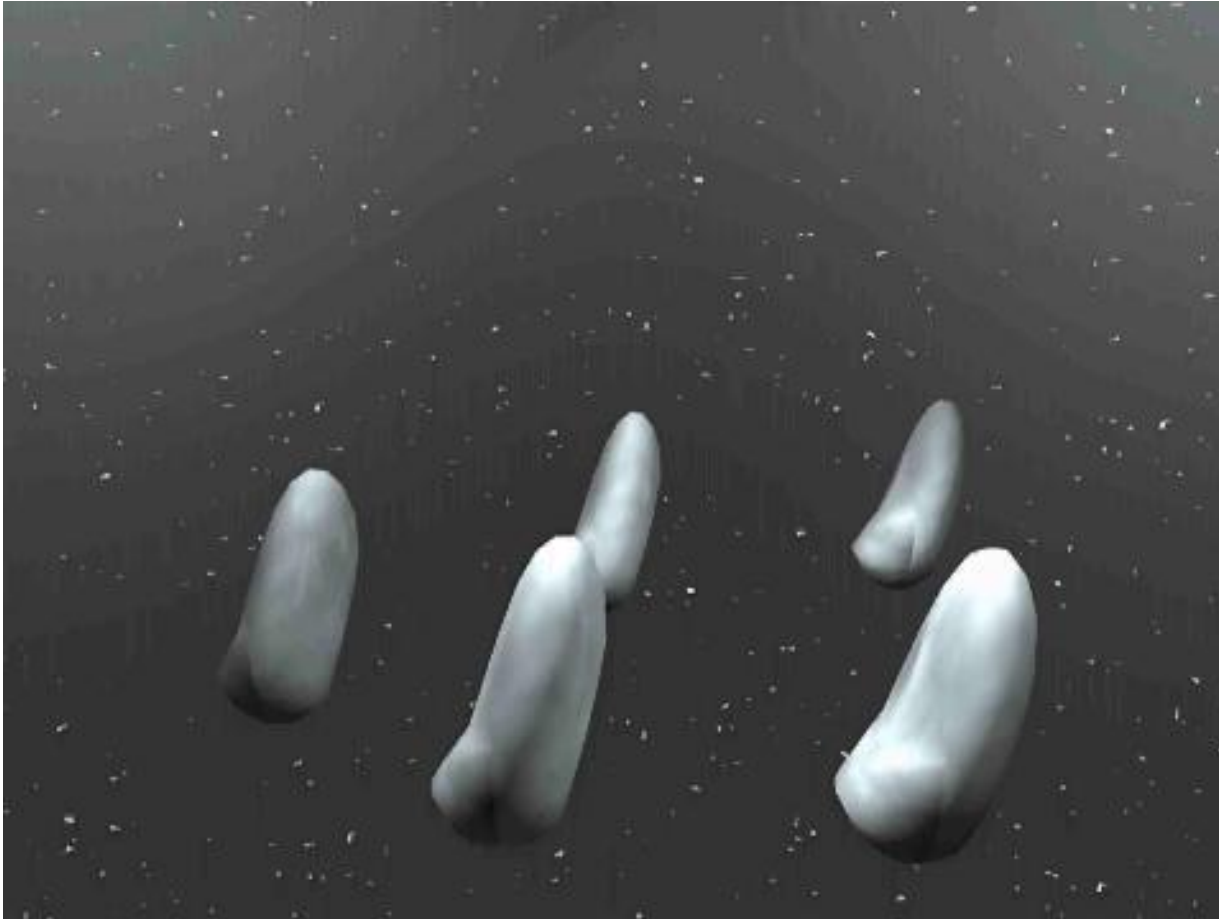


Importance of the Damaged Starch measurement



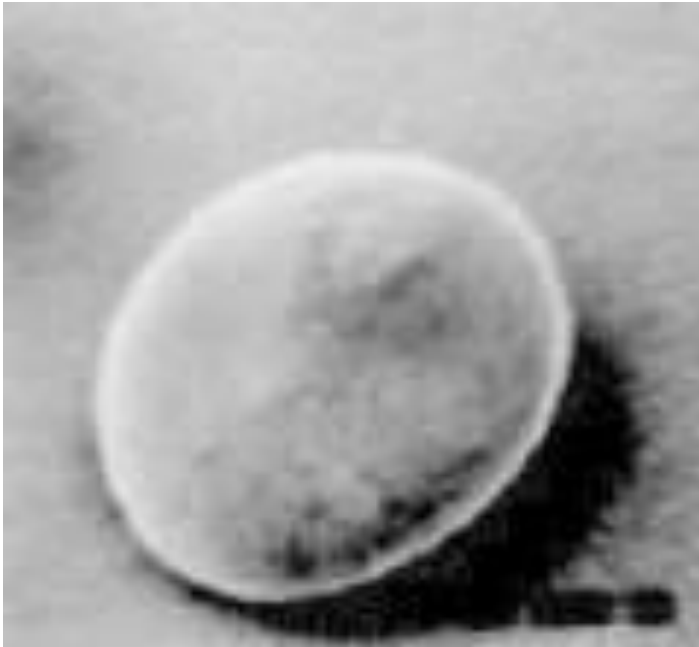


Presentation map

- 1/ The damaged starch
- 2/ The milling
 - Industrial
 - Laboratory
- 3/ Effects on final products
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- 6/ Conclusions



The Starch



- 67-68% of the Grain
- 78-82% of the Flour
- Amylose / Amylopectin
- Semi crystalline structure

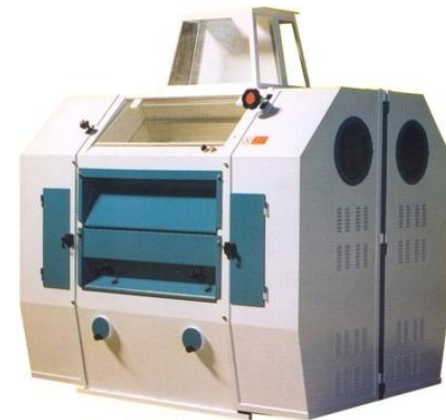


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Where does it come from ?

- Damaged starch comes from the wheat itself (as a function of hardness)
 - genetic criteria-
- It also comes from milling, including wheat tempering
 - mechanical criteria-



Where does it comes from ?

