A Reverse-Engineering Approach to Improve Pasta Quality.

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Growing Pasta Consumption.

Market Drivers:

- Quality

- Affordability

- Local Raw Material use

- Convenience

- Health

The most dynamic growth markets 2017 are in Asia (+ 8.6%) and Africa (+ 2.6%), pasta trends are positive in Europe, based on data from the I.P.O.


**Food Business Africa 2017:** Locally Produced Pasta in Ethiopia

Reverse-Engineering.

- A general approach starting from consumer preferences to raw material characteristics.

  – Identification of key features (preferences).

  – Assessing physical-chemical bases to innovate.

  – Redesigning process and products from end-products to raw materials.

  – Organizing sourcing according to end-uses.

  – Managing genetic resources and biodiversity.

- Integrated solutions to optimize quality and cost with more flexibility for the supply chain.
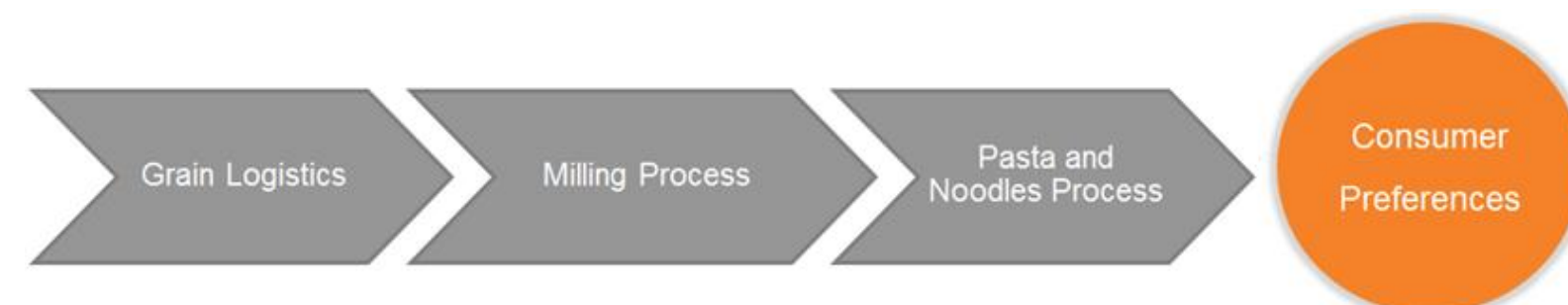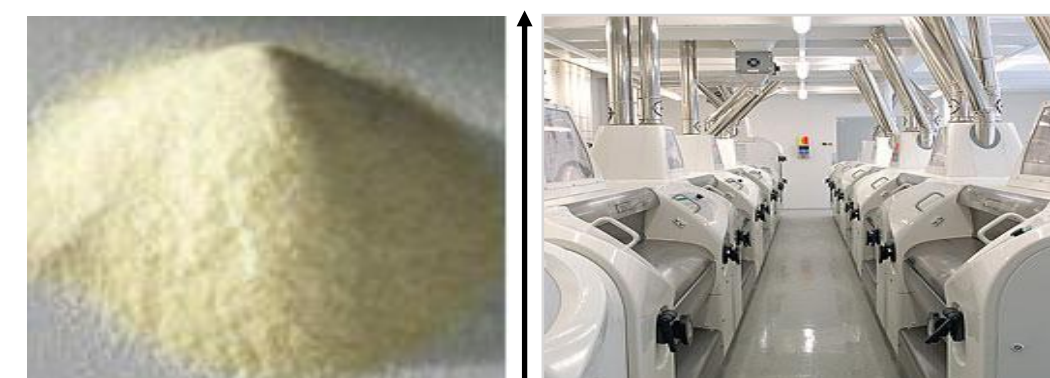
Consumer Preferences
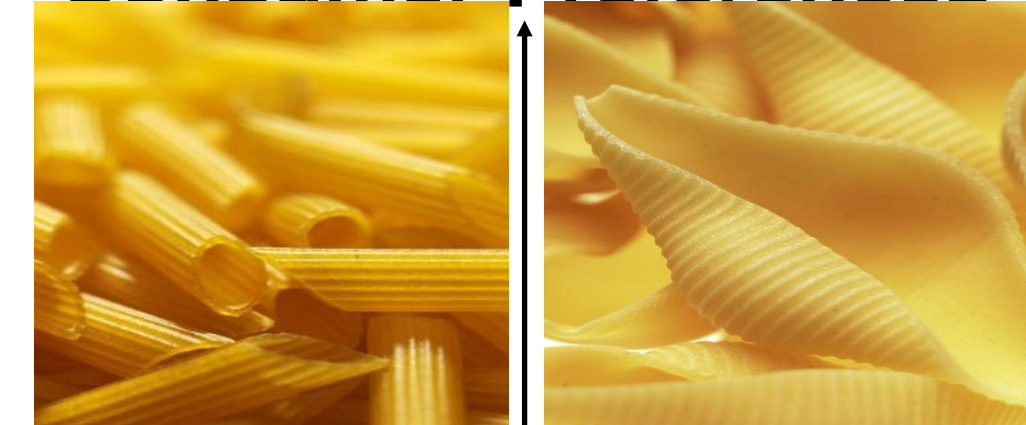
Pasta processing

**Milling processing**

Grain Quality Procurement

Grain Logistics → Milling Process → Pasta and Noodles Process → Consumer Preferences

Pasta Quality Attributes.

|	Parameters	Physicochemical basis

Sensory Aspects	Color: Yellow Index
	   Brown Index
	   Red Index
	
	Cracks: In- and outside
	
	Specks: Black
	   Brown
	   White
		Carotenoids, LOX
		Polyphenol-oxidases
		Maillard reaction
		
		Drying conditions
		
		Ergot, Milling conditions
		Milling conditions
		Hydration and mixing

Cooking Quality	Visco-elasticity Surface condition Cooking losses	Proteins quantity and composition Pasta process shear and hydrothermal treatment Protein & Starch
Nutritional Quality	Calories, Fibers Glycemic Index Micronutrients Amino Acid Balance	Starch Pentosans (soluble, insoluble) Protein network Vitamins, minerals

Pasta Quality Evaluation.

Cooking Quality Parameters

- <u>Cooking losses</u>: residue in cooking water

- <u>Surface condition</u>: Stickiness and surface disintegration
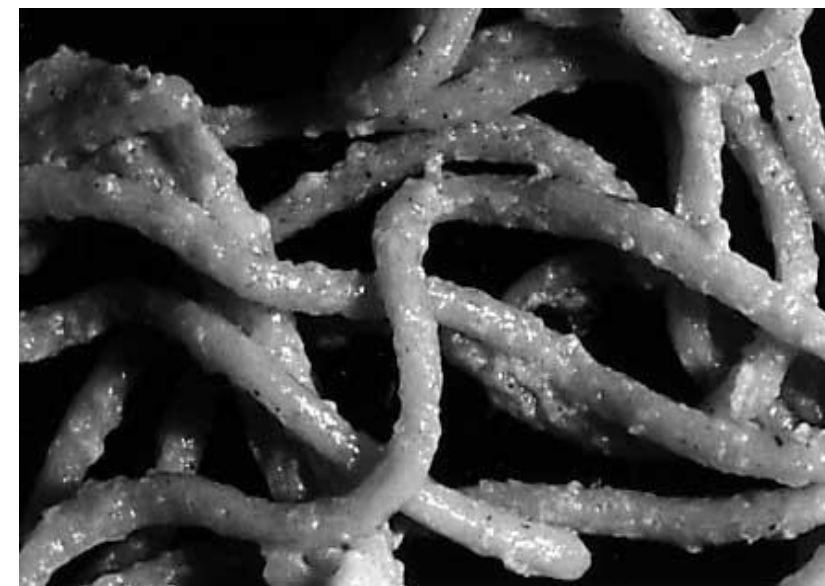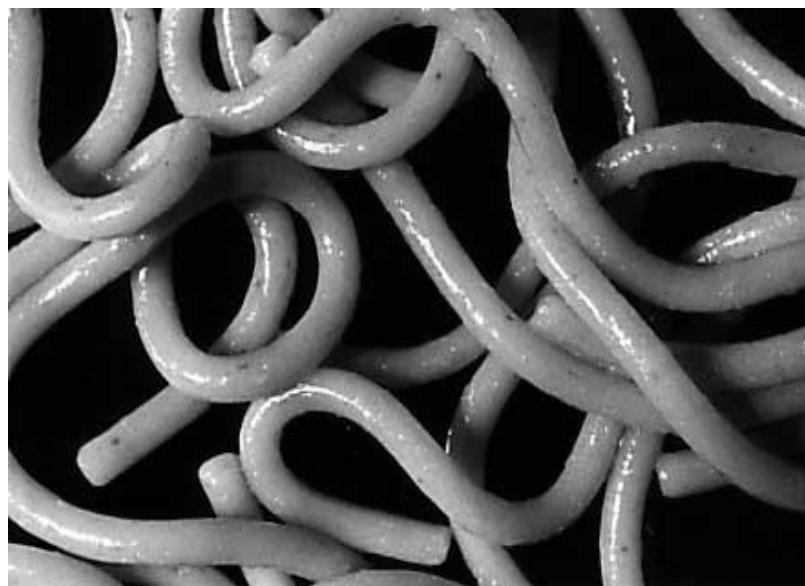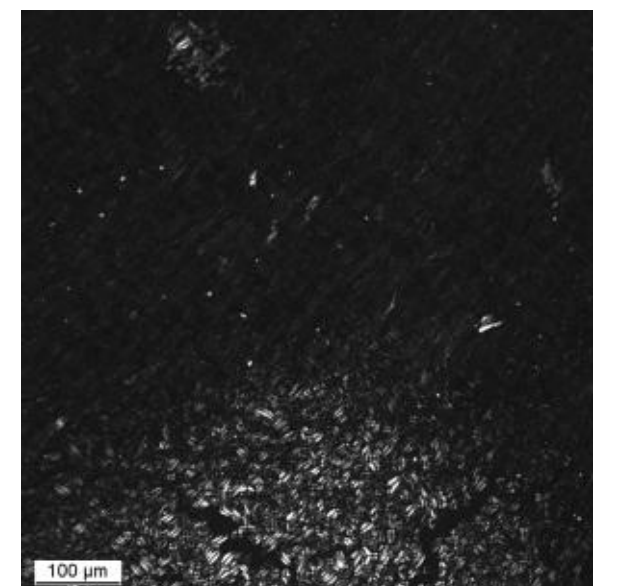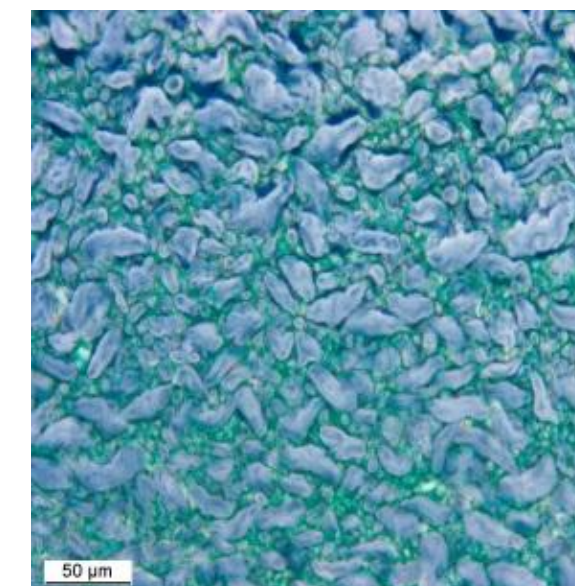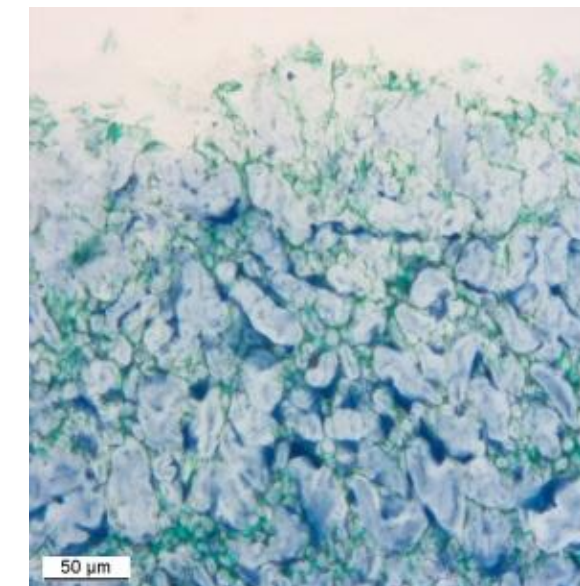

