



Functional starch: A better use of starch in foods

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Jung Sun Hong

- Summary

- Food chemistry, carbohydrates/starch chemistry
- A specialist in modification techniques of starch
 - Chemical, physical, and enzymatic method
 - For specific application in food system and industrial purposes
- A strong research background in fundamental aspect of carbohydrates polymers/starches and their derivatives

- Education

Ph.D., School of Food Science, University of Idaho, Moscow, Idaho, US.

Jan 2013

M.S., 서울대학교 식품생명공학과 (Enzyme technology) Feb 2008

B.S., 동국대학교 식품공학과 Feb 2006

Current affiliation

Department of Microbial and Molecular Systems

Centre for Food and Microbial Technology

Laboratory of Food Chemistry and Biochemistry
Leuven Food Science and Nutrition Research Centre (LFoRCe)

Laboratory of Food Technology

Laboratory of Food Microbiology

Laboratory of Malting and Brewing Sciences

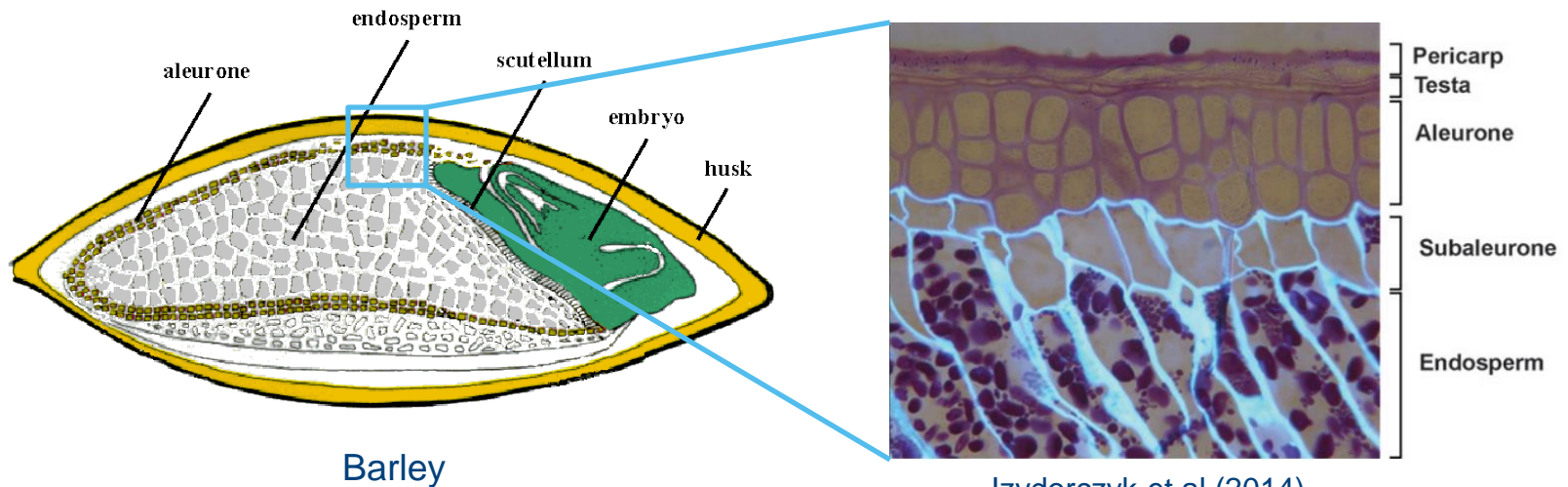
Lab LFoRCe

Mission

- To generate basic insights in
 - Structure and properties of cereal constituents
 - **Starch**
 - Non-starch polysaccharides
 - Storage proteins
 - Enzymes
 - Lipid
- To improve processing, final products and/or health related functionality

Starch?

- Energy storage form in plants
- The most important carbohydrate in the human diet
- Abundant source of functional biopolymers
 - Thickeners and stabilizers in food and non-food products
 - Biodegradable components in numerous chemical applications (e.g., plastics, detergents, glues *etc.*)



Starch application

EU - 2013

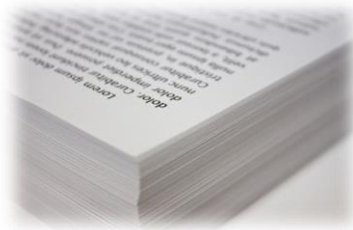
Total Market: 9 million tones



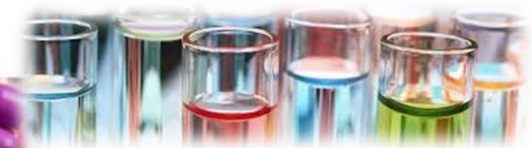
Confectionary and drink (32%)



Processed foods (29%)