A/ genetic criteria

For the same milling process, a hard kernel :

- Needs a longer resting time
 - Produce more semolina during breaking
- Produce a flour with more damaged starch

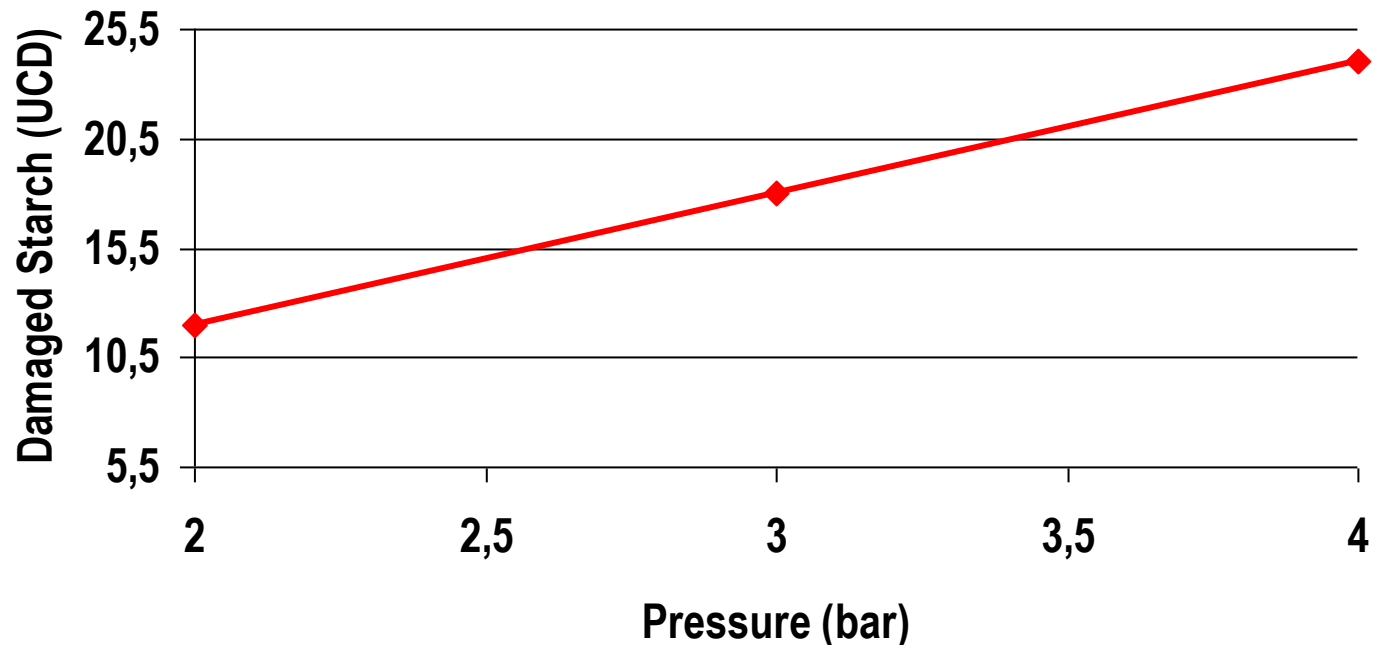
“Wheat hardness can be described as a resistance to crushing”



Where does it come from ?

B/ Mechanical criteria

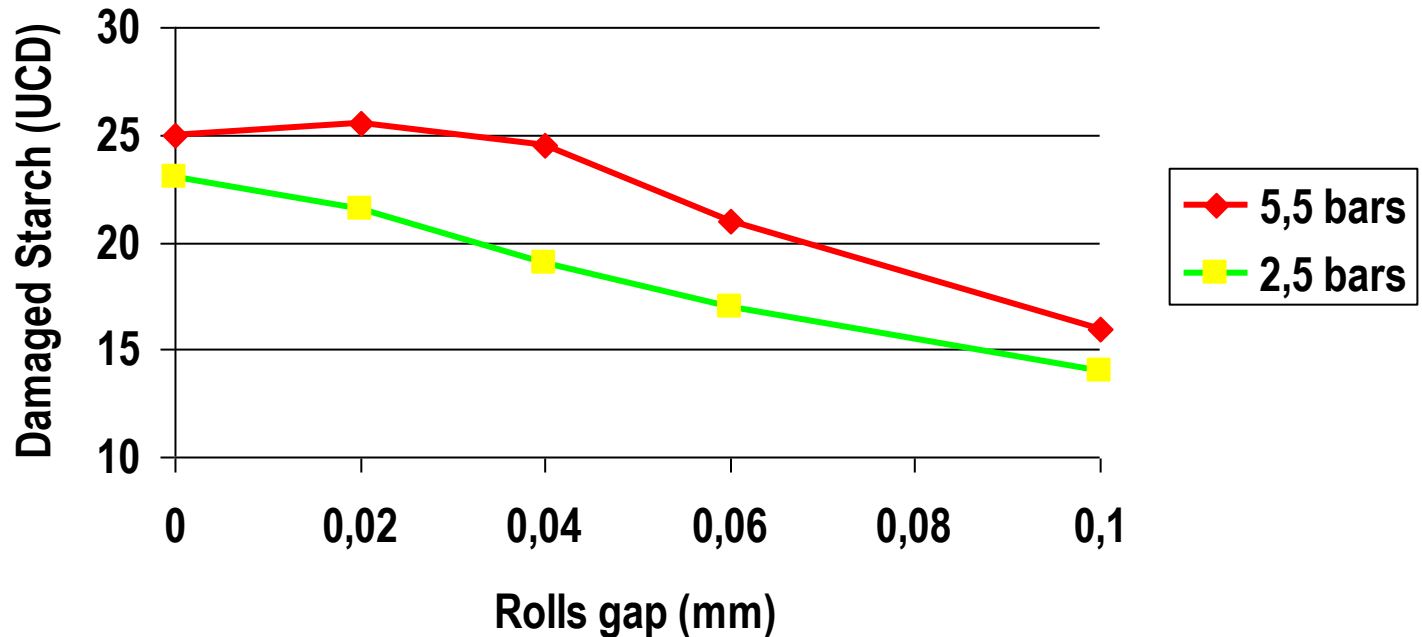
Damaged starch = f (Rolls pressure)



Where does it come from ?