- <u>Visco-elasticity</u>: Firmness and elasticity
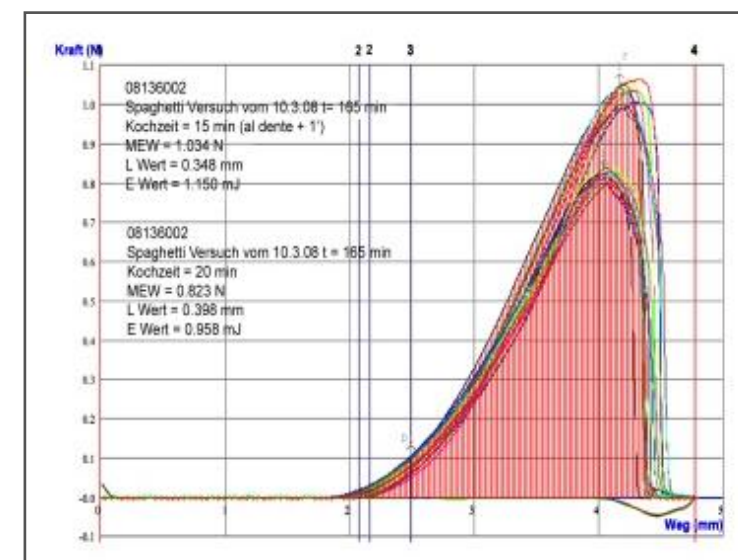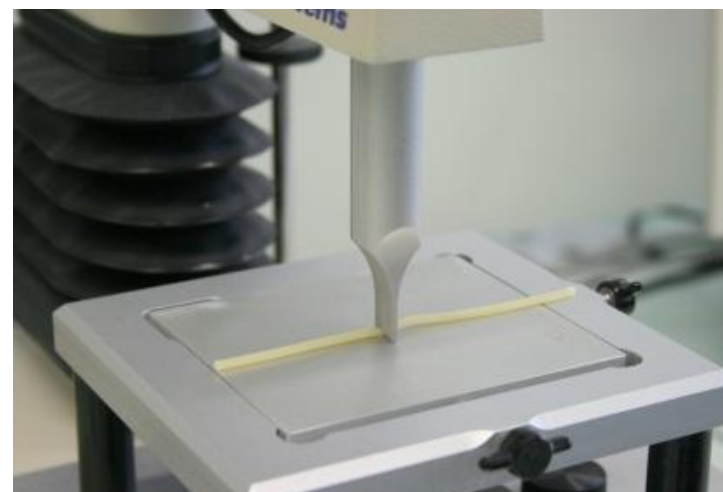
Physico-chemical base

- Starch/protein distribution and their transformation during cooking

- Starch gelatinization and melting of amylose-lipid complexes (DSC)

- Light microscopy of unstained (polarised light) and stained (bright field) cryosections. Magnification up to 1'000x

Pasta Processing.

Process semolina or flour (*particulate structure*) into a dough (*continuous structure*) of defined shapes:

... by adding water to:

- Activate semolina and flour components (proteins)

... and by supplying mechanical energy to:

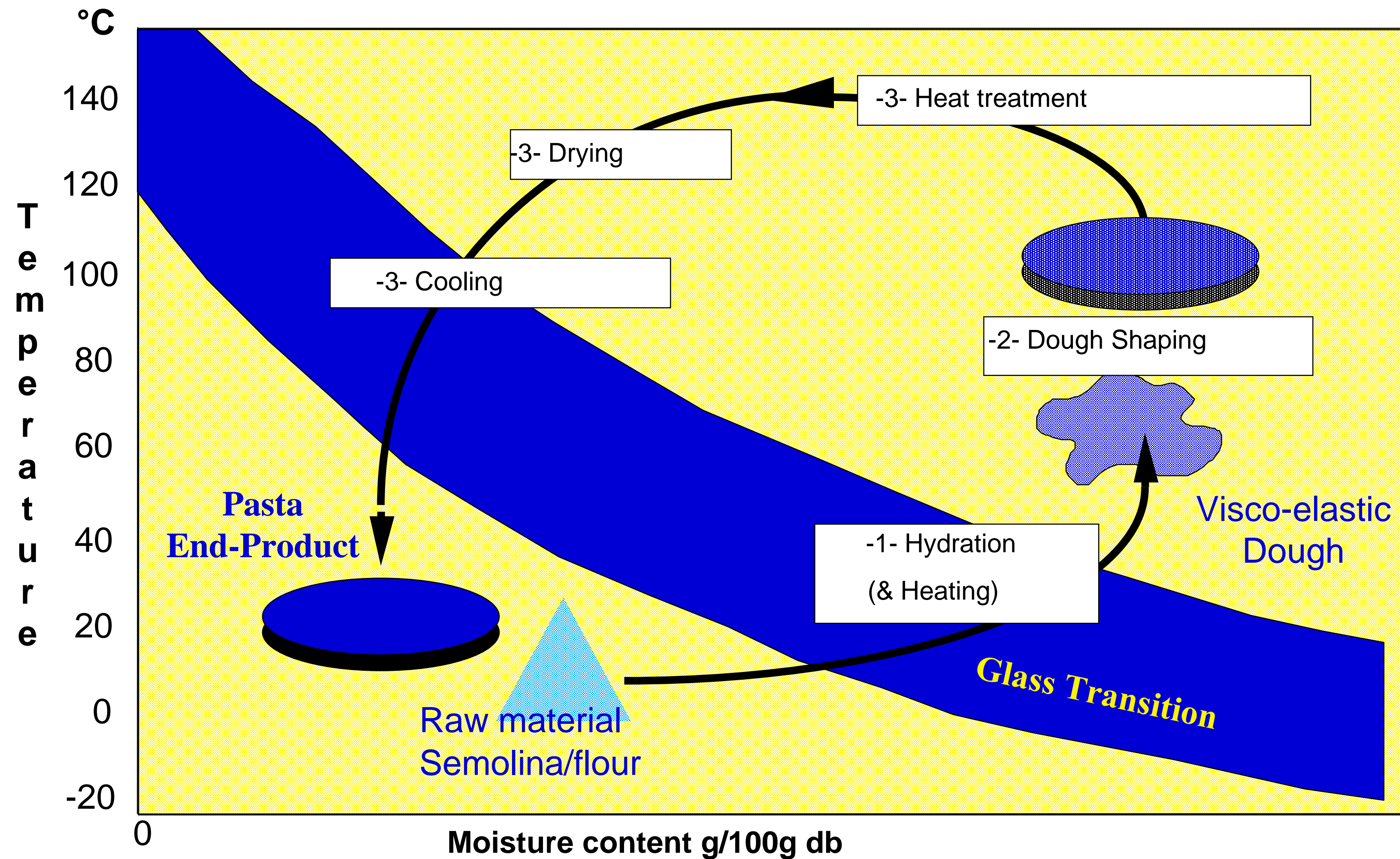- Promote the formation of interactions between components
- Forming a structured network and a continuous dough
- Give the product a special shape

… and finally to remove the water added to:

- Stabilize structure
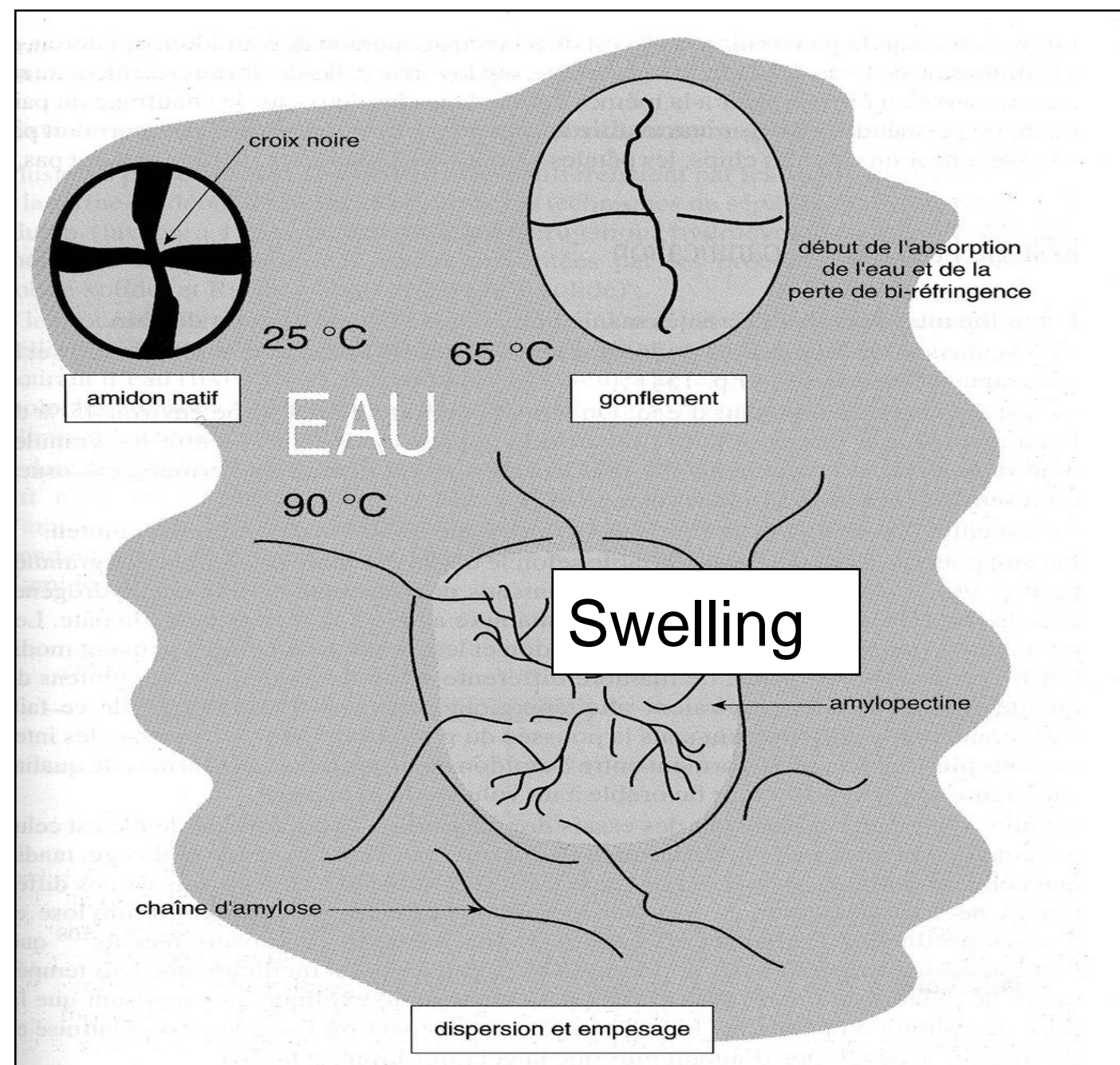- Increase the shelf life
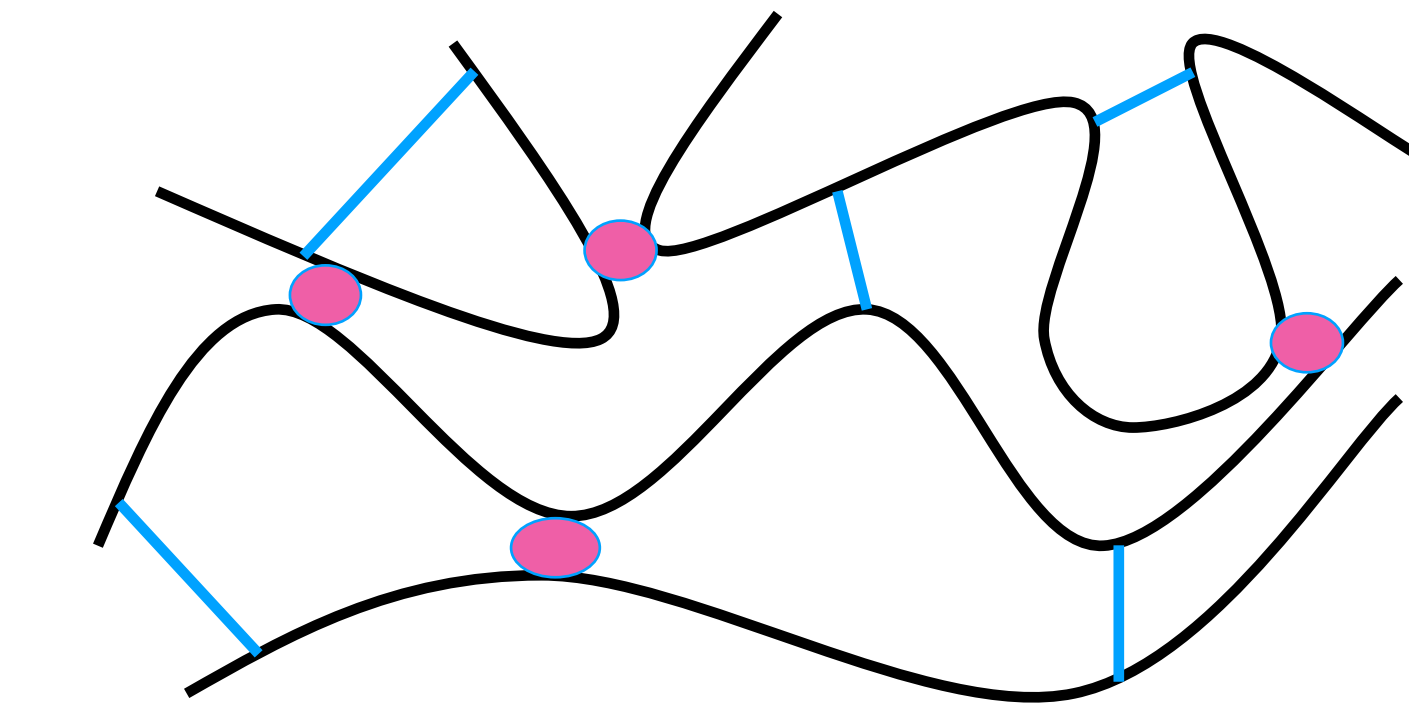
Glass Transition & Pasta Processing.

Pasta Extrusion.

Structuring a continuous network able to resist to starch swelling during cooking process

Starch Swelling and Gelatinization


— Disulfide bond (elasticity)

⬤ Non Covalent bond (viscosity)

*Protein Network structuring and denaturation*

Pasta Extrusion and Glass Transition.

- A precise hydration to activate semolina and flour components to reach glass transition of proteins