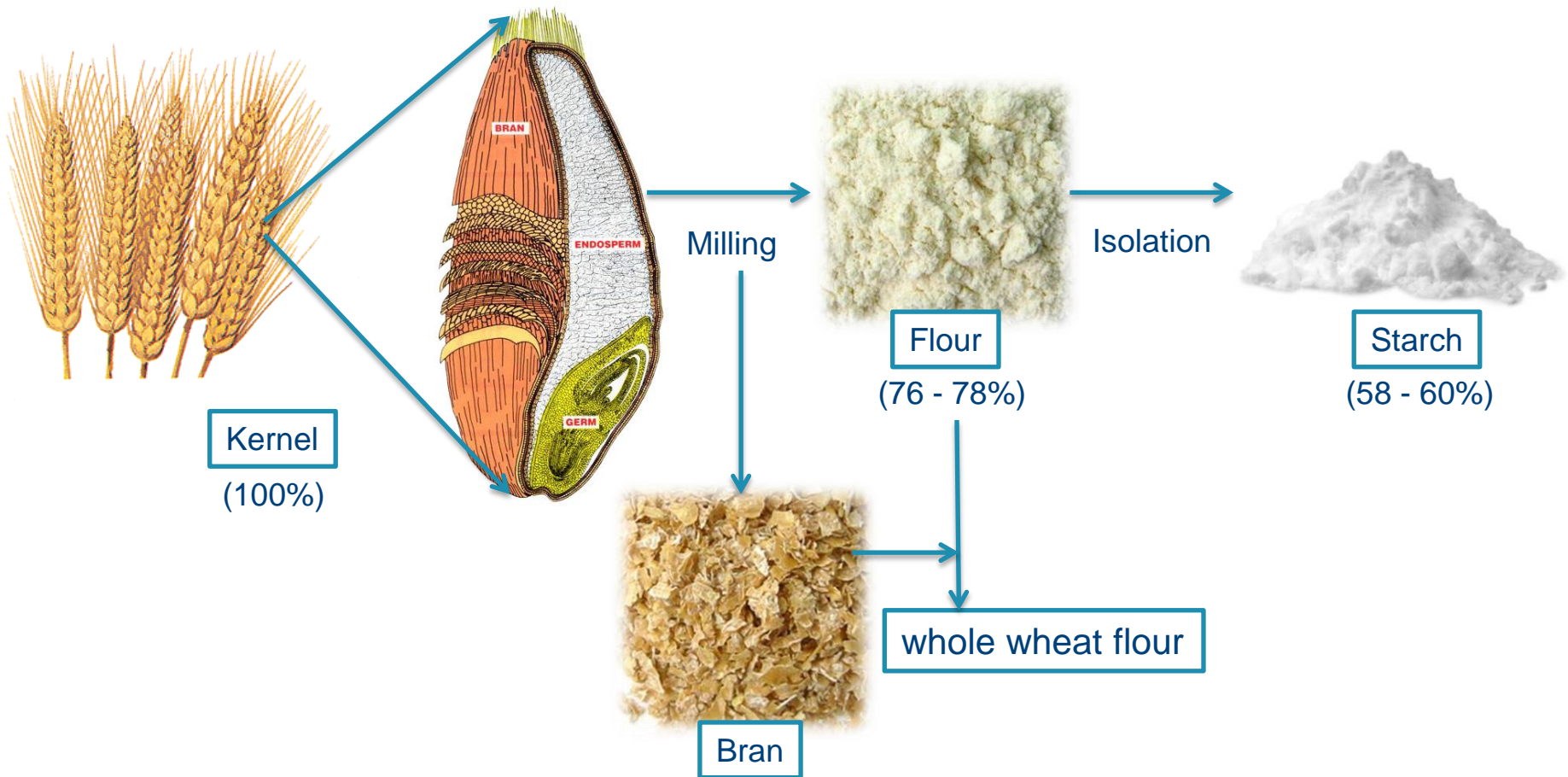
Corrugating and paper making (29%)



Pharma & Chemicals (5%)

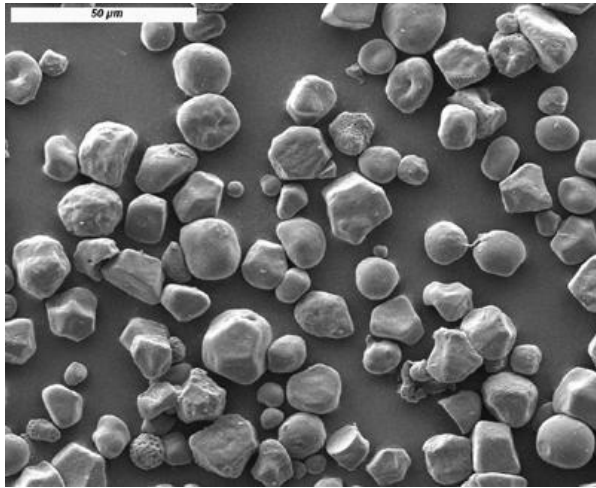
Extraction of starch from plants

wheat

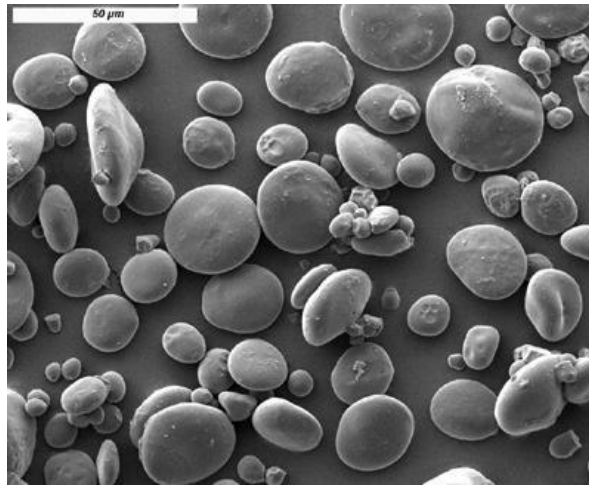


Starch granules

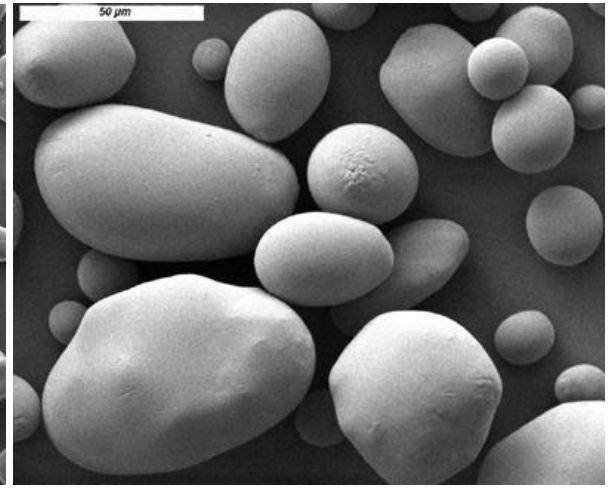
Scanning electron microscopy



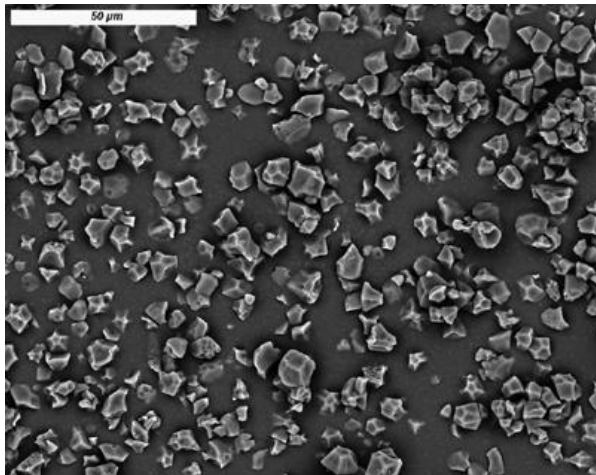
corn (48%)