B/ Mechanical criteria

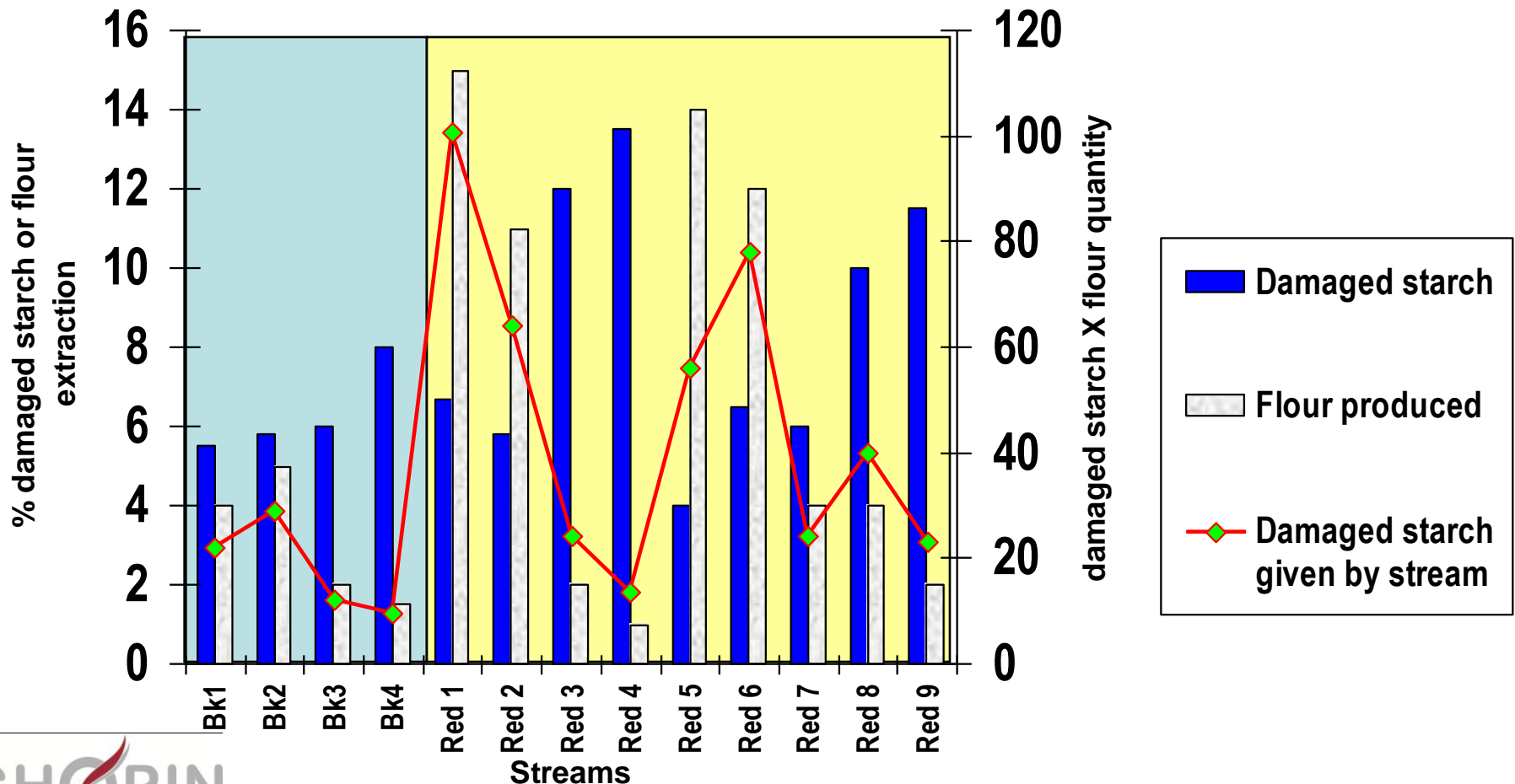
Damaged Starch = f (Rolls adjustments)



Where does it come from ?