- Avoiding shearing and heating which are detrimental for the protein network

- For gluten free, modifying starch component by heat treatment is necessary to obtain binding capacity
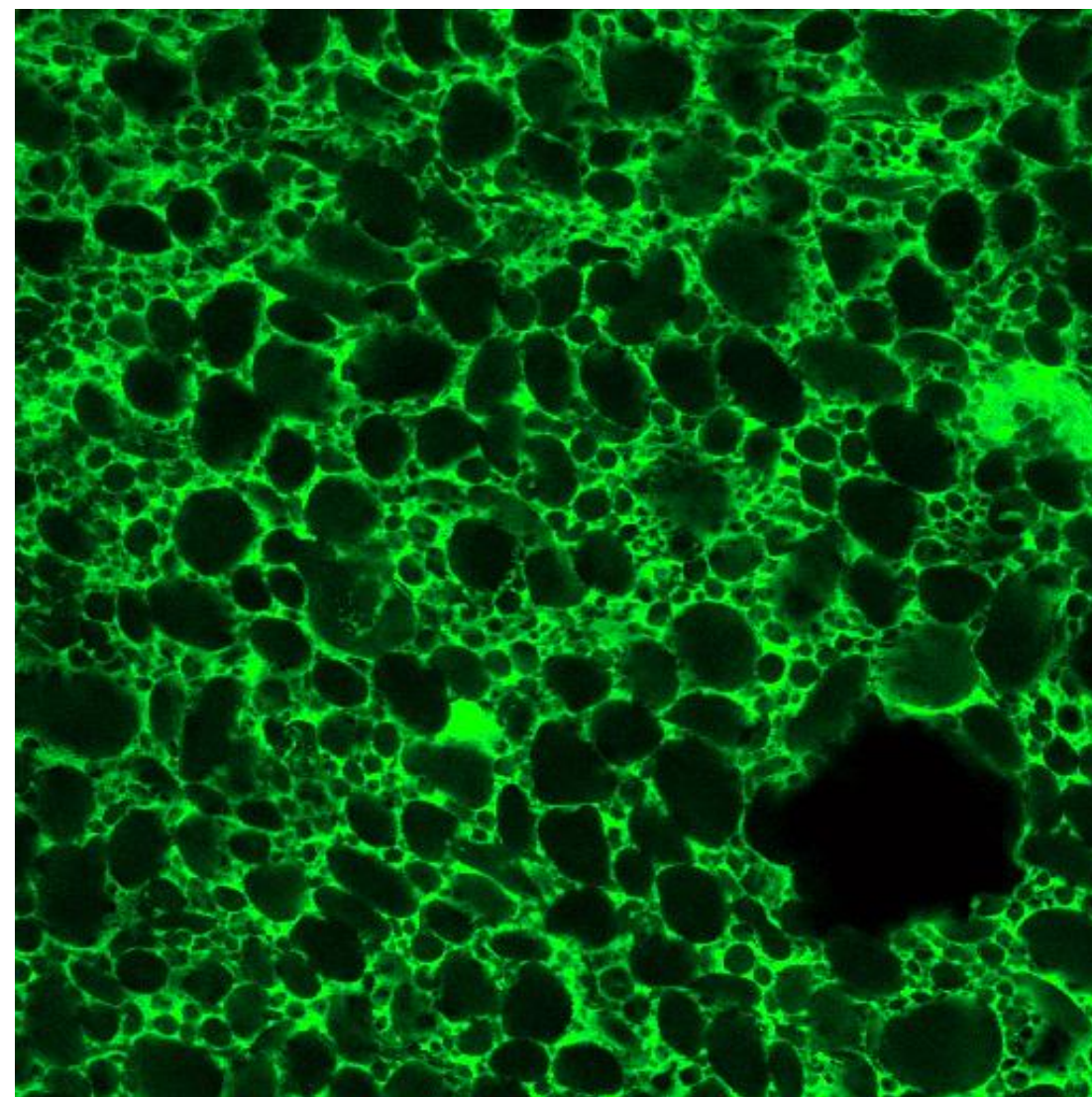
Confocal laser scanning microscopy.
green: protein phase
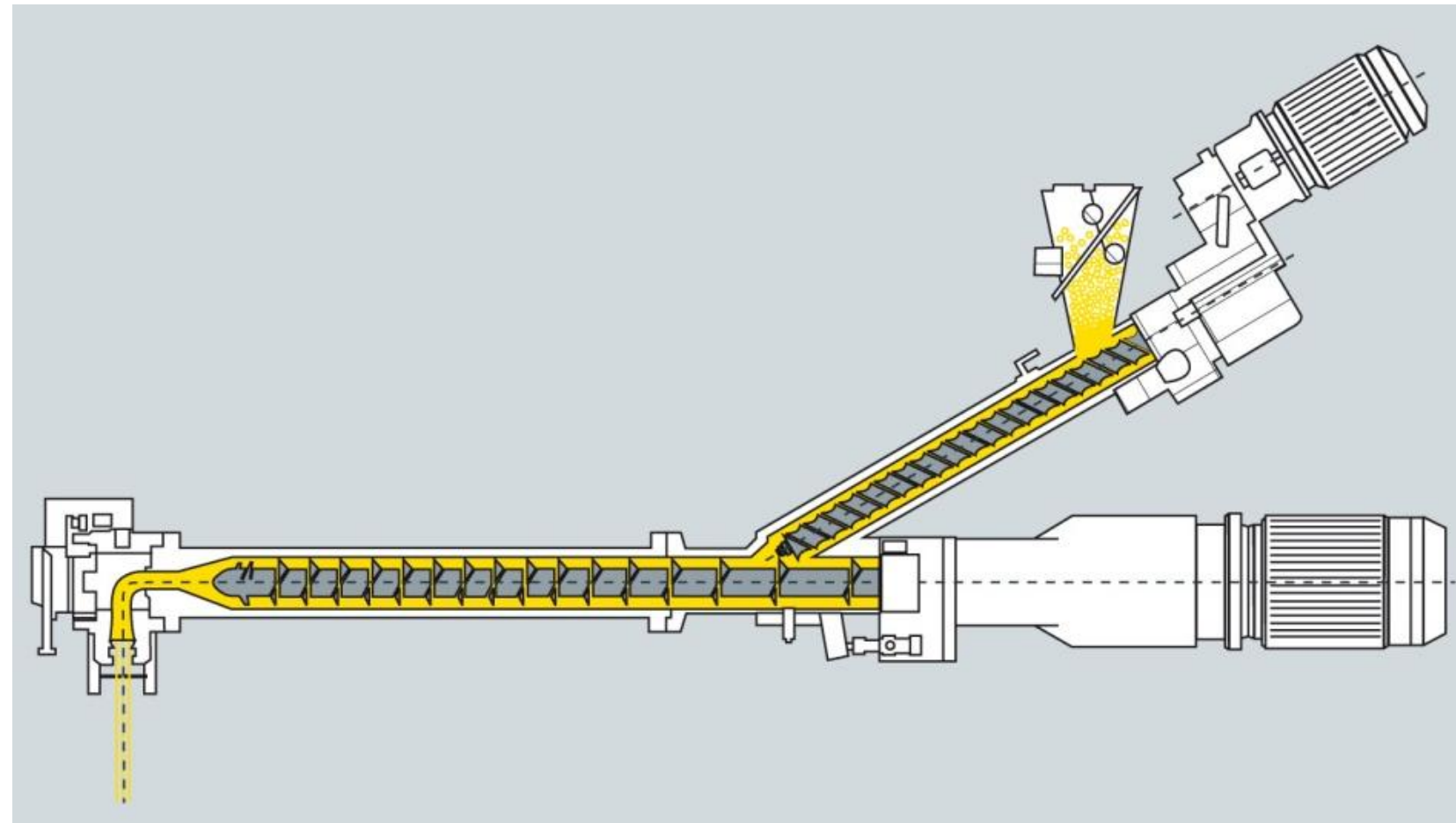black: starch granules
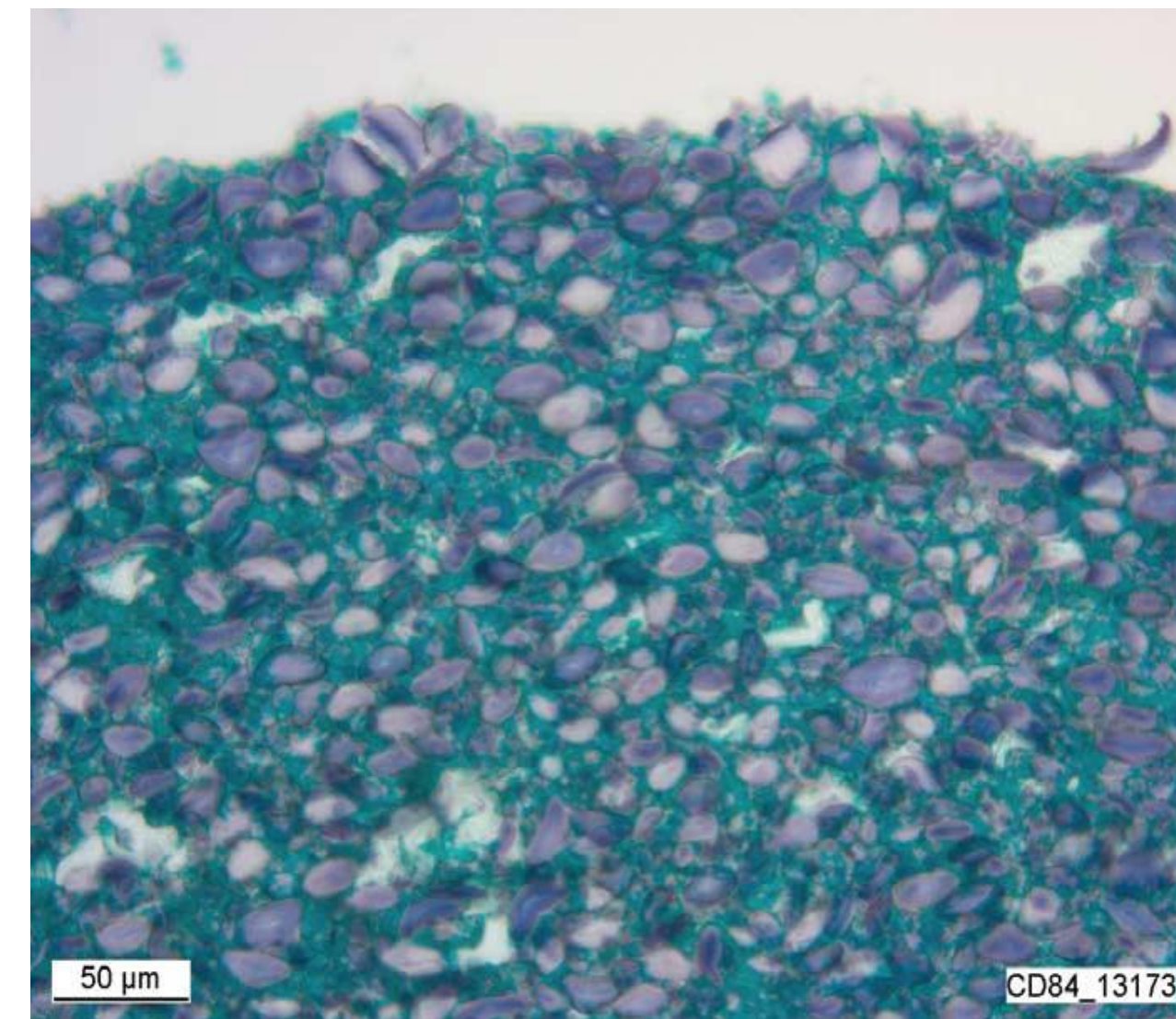
Light microscopy.
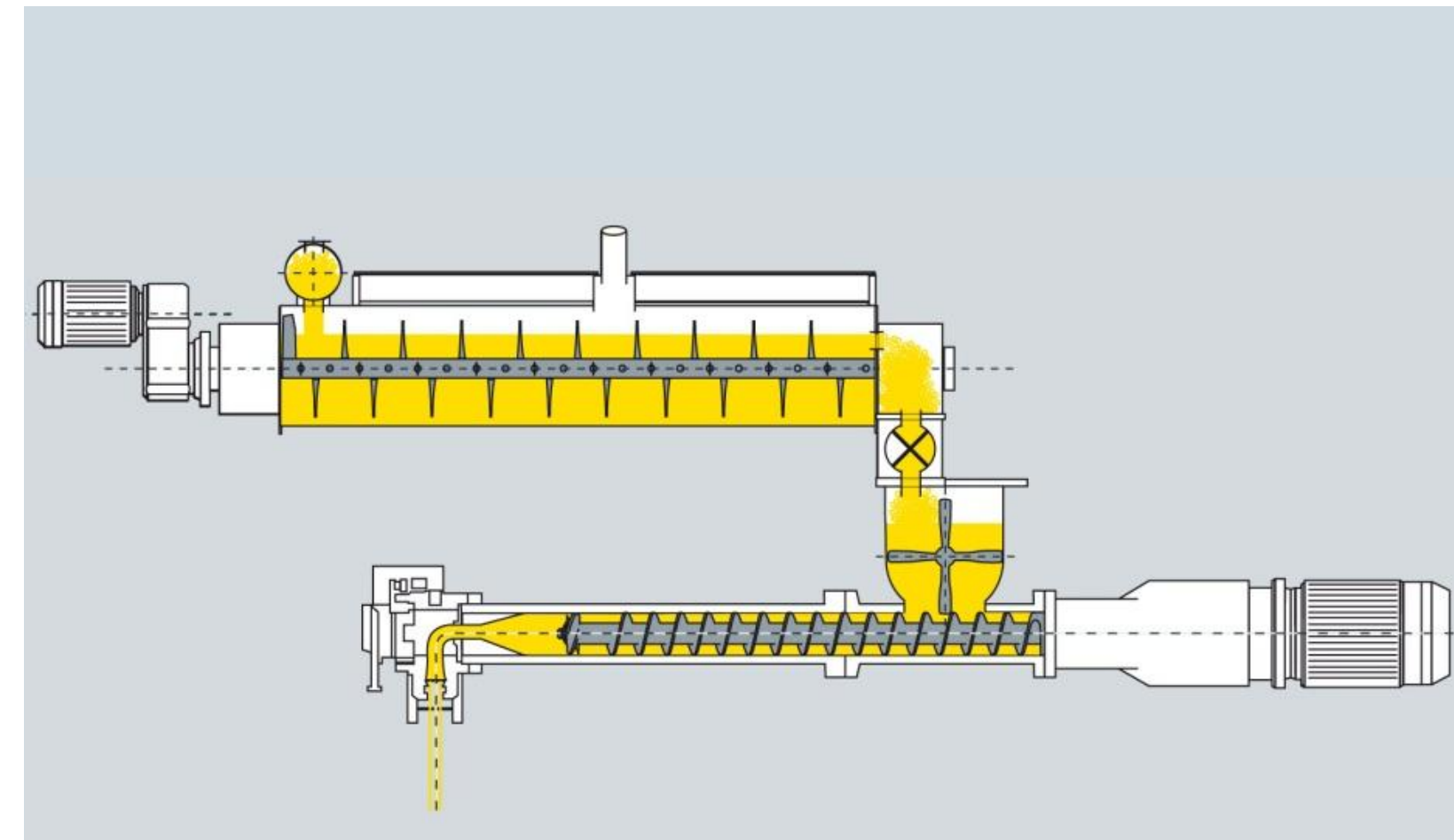green: protein phase
purple: starch granules

Pasta Extrusion.