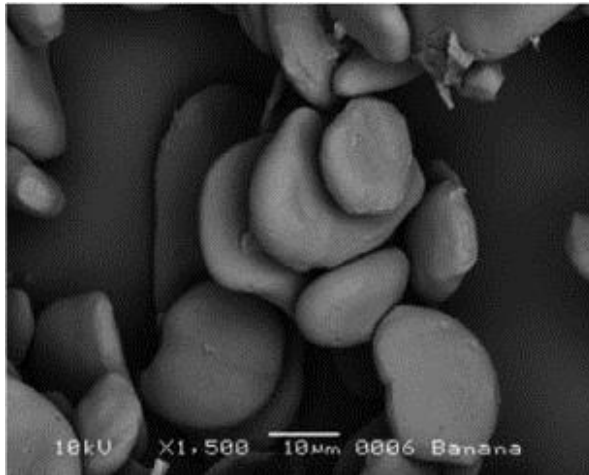
wheat (39%)



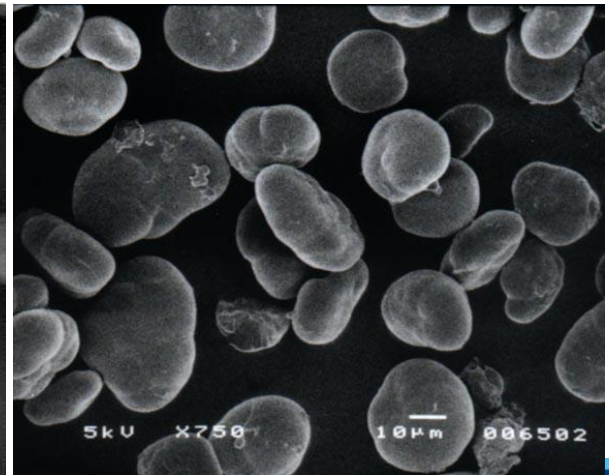
potato (13%)