B/ Mechanical criteria

Diagram Study



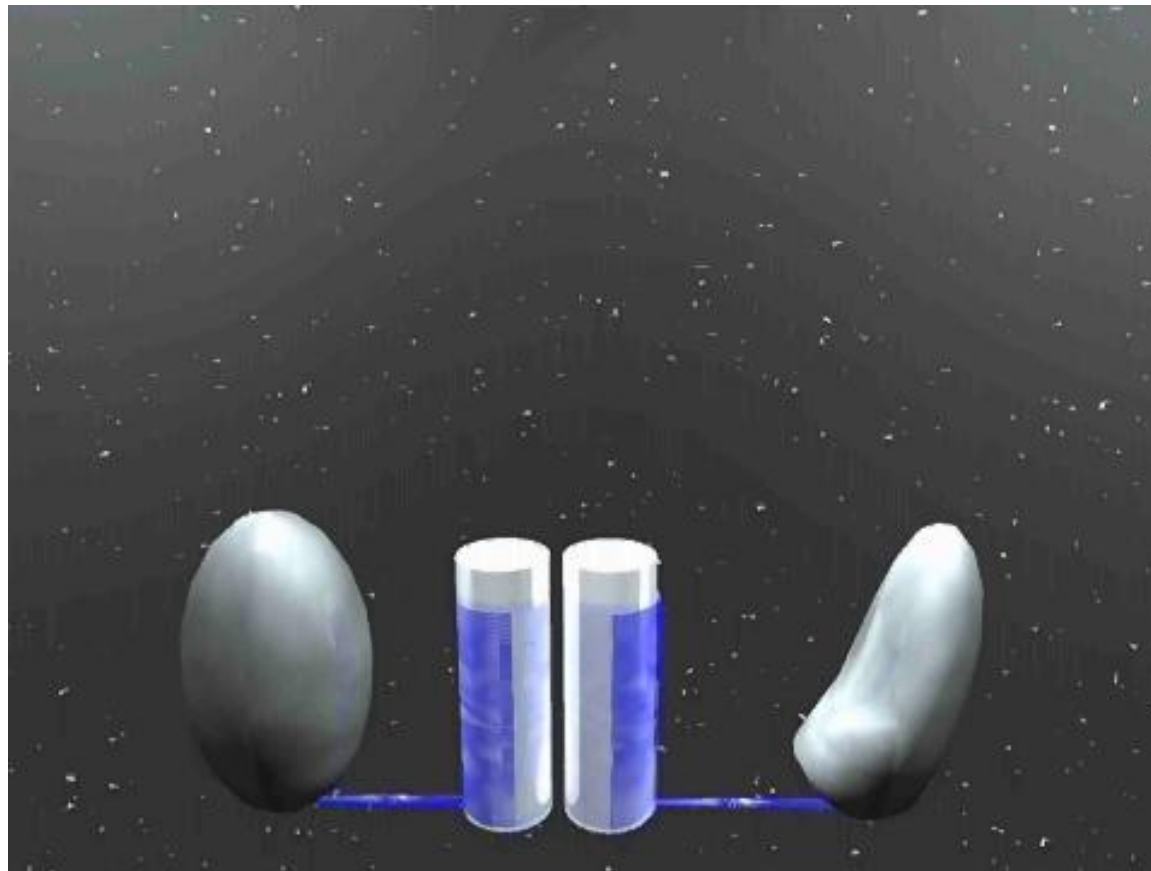


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Absorption



Protein absorbs
1.8 times its
weight of water

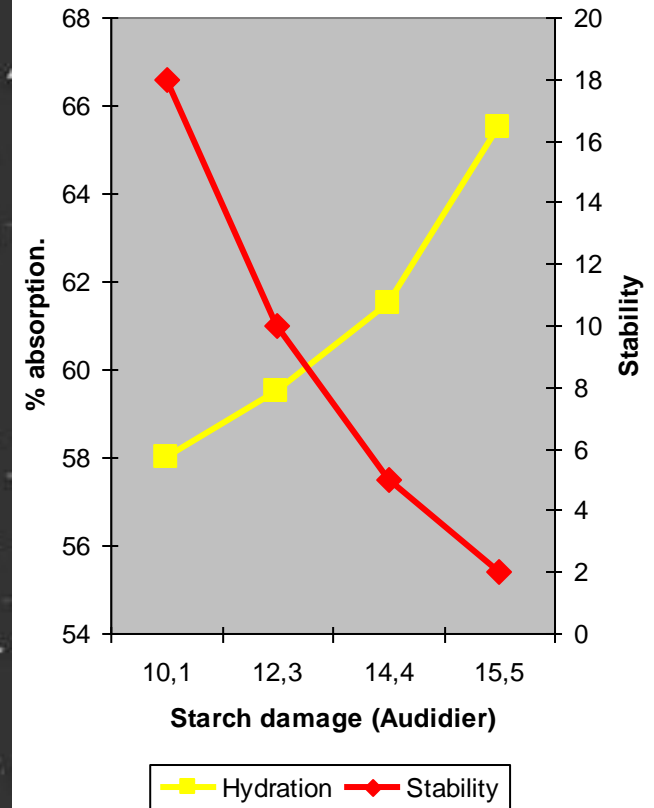
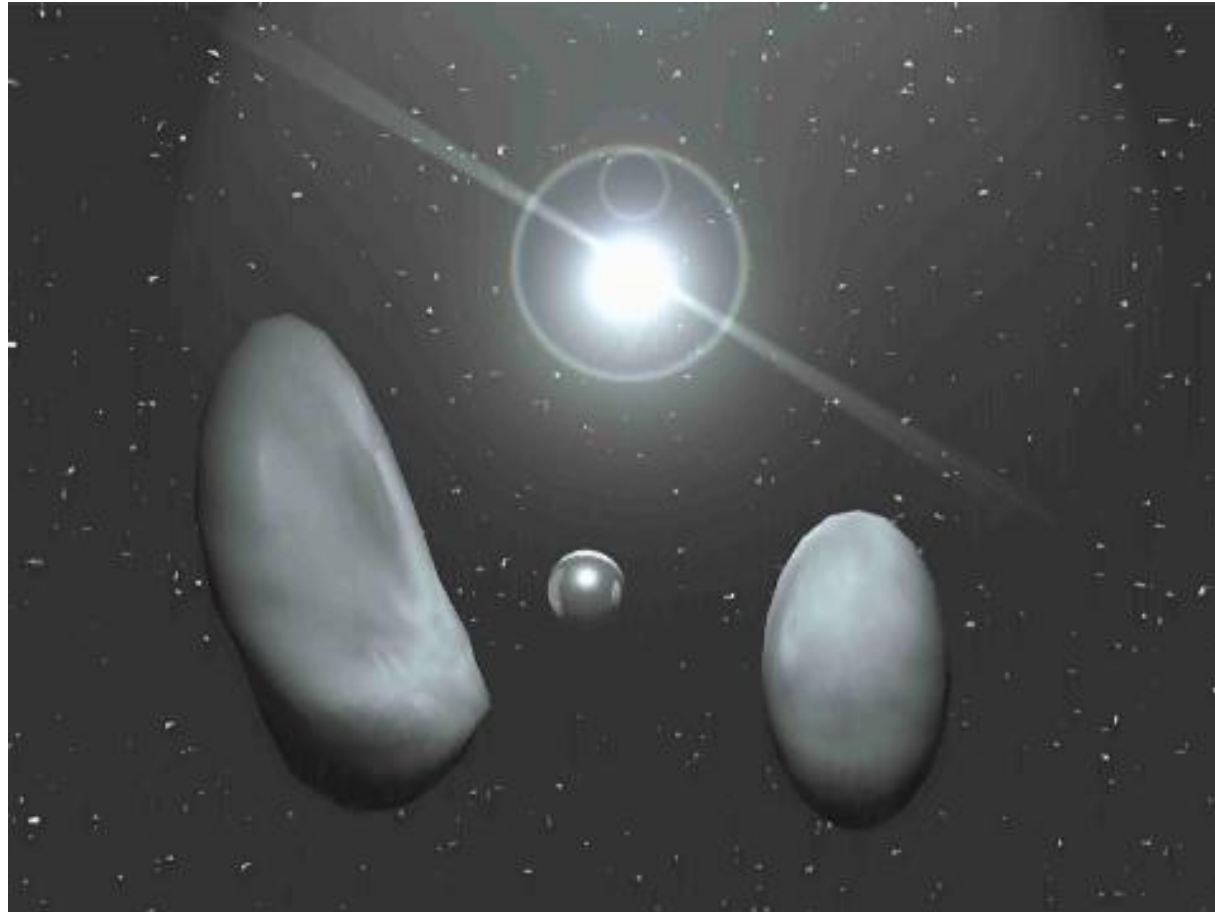
Pentosans 10
times..

Native starch 0.4
times...

Damaged starch
4 times...



Water Release



Why to care about damaged starch?

| | What we look for | To be avoided |
|----------|--|---|
| Kneading | <ul style="list-style-type: none">• A High yield (Water absorption capacity)• Good tolerance | <ul style="list-style-type: none">• Sticky dough• Low hydrating flour |
| Molding | <ul style="list-style-type: none">• Good tolerance• Good behavior | <ul style="list-style-type: none">• Sticky dough• Dough too tough or soft |
| Proofing | <ul style="list-style-type: none">• Good volume• Taste development | <ul style="list-style-type: none">• break down of dough with little volume |
| Baking | <ul style="list-style-type: none">• Volume increase• A good color | <ul style="list-style-type: none">• Dough collapsing in oven• Breads too “red” |
| After | <ul style="list-style-type: none">• A good taste• A good conservation | <ul style="list-style-type: none">• Too fast crumb hardening |

In yellow, damaged starch action spots



How does it act ?

- Alongside with the action already determined on hydration, starch damage has an action on :
- Dough plastic characteristics
- Proofing
- Bread crust color





How does it act ?

Effects on proofing characteristics

- **Amylases can't attack a native starch granule.**
- **More damage more attacks are possible.**
- **Breaking the granule molecules liberates water.**
- **Simple sugar are present and create :**
 - Intense yeast activity (a lot of CO₂)
 - Coloration possibility higher.





How does it act ?