Polymatik™

Priomatik™

- For fine semolina, flour & and gluten free materials
- Highest hygienic standard
- Fast recipe changes

- Especially suited for coarse semolina
- Long retention times for full hydration of coarse semolina

Pasta Drying Targets.

- Eliminate water used for shaping to ensure long shelf life of finished products.

- Limit stress generated by water transfer to avoid cracks.

- Stabilising and reinforcing the network formed during extrusion by exploiting glass transition concept.

Pasta Drying and Glass Transition.
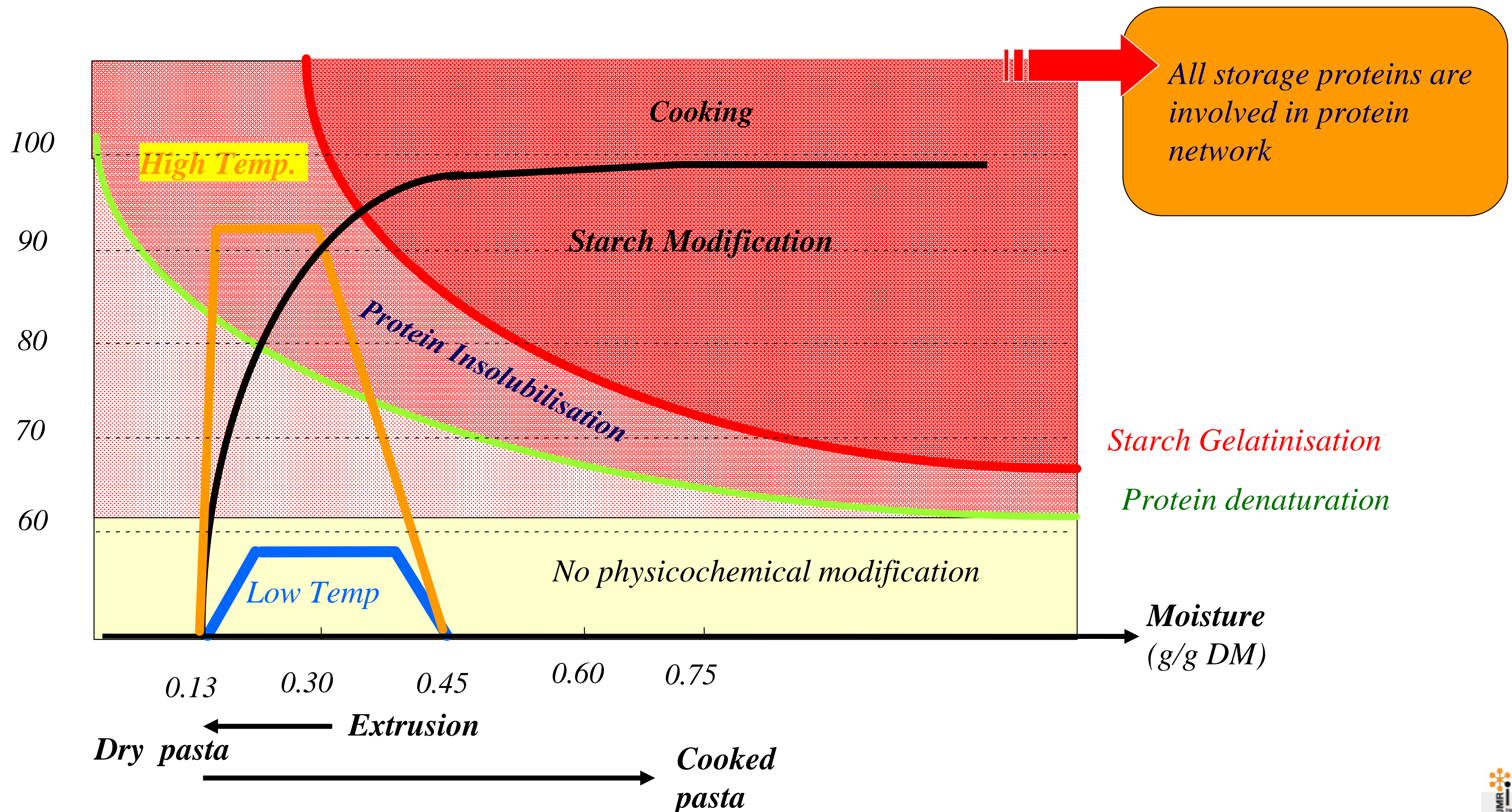
Pasta Drying and Glass Transition.

▪ Drying maintaining pasta protein at rubbery state allows:

‑ To avoid cracks

‑ To reinforce the network and improving pasta quality

‑ To save energy **:** 40% less heating energy, 20% less cooling energy, 10% less electrical energy

▪ For gluten free, complexation of amylose by lipids
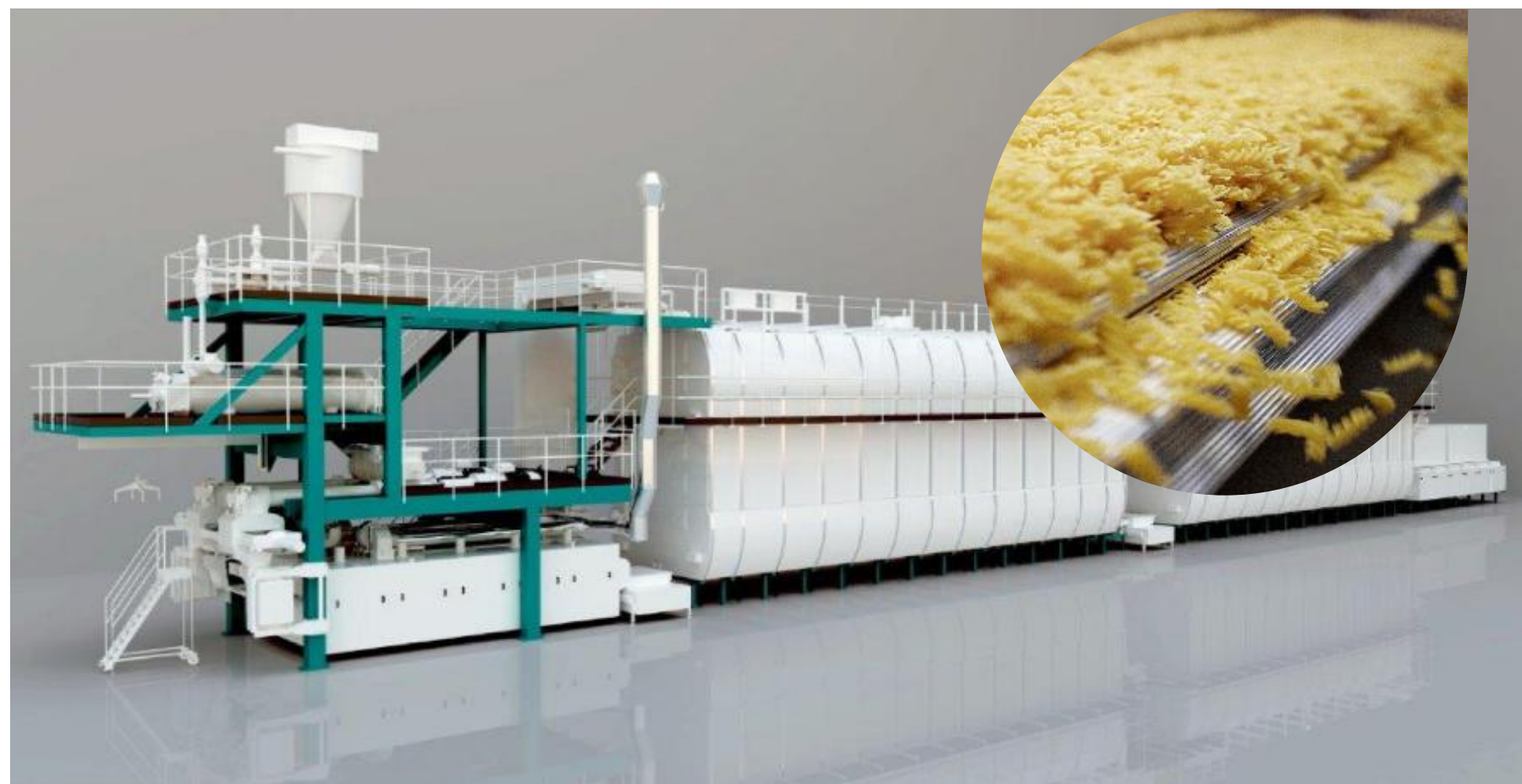
Short Goods Dryer
TTHD/TTHE
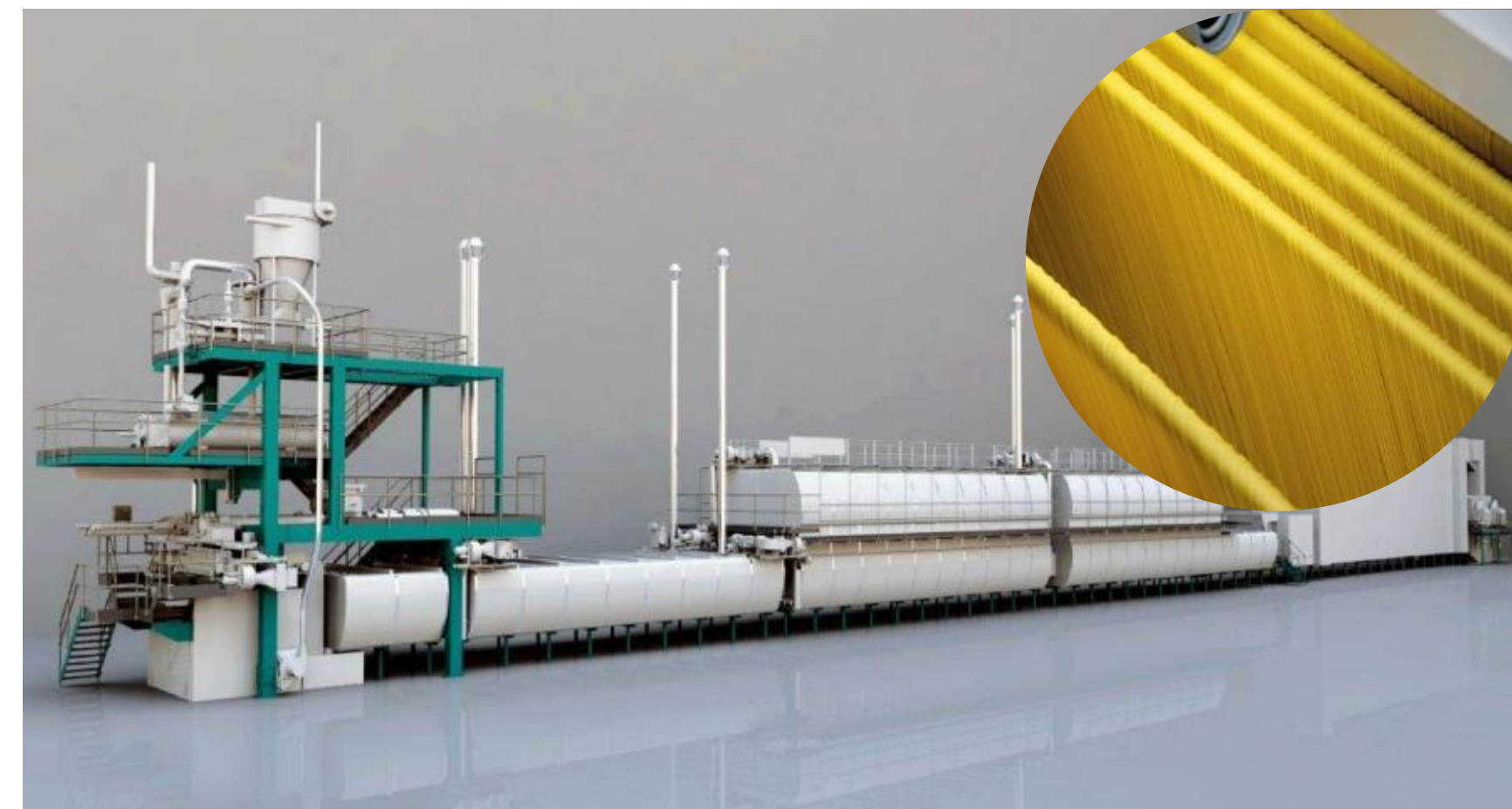
Long Goods Dryer
TDHE/TDHF