rice



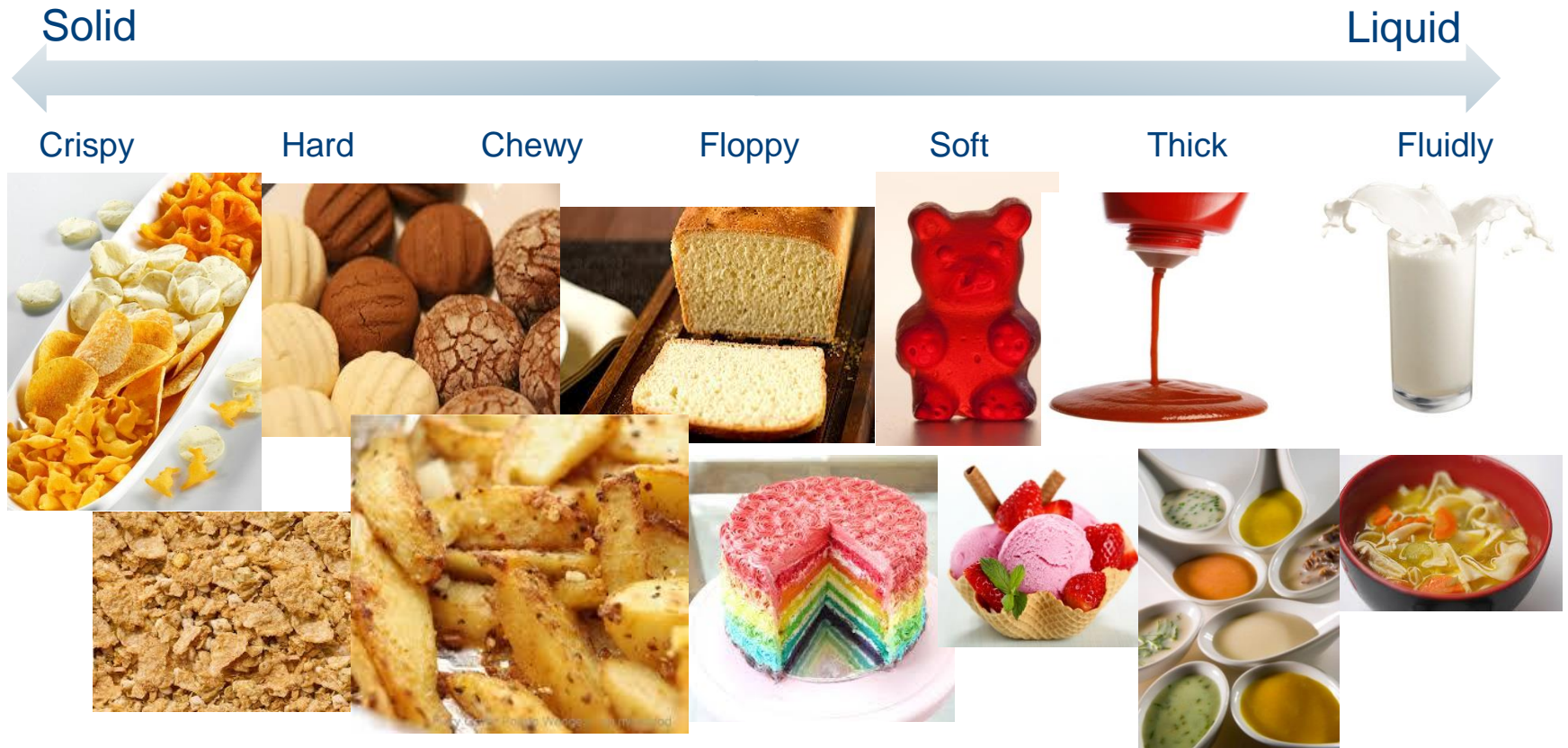
banana



pea

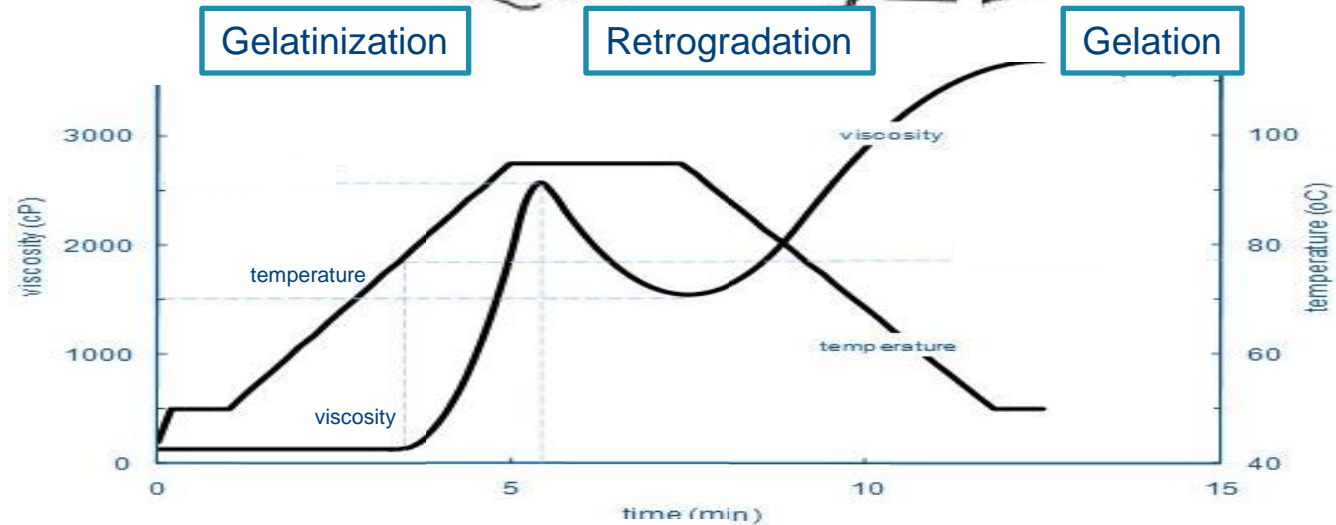
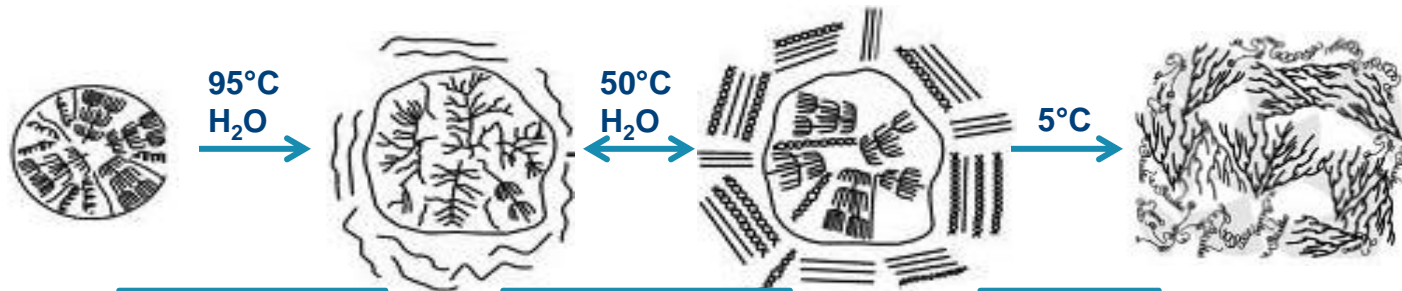
Starch in Foods

Food thickener

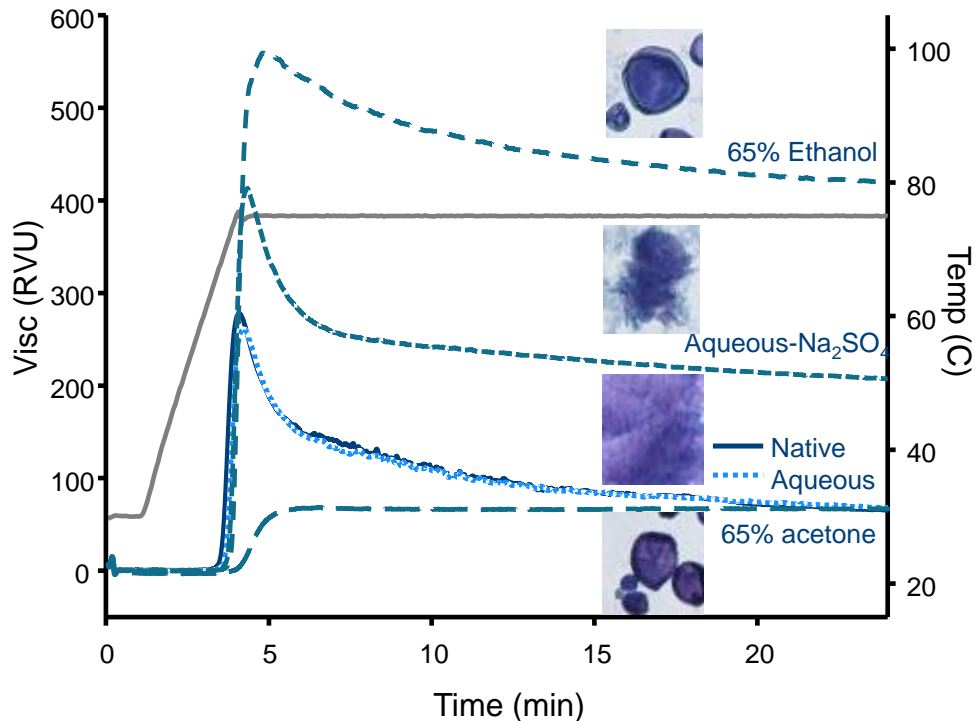


Starch in Foods

Phase transition



Functional food starch



- Viscosity of 7% (w/v) native starch and cross-linked starch in 92.5% (w/w) DMSO-water solution (Hong et al., 2015)

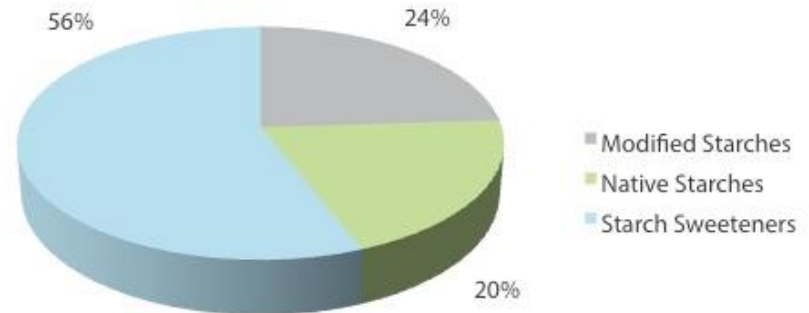
To obtain functional starch,

- Need additional process (modification) to enhance functionality of starch using
 - Chemicals
 - Enzymes
 - Physical treatments
 - Dual/multiple processes