Effects on final product

- Higher input of water allows to keep the loaf fresh longer.

But :

- Simple sugar release provokes a very red crust
- If intense, damaged starch can be responsible for :
 - Sticky crumb
 - No volume bread
 - Too red bread.





How does it act ?

Effects on final product

- If I do not have enough starch damage, I can :
 - Set the process differently
 - Choose a harder type of wheat...
 - Both of them...
- If I have to many starch damage, I can :
 - Take care of amylases content (falling number)
 - Add gluten to increase rheological properties.
 - Set the process differently
 - Change wheat for a softer one...

In every case, we see the necessity for measuring the damaged starch in the flour !!!



All concerned!

- « Proofed » Bread
- Flat breads
- Biscuits
- Noodles, fideos (wheat flour)
- « Durum » Wheat
 - For breadmaking
 - For pasta
- Tortillas !!...



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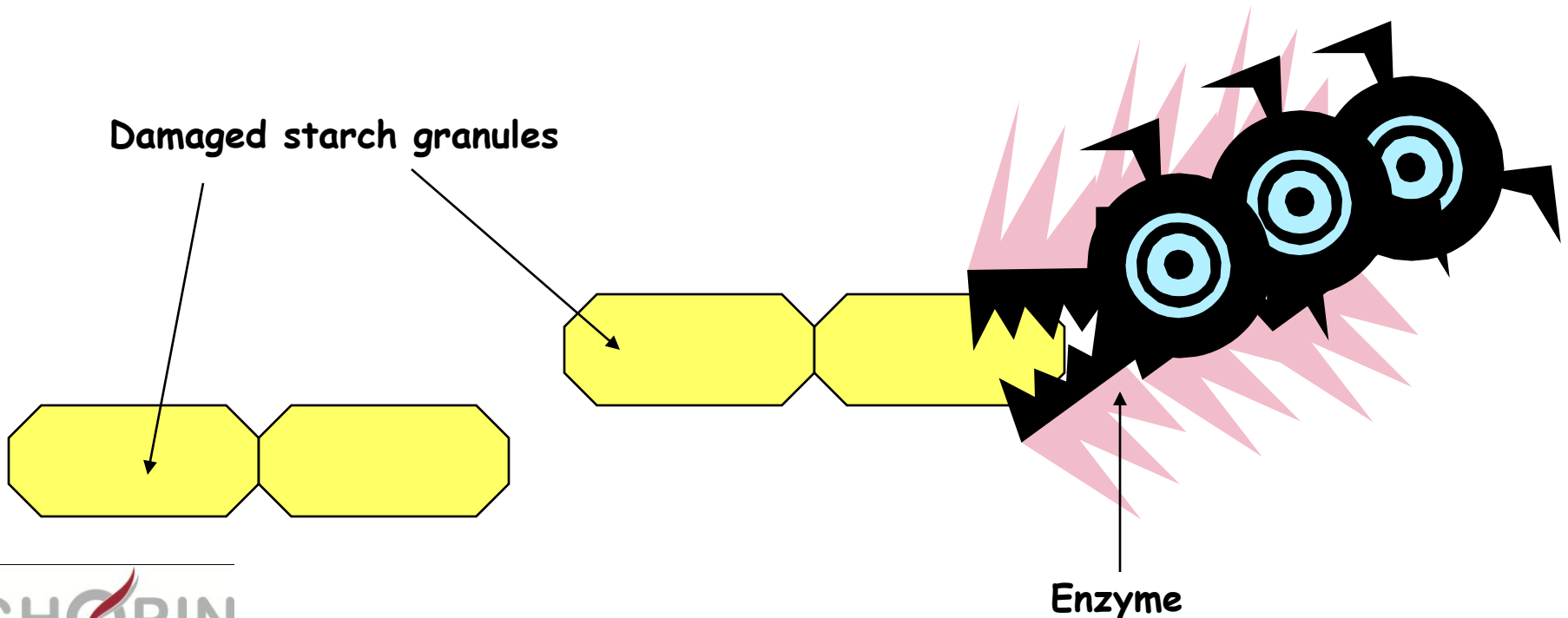
How to measure it ?

Existing methods :

- Colorimetric
- Polarimetric
- Spectrophotometric
- Enzymatic
- Amperometric

Enzymatic method

This method determines the ***percentage*** of starch granules in flour or starch preparations that are susceptible to ***hydrolysis by α -amylase***.





What do you need?

- **Equipment :**
 - *Constant- temperature bath (30°)*
 - *Micro-buret (10-ml)*
 - *Test tubes Pyrex (25 x 200-mm)*
 - *Spectrophotometer (only for Spectrophotometric method)...*
- **Reagents :**
 - *Acetate buffer*
 - *H₂SO₄ solution*
 - *Sodium tungstate solution*
 - *α-Amylase preparation...*



Long and hard procedure

- More than 10 **manipulations**
- Several **preparations** of reagents
- Strict **control** of environmental parameters
- Extreme **precision in times and temperatures**
- **Calculation** to carry out



Standards

3 Methods defined by 3 standards :

- ✓ **AACC 76-30** (manual method)
- ✓ **AACC 76-31** (spectrophotometric method)
- ✓ **ICC 164** (Megazyme enzymatic kit)

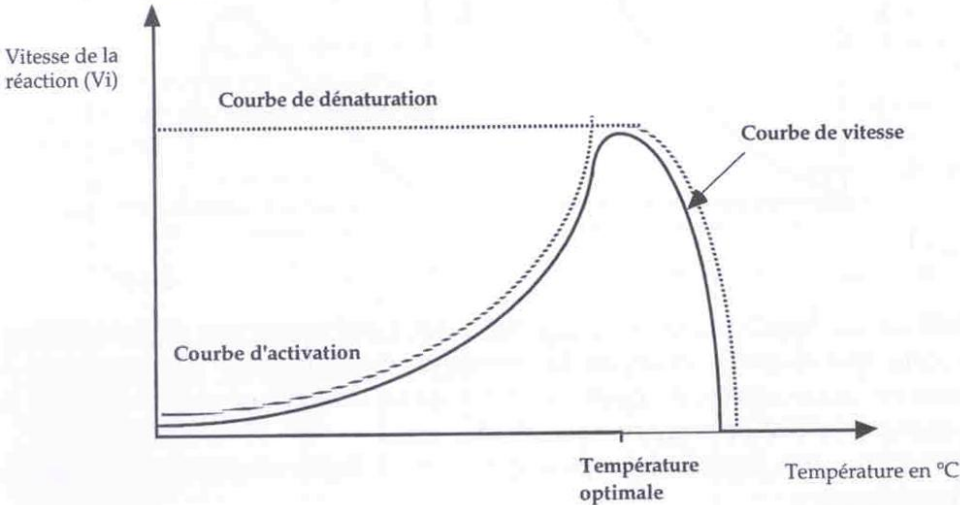


Why 3 standards?