PastaSense^TM.

Characterization of raw materials and pasta along the production line.
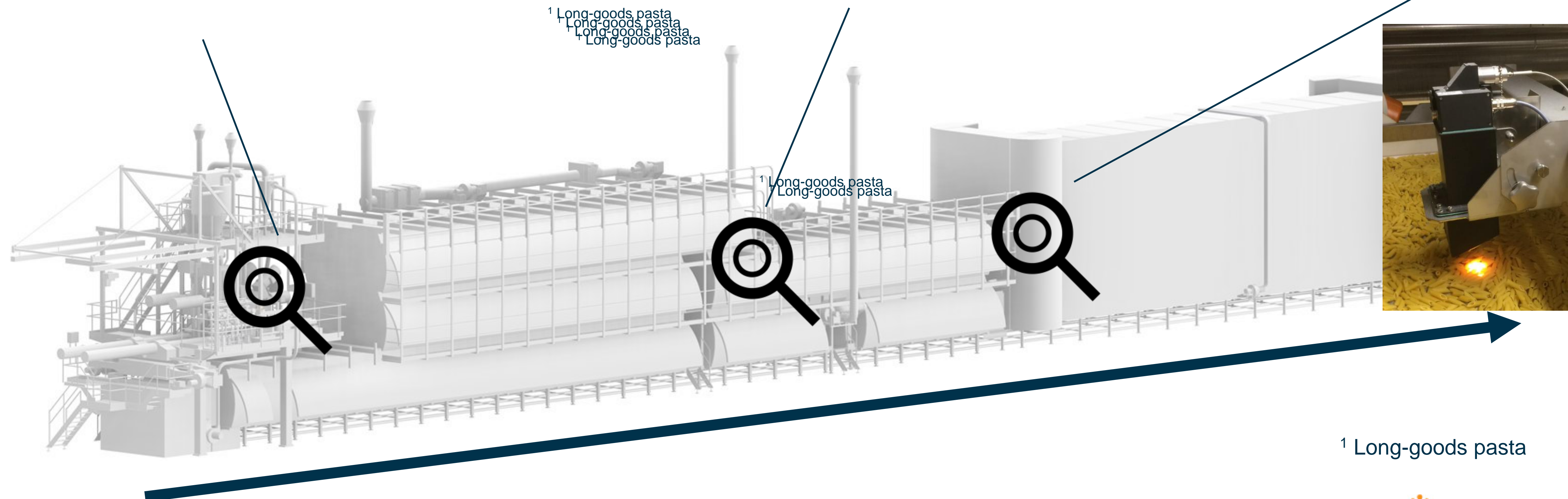
Raw material dosing unit MSDA
- **Moisture**
- **Ash**
- **Protein**
- Color
- Spots

Product **drying and stabilization**
- **Moisture**

End product
- **Moisture**
- **Color**[1]

[1] Long-goods pasta
[1] Long-goods pasta
[1] Long-goods pasta
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Milling Process.

Process wheat and other grains in form of semolina or flour by:

- Removing contaminants (mycotoxins, microbial flora and other residues).

- Adjusting separation of milling fractions to avoid specks in the end-products.

- Dissociating grain kernel for limiting discoloration and browness reactions during pasta production.

Milling Monitoring.

- Delivering a consistent quality of semolina and flour.

- Guaranteeing high yields in flour and semolina.

NIR Multi Online Analyzer MYRG
for ash, moisture, protein…
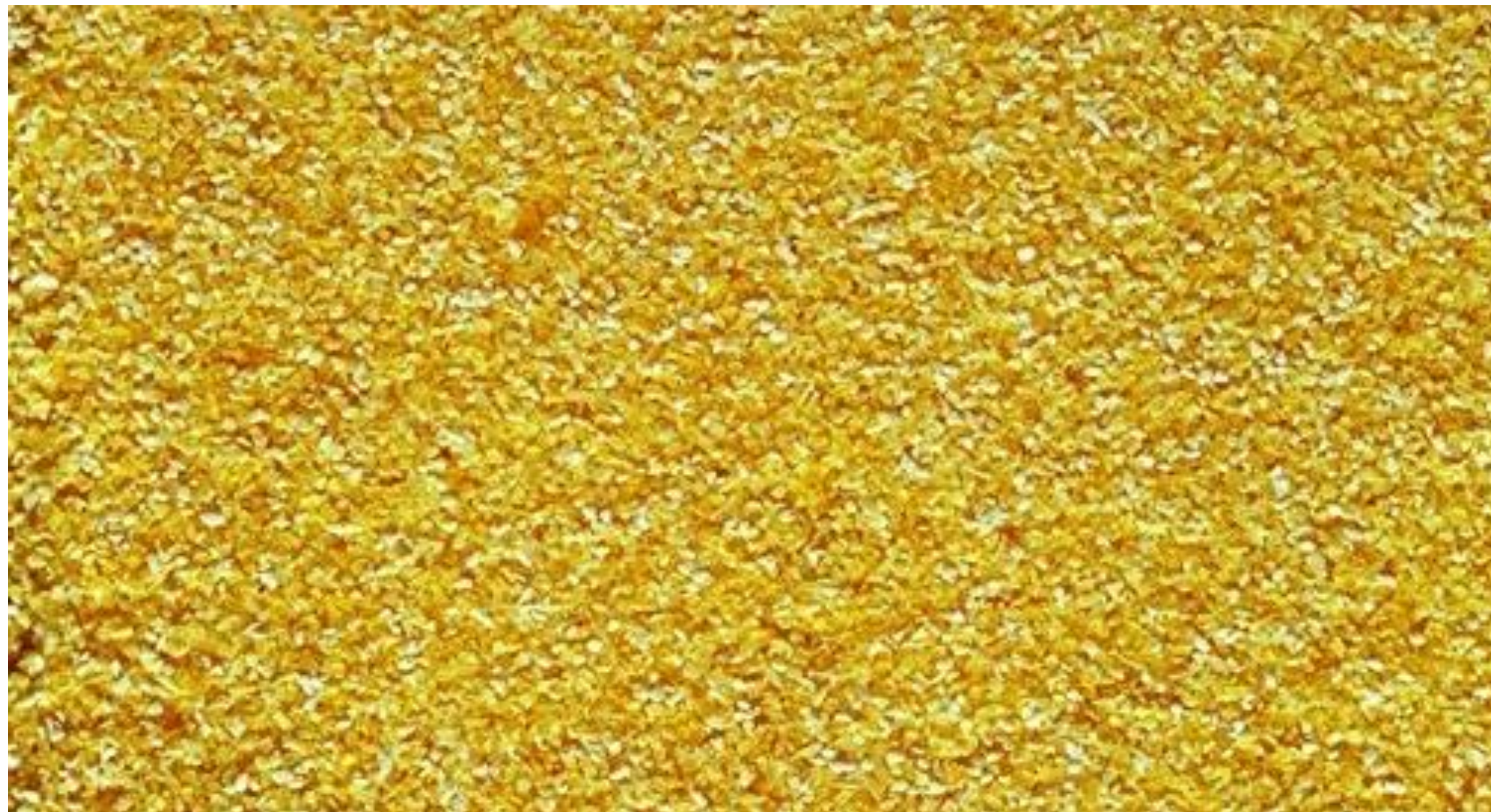