Functional food starch

- 80% of starch in markets is modified!
 - Fat Replacer/Fat Mimetic
 - Low-fat butter spread/margarine
 - Low fat mayonnaise
 - Low fat milk type products
 - Low -fat ice cream
 - Texture Improvers
 - Improve bread texture
 - Crispness of crackers and biscuits
 - Viscosity breakdown resistant for can foods
 - Desired chewiness for extruded products
 - Functional fiber
 - Slow digestible cookies
 - Resistant starch muffin
 - Encapsulation of flavor/oil

Abbas et al. 2010

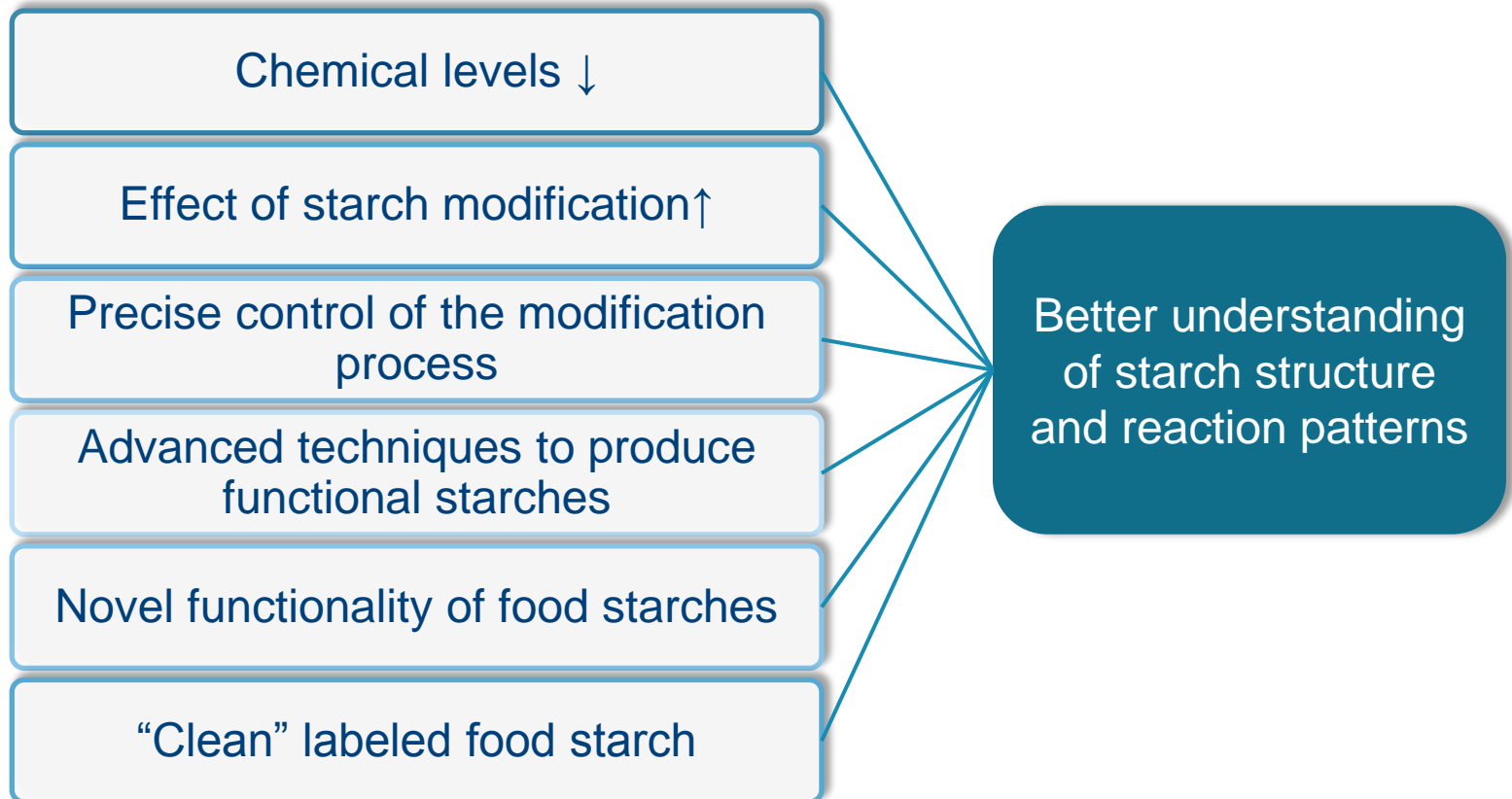


Total Market: 9 mio tonnes

European starch industry association (aAf)

