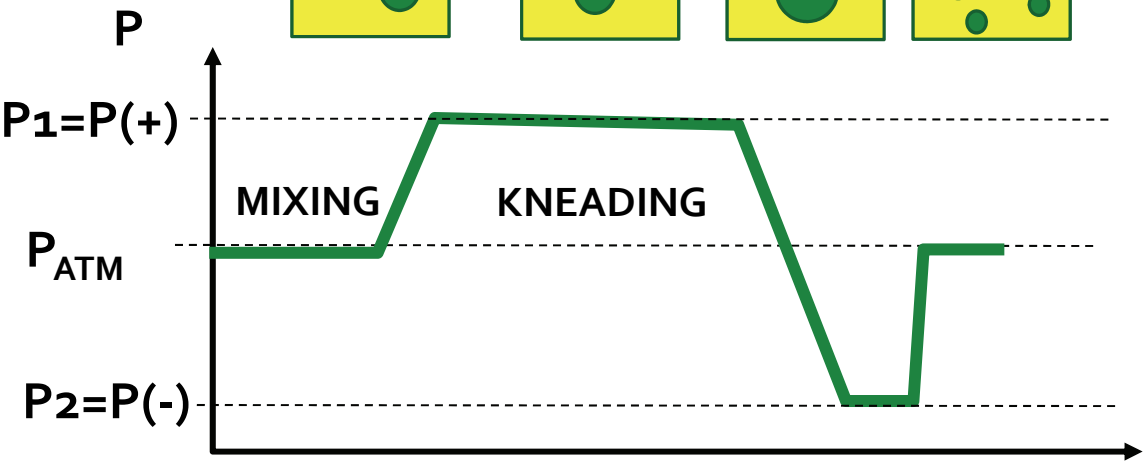
**TIN SLICED BREAD**
- ↗ DOUGH & BREAD POROSITY

# INTEREST OF PRESSURE - VACUUM MIXING

## PAN BREAD

- Reduction of size of gas nuclei in the dough
- Faster start of expansion during fermentation
- More homogenous gas cell distribution
- ↗ dough rheology ?







# CONTINUUM : CONTINUOUS MIXER (VMI)

- **BASED ON IN LINE MIXING + KNEADING**
- **VACUUM APPLIED ON LINE**
  **➔ control of the dough structure**
- **ENERGY EFFICIENCY**
  **➔ reduced dough warming (~100 kJ/kg)**
- **IN PLACE CLEANING**

VMI THE MIXING COMPANY

EUROPAIN & INTERSUC PARIS 2014

**INNOVATION AWARD 2014**

# LA ROCHELLE – FRANCE
# JUNE 2014: DISSEMINATION EVENT
# « PLEASURE CONFERENCE »


food innovations gmbh
biozoon

# Thank you very much for your attention!

**For more information find us on**

www.pleasure-fp7.com

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