Online Optical Measurement MYHB
for color and specks

PSM Online MYTA
for particle size distribution between 10…5000 microns
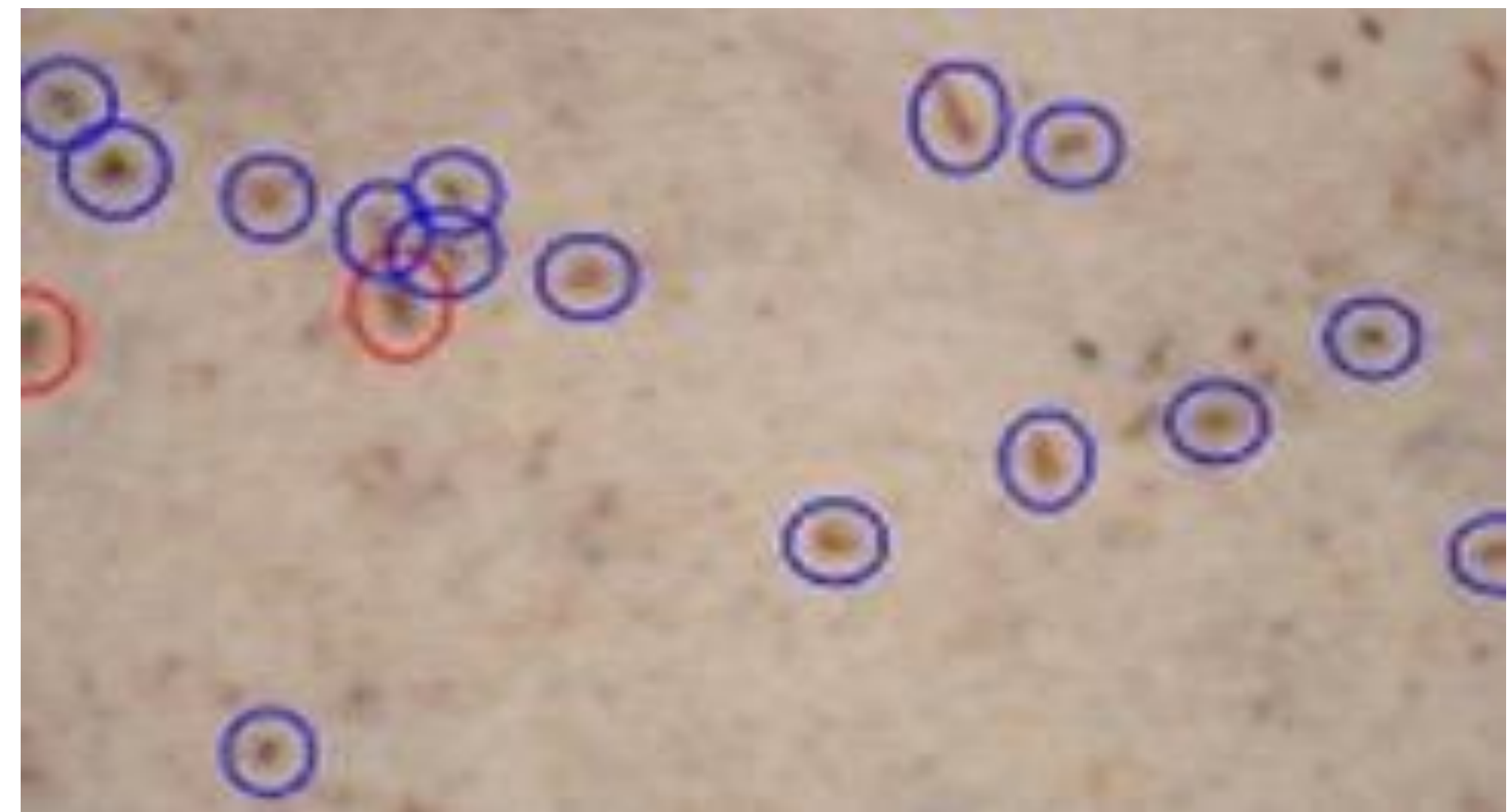
Milling Monitoring.

Market demand MYHB

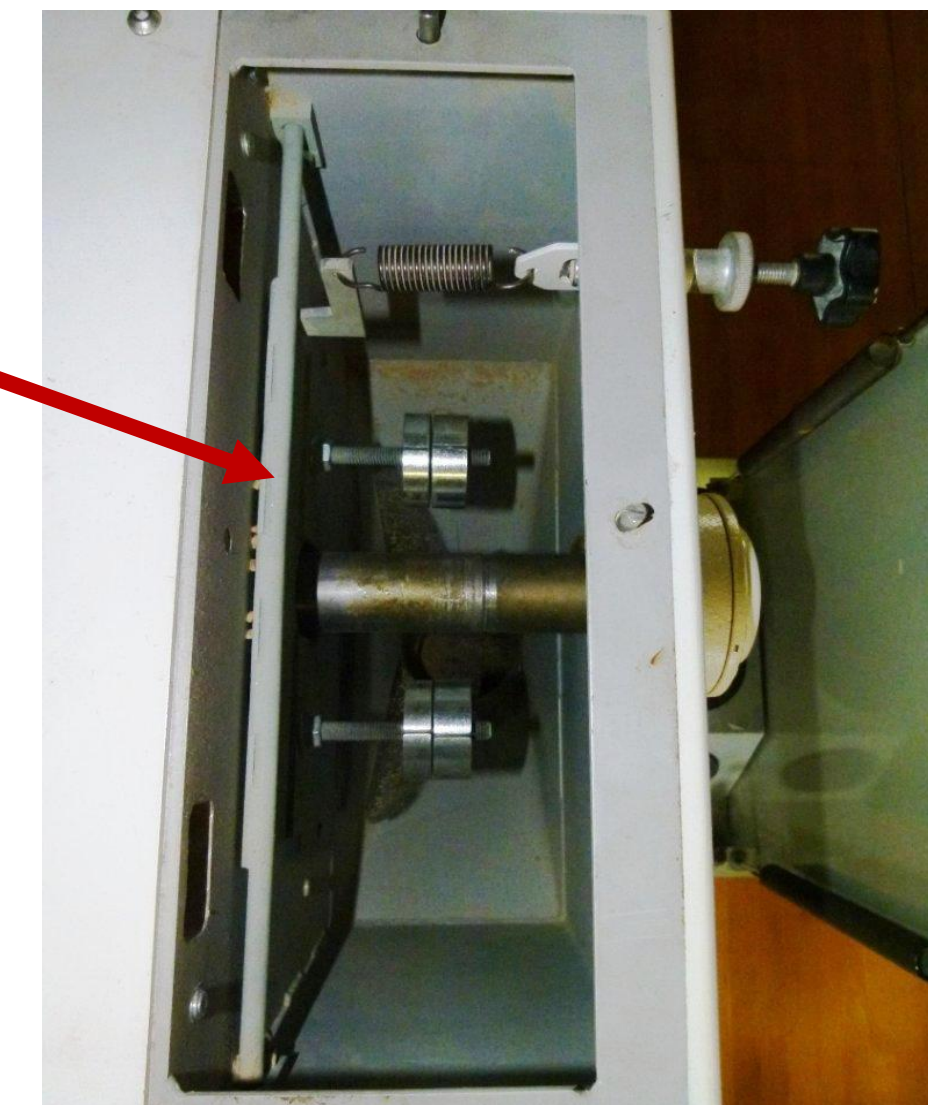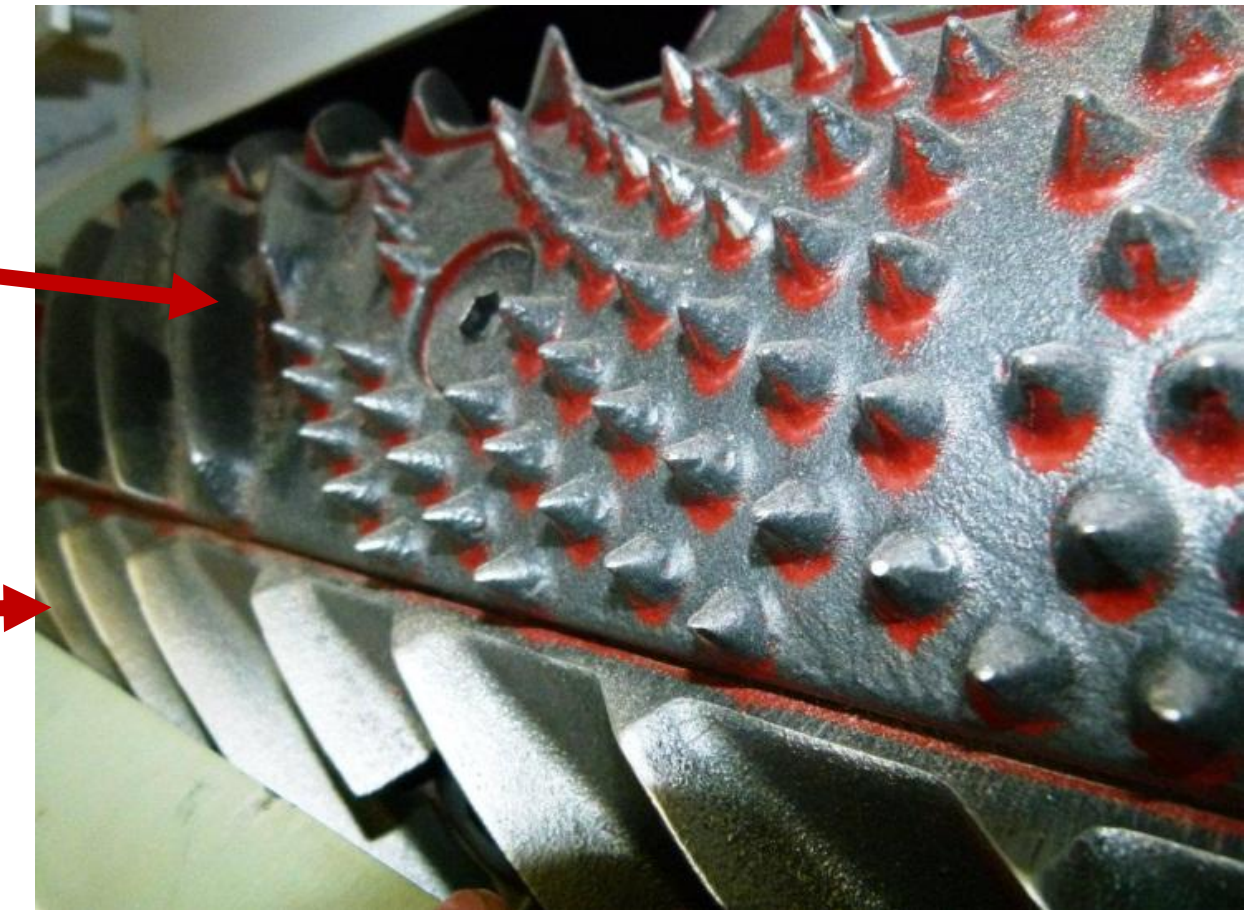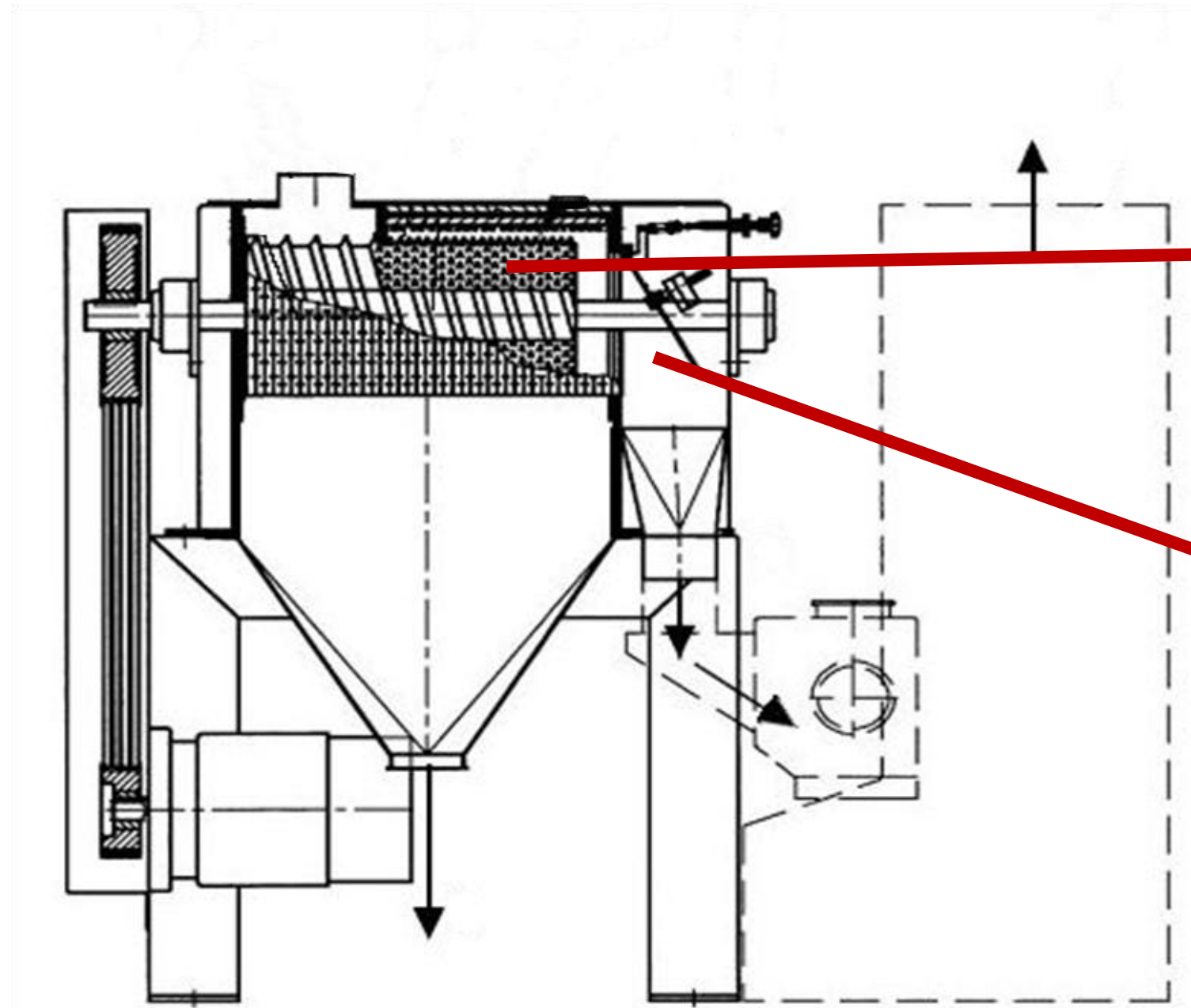- to control color of flour and durum semolina