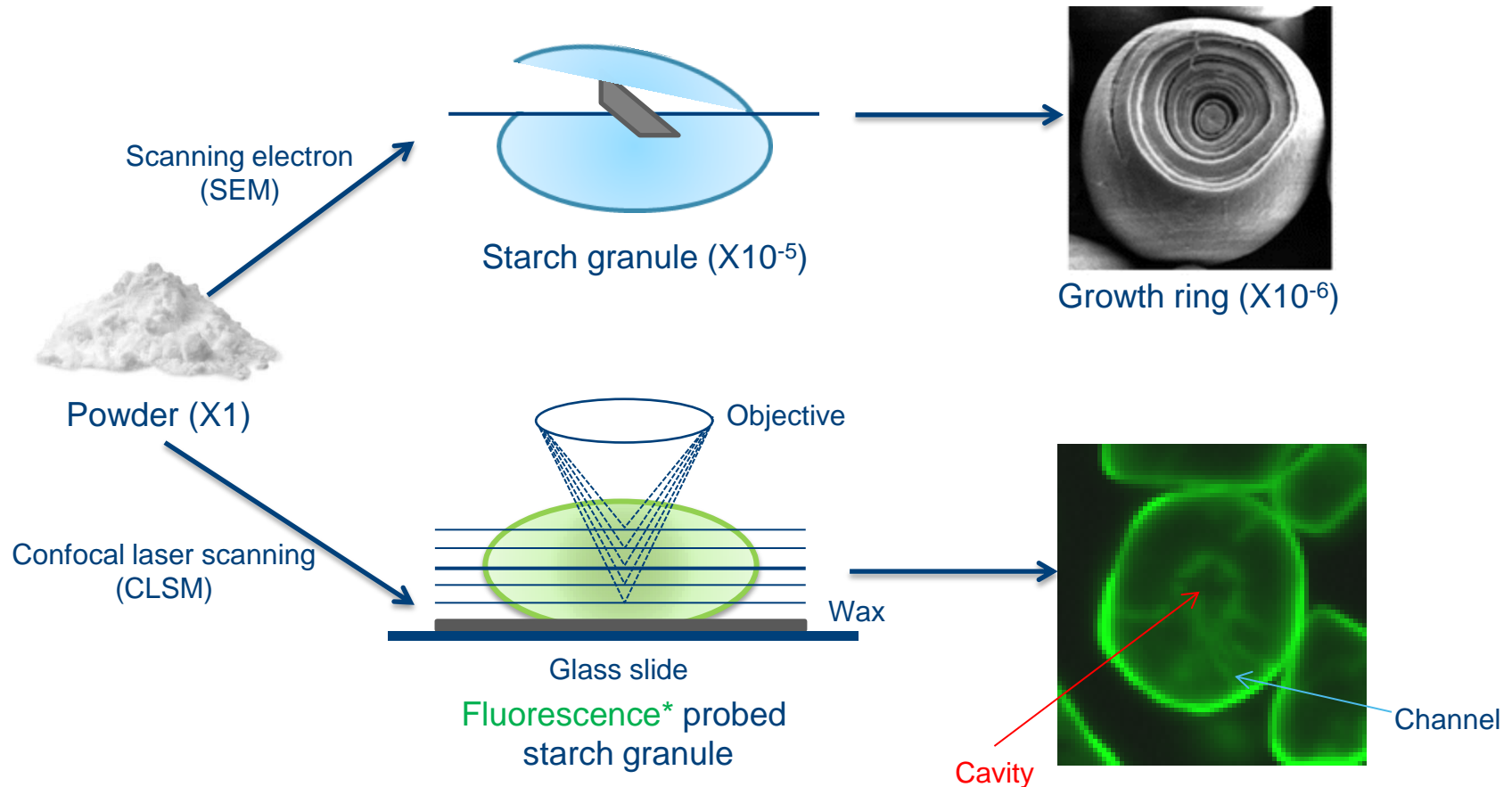
Functional food starch

Prospects



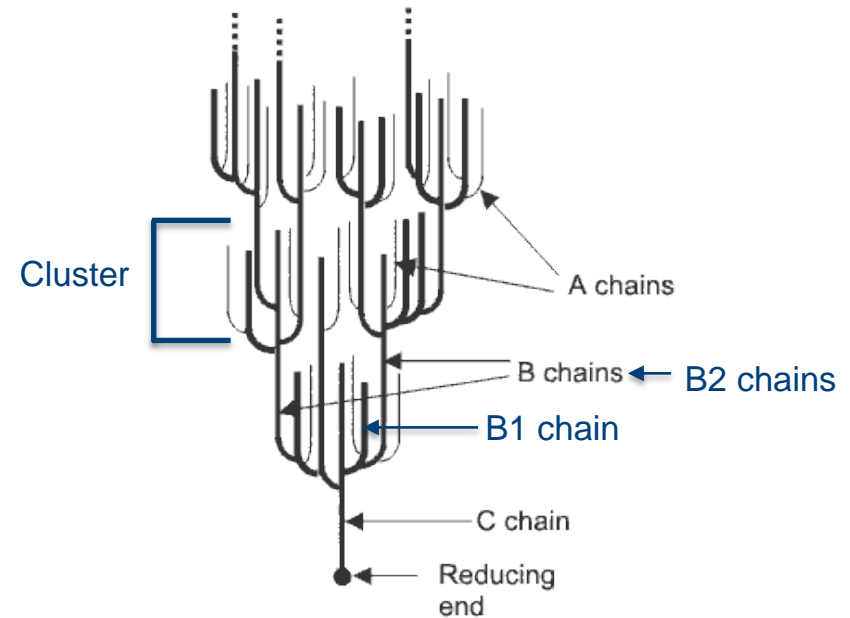
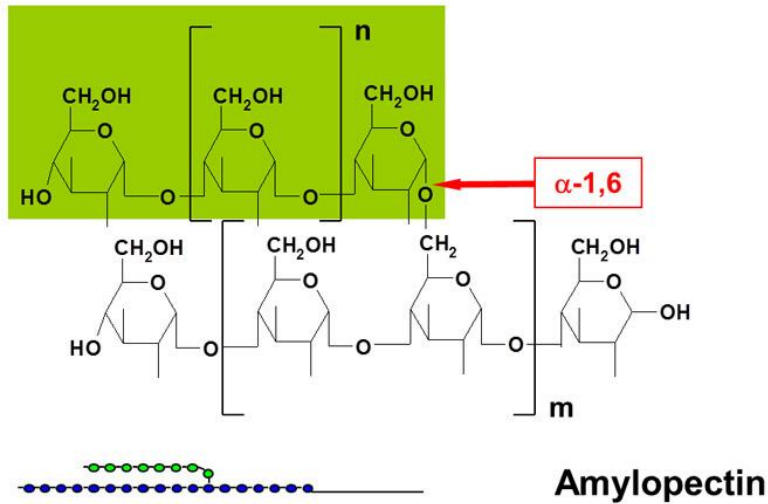
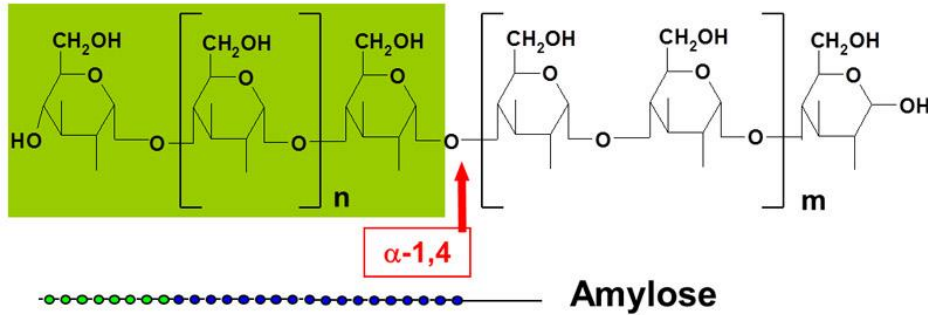
Starch structure