- ∞ The *manual method* is a basic method, long and tedious. Starch damage is determined chemically.
- ∞ *Spectrophotometric method* needs two different operations with enzymes in order to separate glucose particles. Use of the spectro enables to determine starch damage more precisely.
- ∞ *Megazyme kit* contains several of the reagents to use during the process in predefined quantities (for 200 tests) and constant quality, in order to reduce manipulations.

Difficulties

Enzymatic method plants difficulties related to several parameters because enzyme efficiency changes according to :

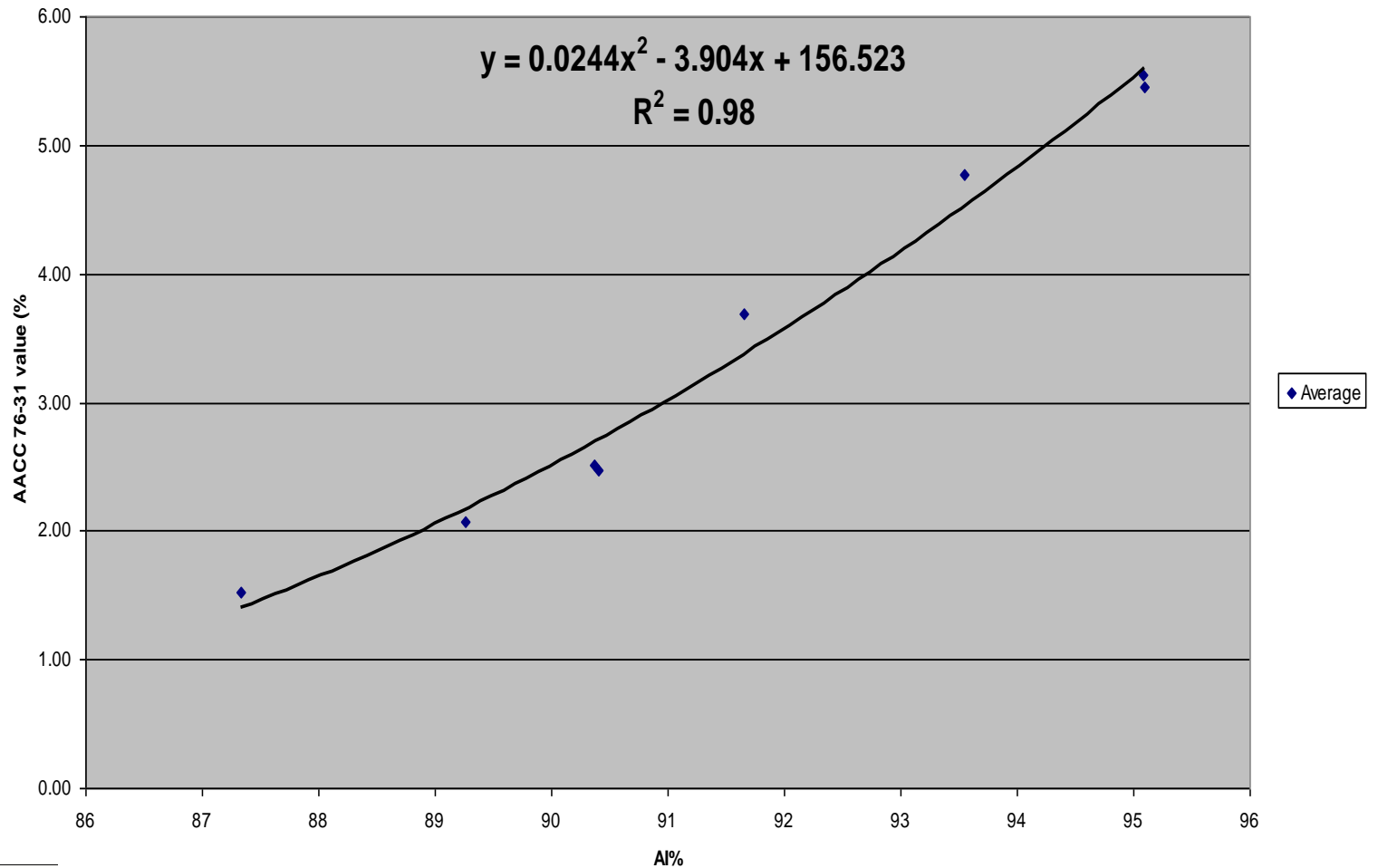


- ⇒ ***PH*** of liquid solutions.
- ⇒ ***Temperature***, external and internal.
- ⇒ ***Enzymatic intrinsic activity***.
- ⇒ ***Time*** of incubation of flour samples and manipulations.

Thus, these four parameters have to be strictly controlled and constant.



AACC 76-31 Vs AI%





Amperometric method

- **Medcalf & Gilles** method, 1965.
- This method determines the **quantity** of starch granules in flour or starch preparations that are susceptible to **absorb iodine**.



Procedure

- ① Preparation of a ***iodine solution*** based on chemicals reagents.
- ② Iodine creates ***electric flow***.
- ③ When ***iodine fixes on damaged starch***, current intensity decreases.
- ④ The ***less intensive*** electric current is, the ***more damaged starch*** is present in flour.