- to monitor max. number of specks
- to avoid oversized specks

Pearling.

Rotor with flutes and knob segments

Pearling durum grain before milling, an efficient way for:

▪ Less contaminants in semolina

▪ Higher quality of semolina (less specks)

▪ Higher milling yield

Grain Cleaning.

- A primordial step for pasta production

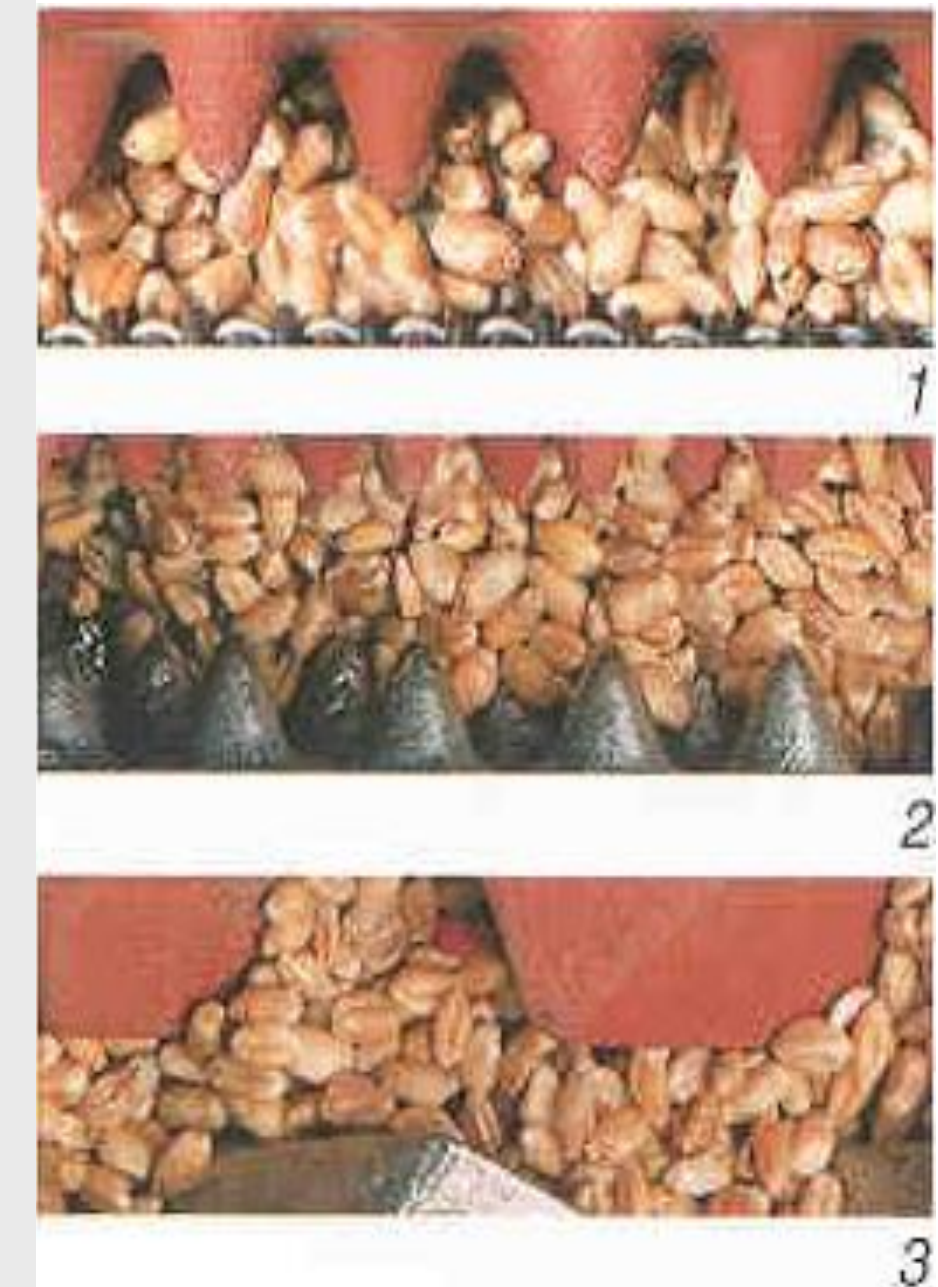- Removing impurities with accuracy at high throughput

Scourer MHXS

Working principle

friction forces by:

1. Grain against screen

2. Grain against rotor segments

3. Grain against grain

Important:

Aspiration channel after scourer for removal of remaining dust

Raw Materials Applied for Pasta Production.

	Durum Wheat	Common Wheat	Local Crops Gluten-Free Cereals
Color	- High content of Carotenoids - Low content of Polyphenol Oxydases	- Low carotenoids content - High oxydase activities - Dark bran	- Large variability in carotenoids content - Variability in enzymes activities
Cooking Quality	- High protein content - Good rheological balance	- Low protein content - Inappropriate rheological balance	- Low protein content - Protein cannot be structured in a continuous network
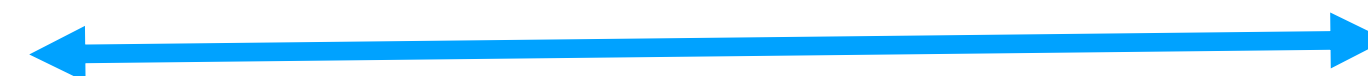
Raw Materials.

- **Analytical control with rapid methods for:**

  - Reducing variability of raw materials

  - Improving homogeneity of milling batches for a consistent quality

- **Fine tuning pasta quality through ingredients:**

  - Improving protein network (protein content and gluten quality)

  - Limiting starch swelling during cooking

  - Starch complexation with lipids

Summary.

- Pasta quality needs integrated solutions starting from consumer requirements to raw material characteristics.

- A deep knowledge on physico-chemical base of pasta quality is necessary to control:

  - Processes, raw materials and their interactions

  and in order to develop

  - New ingredients for fine tuning quality issues

  - New sensors technology and data monitoring for optimizing consistent quality

- Reverse engineering approach is an efficient way to improve Quality to Cost ratio.

Contact Bühler Booth.

Milling Solutions
Flour Service.
**Pasta Solution
DP FlourZyme®**

From Grain to Pasta and Noodles.

Ever-increasing pasta and noodles consumption. For many people pasta and noodles are part of their daily lifestyle. The word "pasta" means "dough" in Italian and the typical ingredients are durum semolina and water.

Middle East and Africa.

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