Microscopic view



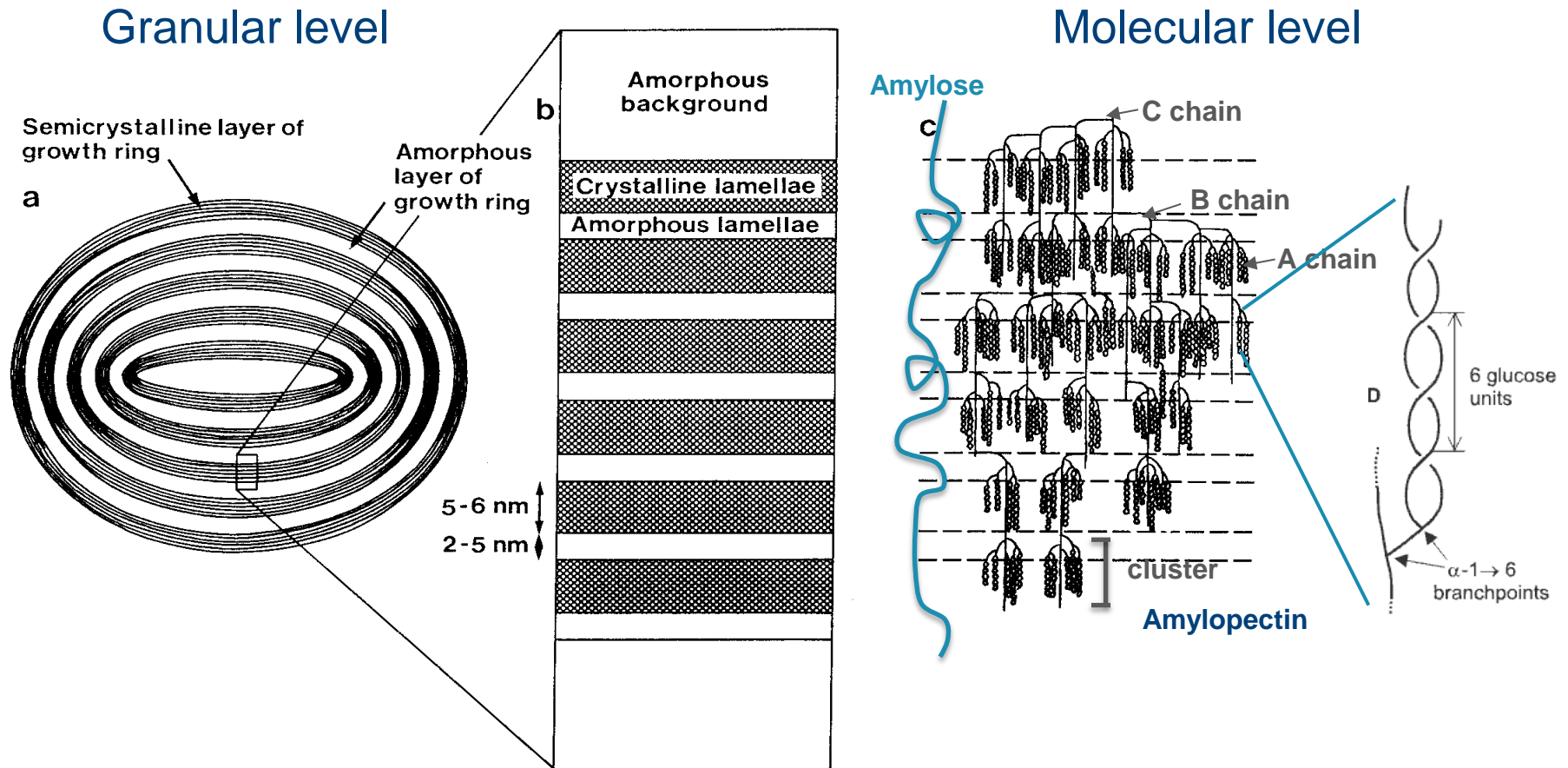
Starch structure

Amylose and Amylopectin



Starch structure

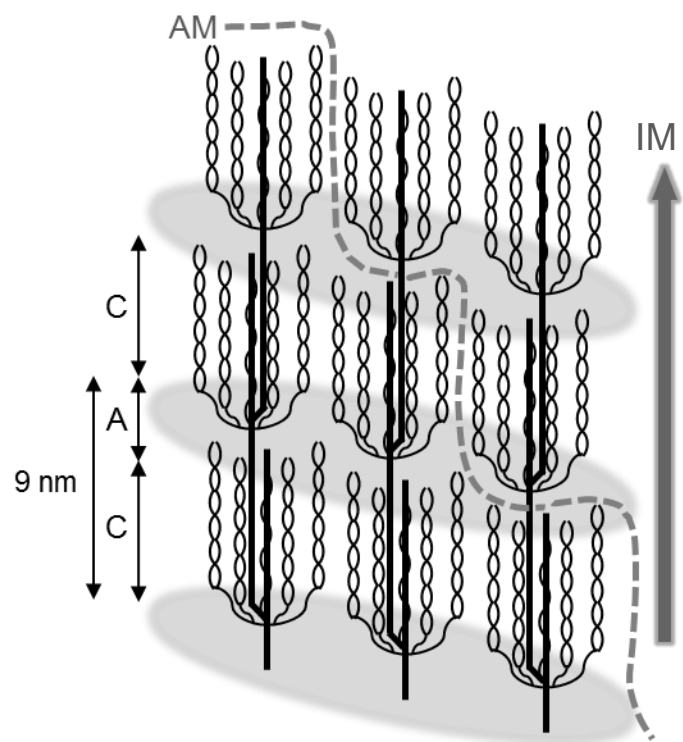
From granules to molecules



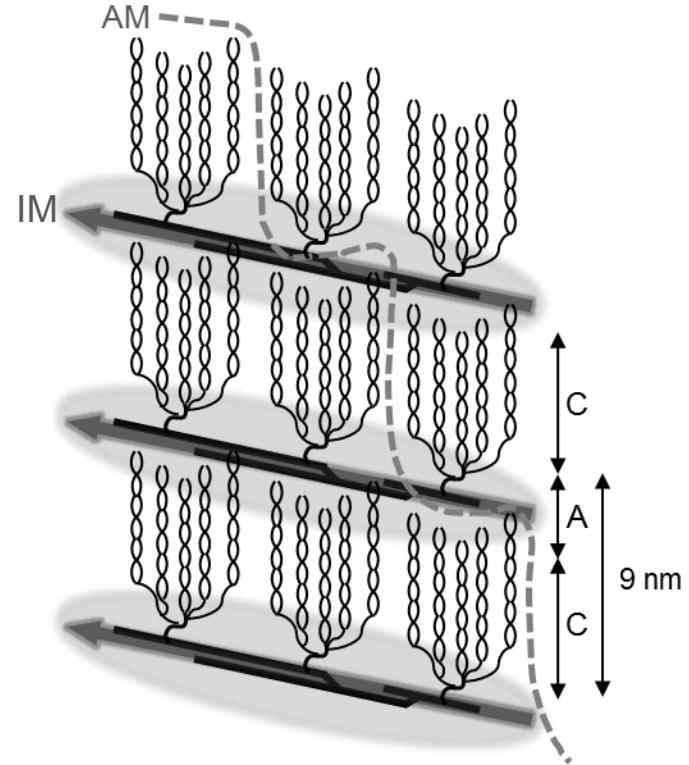
Jenkins & Donald, 1995

Proposed model for starch molecules organization

Based on reactivities of starch chains



Cluster model
(traditional model)

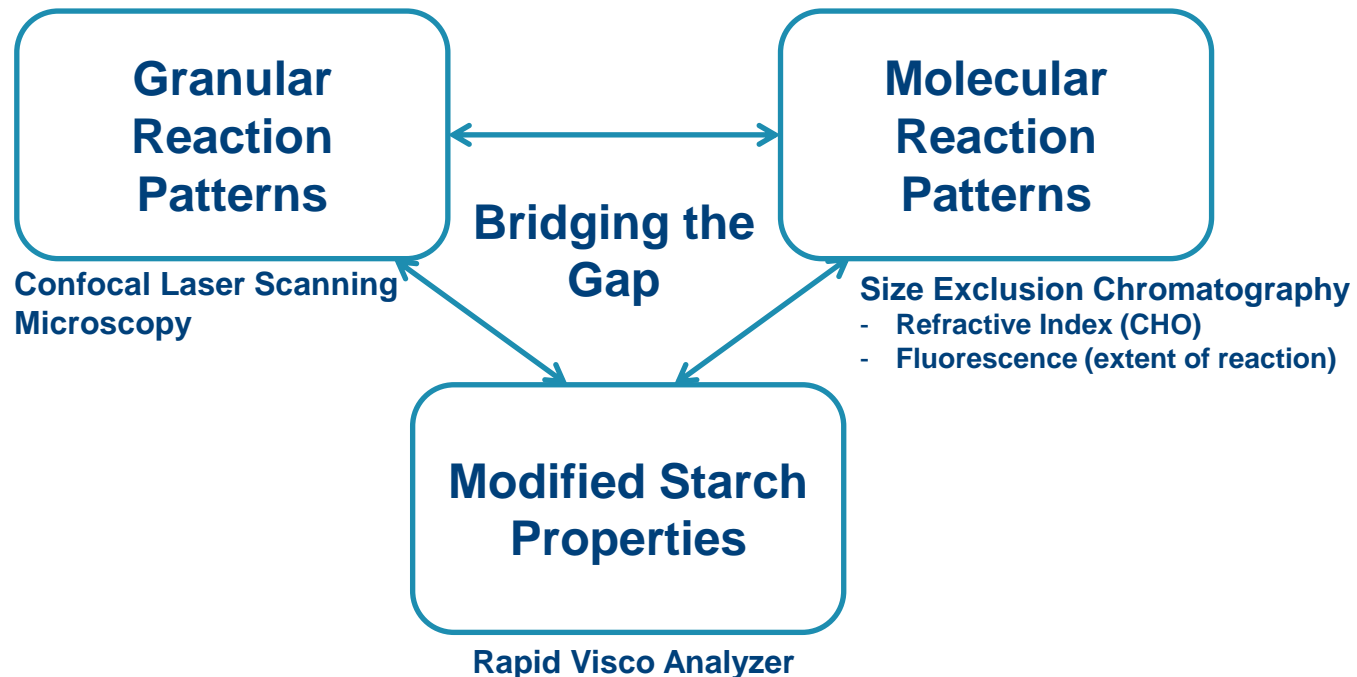


Backbone structure model
(alternative model)

Hong & Huber (2015)

Overall research goal & approach

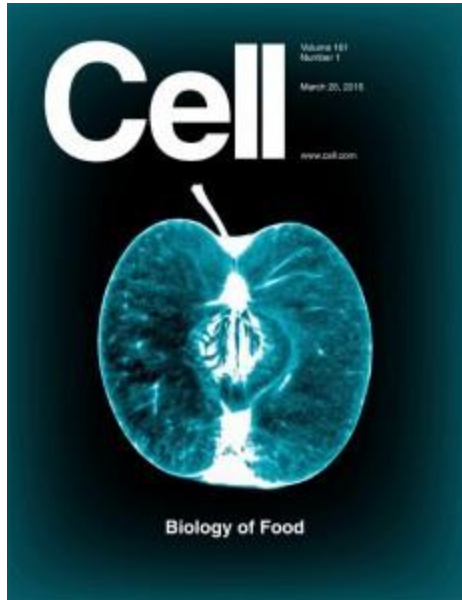
- Model reaction system
 - Fluorescent probed starch derivatives



Conclusions

- Starch granular architecture impacts reactivities of starch chains molecules.
- Granular/molecular reaction patterns impact physical properties of modified starches.
- By controlling reaction parameters,
 - “Design of reaction pattern”
 - A minimal level of reagent addition
- Starch model reaction approach: provides insight beyond current understanding of starch structure.

Carbohydrates and Health



Mar 2015

The quality of carbohydrates is important!

“Tell me what you eat, and I will tell what you are.”

- Jean Anthelme Brillat-Savarin

The relationship between protein:carbohydrate dietary intake vs. lifespan in Mice (Simpson et al., 2014)