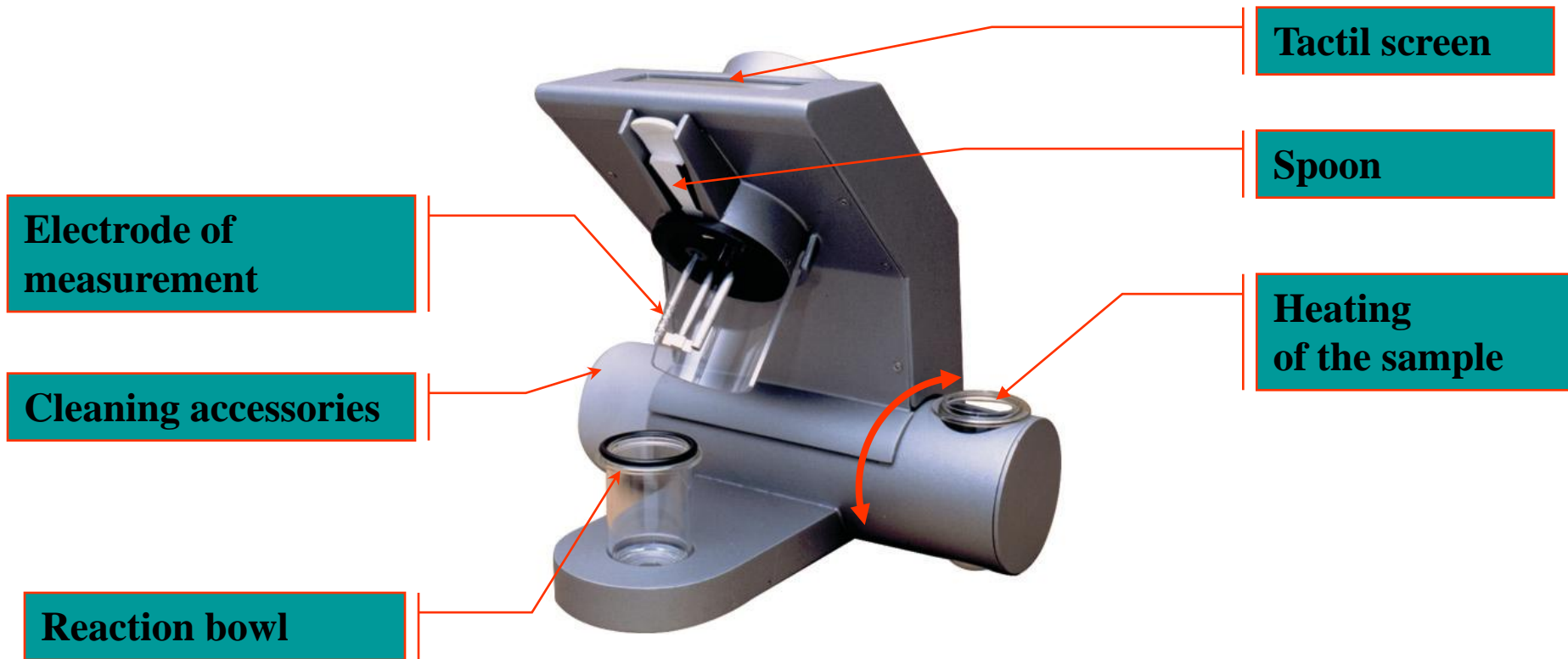
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SDmatic

- Composition -



Informatic system - Sensitive Screen-



Test

Control

Maintenance

- User-friendly
- Tactile Screen
- Simple Menus
- Possible automatic control of the important parts

Solution preparation



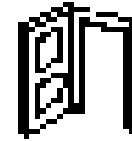
Products in powder

- **No preparation is required !!**
 - 120 ml of distilled water +/-0,1ml
 - 3 grams of Boric Acid (H_3BO_3) +/- 0,2 g
 - 3 grams of Potassium Iodide (KI) +/- 0,2 g
 - 1 drop of Sodium Thiosulphate
- **No precise weighing is required !!**

Test Preparation



Farine : 1.000g
H2O : 14.00%
Prot : 12.00%ns



- 1 gram of flour +/- 0,1g
- Quick Preparation
- It does not require qualification
- Quick Test (10min.)
- Automatic Stop

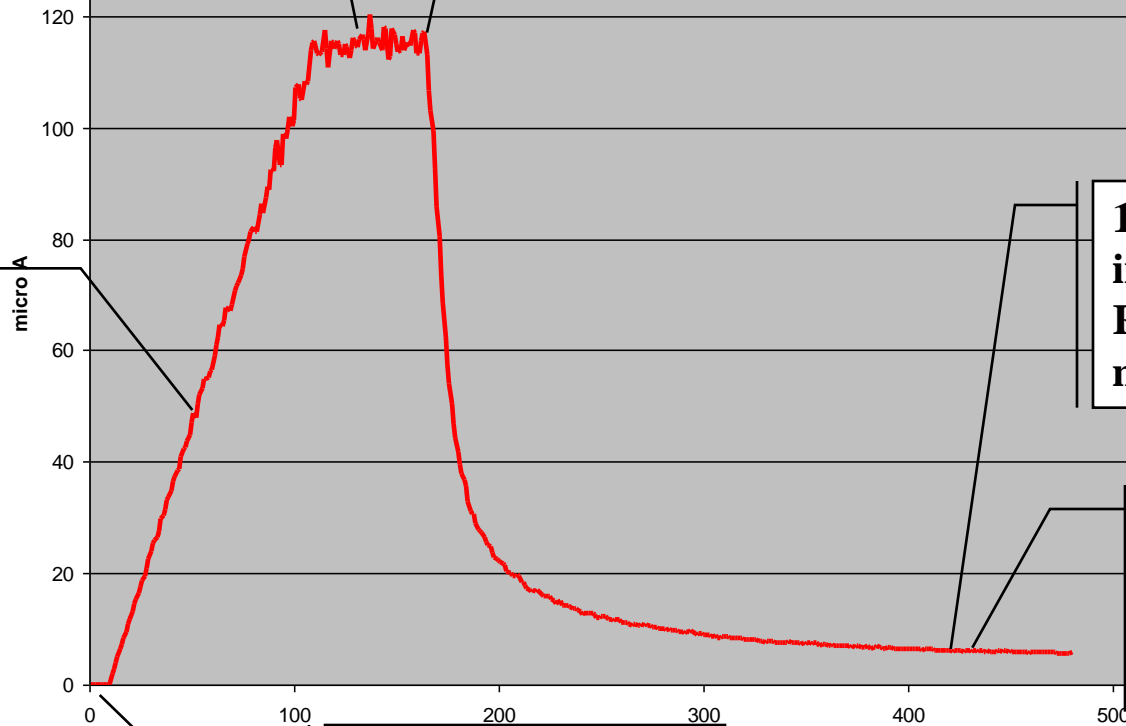


Measurement principle

Maximum value measurement
(I_m)

Flour incorporation

Iodin generation as a function of flour weight (100 s for 1 gram)



