

Future Starches: For Food IndustryJaspreet Singh, PhDJ.X.Singh@massey.ac.nz





- Centre of Research Excellence (CoRE) for foods and nutrition, funded by New Zealand Government and supported by local/international food industry
- Internationally renowned and well-connected
- A collaborative partnership between academics/ researchers from:







Riddet Institute: A National Centre of Research Excellence (CoRE) based in Palmerston North

Bringing together New Zealand's best talent in food and nutritional sciences **Auckland** (University of Auckland, Plant & Food)

> Hamilton (AgResearch)

Palmerston North (Massey University, Plant & Food, AgResearch, Fonterra)

Wellington (Victoria University, MacDiarmid Institute)

Christchurch (*Plant and Food, University of Canterbury, AgResearch*)

Dunedin (University of Otago)



A Centre of Research Excellence with Global Connections







Major International/National Clients











The Riddet Institute Japan Connection



Research Collaborations with:

- Mumamoto University
- University of Shizuoka

Tokyo University of Marine Science And Technology



A two day Japan-New Zealand <u>Functional Food Workshop</u> at the Riddet Institute in July, 2009







Riddet Institute

Future Foods-Different For Different People



Need Low Calorie Foods



Need High Calorie Foods



Designing Future Foods – Lessons from Nature

- "All foods pass through a common unit operation, the GI tract, yet it is the least studied and least understood of all of the food processes."
- Norton, I., Fryer, P. and Moore, S. (2006) AIChE Journal 52: 1632-1640.

- Understanding of the human digestive machine
- Understanding of how food structure changes as it traverse through the entire GIT
- Understanding the metabolic and physiological consequences
- Can we make the desirable structures



Starch – An Important Food Ingredient In Our Diet





Major Starch Sources





Starch - A Carbohydrate Polymer

A major storage polysaccharide present in plants in the form of granules mainly comprised of amylose and amylopectin chains









Starch - A Carbohydrate Polymer



a**, 1-4 bond**

Amylopectin - a branched polymer with linear α -D-(1 \rightarrow 4) linked glucose units and additional α -D-(1 \rightarrow 6) glycosidic linked branch points Minor constituents (Phosphorus, lipids and proteins)



Starch Characteristics- Gelatinization of Starch





Starch Characteristics- Viscosity (Rheological Characteristics)









Starch Characteristics- Retrogradation of Starch





Digestibility of Starch in Human System



Raw Starch Non digestible in human system **Retrograded Starch**



Digestible in human system

Very high in resistant starch

Less digestible in human system



Starch Digestion Depends On

- ✓ Starch Structure
- ✓ Nature of Food Matrix
- ✓ Starch Processing Procedure and Storage Conditions







In vitro Starch Digestion



Step 1 : Simulated gastric juice - pepsin pH =1.2; Duration :30 min Step 2 : Simulated intestinal juice Pancreatin, amyloglucosidase pH = 6.8; Duration :2h





Native Starch Structure vs Digestibility

Digestibility of cooked starches (Source: Wolf et al., 1999)

Starch Waxy maize Normal maize	In vitro hydrolysis (%) 96 86.2		
		High amylose maize	77.2





Glucose conc (mM)

Development of Novel Starch Structures

- Slowly (or may be medium) digestible starch structures
- Good functional characteristics for use in different food products
- ✓ No safety issues





Spherulites : A Novel Starch Structure









Starch Spherulites Formation

High Temperature (140°C)





Production of Spherulites at Pilot Scale





Screening of Spherulite Quality



Birefringence



Relative Crystallinity





Development of Food Matrix



Starch







Glucose Release During In vitro Digestion



In vitro Digestion Normal Maize Starch



Simulated intestinal juice



On line recording of In vitro Digestion



In vitro Digestion Normal Maize Starch + 1% Gum





On line recording of In vitro Digestion



Starch structure is important during processing in the food industry and during digestion in the human body

New starch structures with greater health benefits and processing performance can be prepared

New food matrix can be developed which slows the digestion of starch

Starch from new sources may have slow digestion properties

Healthy future foods can be prepared by using novel starch structures, suitable food matrix and starch from new sources



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FOOD SCIENCE/FOOD CHEMISTRY/FOOD PROCESSING TECHNOLOGY

ADVANCES IN POTATO CHEMISTRY AND TECHNOLOGY

Edited by Jaspreet Singh and Lovedeep Kaur Ridder Inuture, Massey University, New Zealand

For the first time in a single volume, Advances in Perato Chambery and Technology presents the latest knowledge on the chemistry and technology of potato (Solanum tuberouum L.) and the role and importance of chemistry in determining the processing quality and nutritional value of potatoes.

Addressing developments in potnto chemistry, including identification, analysis and use of chemical components of potatoes in the development of new and 'nnovative food and non-food produces; the expert coverage includes a major focus on catchohydrate and non-carbohydrate composition, cell wall chemistry, analysis of glycoalkaloids, phenolics and anthocyanins, thermal processing and quality optimization, new and sophisticated methods of quality determination of postness and their products. Potato starch characteristics and its modification, nutritional and feeding value, and non-food uses of potatoes are also explored. Chapters focused on developm as in post harves storage, breeding and germplarm resources and production of post set with a bioto to industrial usage are included.

This book will be valuable for food sciencists, nut upper-level undergraduate and graduate (PhD) sy as in research and development of new product

- Genera potato chemistry in detail, providing key universitating of competitions on emerging uses for specific food and non-food app
- Presence coverage of developing areas related to possible production on proceeding including laboratory and industry stalls subfisitiation, and modern quality measure that it chains to help brindustry identify database constraints based on arekiteted out.
- Explores novel application uses of paramets and parato by-producers identify parential areas for development of parato surfery and variative



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