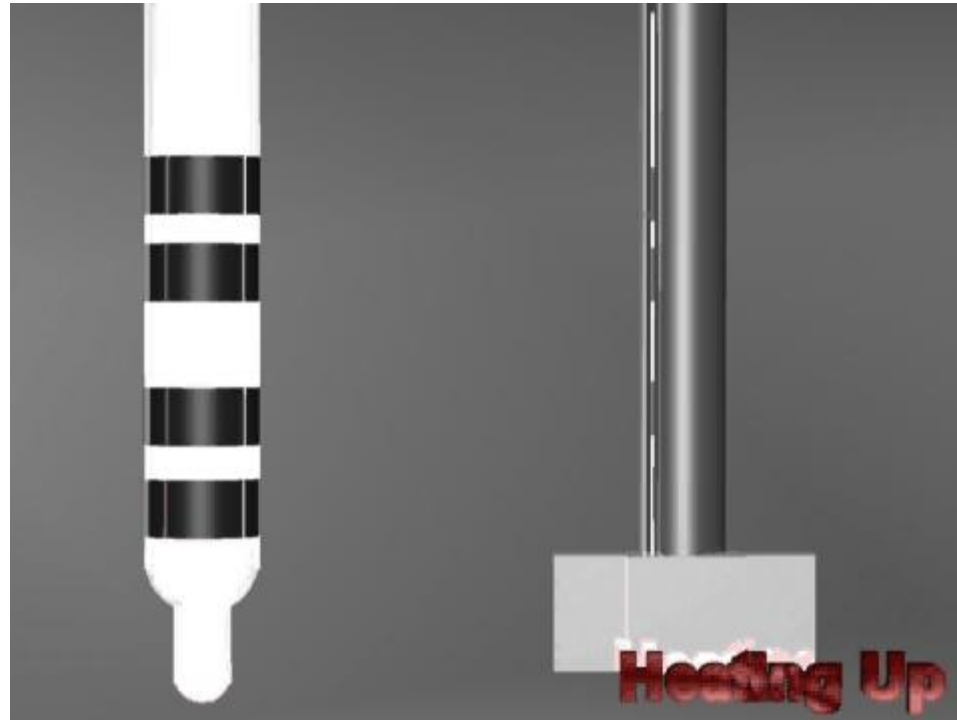
180 s after flour introduction
Residual current is measured (**I_r**)

$I_r/I_m = AI$
Damaged starch measurement

« 0 » measurement since 35°C is reached



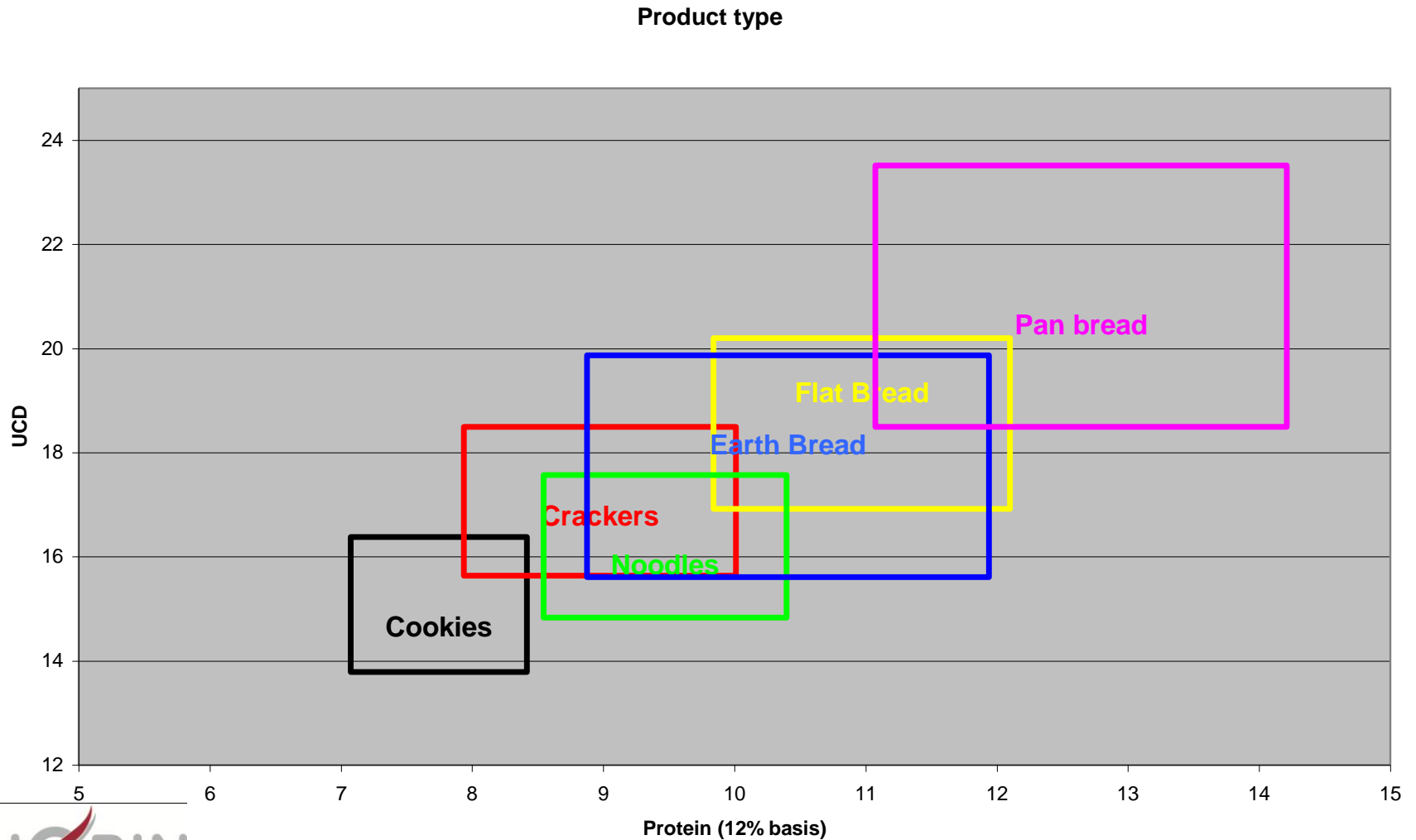
Measurement



- At the end of the test, the SDmatic measures the residual current.
 - More damaged starch, more fixed iodine.
 - The residual current decrease.



Products Classification / damaged starch and protein content





Comparison with the enzymatic methods

| Method | Rank of values | Accuracy of the method | Accuracy of the method |
|----------------|--------------------|------------------------|------------------------|
| SDmatic | 12 - 28 UCD | +/- 0,6 UCD | +/-3% |
| FARRAND | 10 - 45 units | +/- 5,0 units | +/-18% |
| AUDIDIER | 10 - 18 % | +/- 1 % | +/-7% |
| AACC | 4 - 9 % | +/- 0,7 % | +/- 13% |



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Conclusions

The damaged Starch

- can not be avoid during the milling process.
- can be controlled at the mill level.
- has a positive influence on the water absorption.
- can lead to disastrous results during bread making.

Enzymatic methods are not simple.

However, it is necessary to find the optimum level for each bread making process.

Damaged Starch

- **SDmatic**

- Results expressed in UCD, AACCC, Farrand
- Sample 1 g of flour, less 10 min for the test.
- Use a simple method compared to classical (enzyme) methods.
- Self-calibrate automatically before each test
- Benefits

- Hydration control (optimization)
 - good baking yield avoiding sticky dough
 - Biscuit cracks control
- Parallelism + replacement cylinders control
- Setting mill when new wheat harvest

– **New Standard ICC 172**



Thank you very much
for your attention



www.chopin.fr