Introduction to Starches & Their Functional Properties

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Starches in Our Foods

- Indians, both vegetarians and non-vegetarians consume diet containing large amount of plant foods
- Our diet consists of grains like wheat & rice, pulse like peas, chana & beans and root vegetables such as potatoes
- All these have plenty of starches

Starch Contents of Some Foods

- Grains

  White rice 78%, Wheat 60%, Barley 58%

  Rice flour 79%, Wheat Flour 72%, Corn Meal 65%

- Pulses

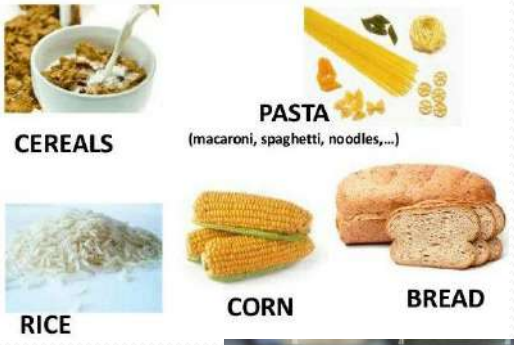
  Peas: 45-50%, Lentils 44-50%, Chickpeas 44%

- Tubers

  Potato 17%, Sweet Potato 17%, Yam 20%

- Food Products

  Bread 66%, Noodles 65%, Naan 43%, Paratha 32%, French fries 24%,

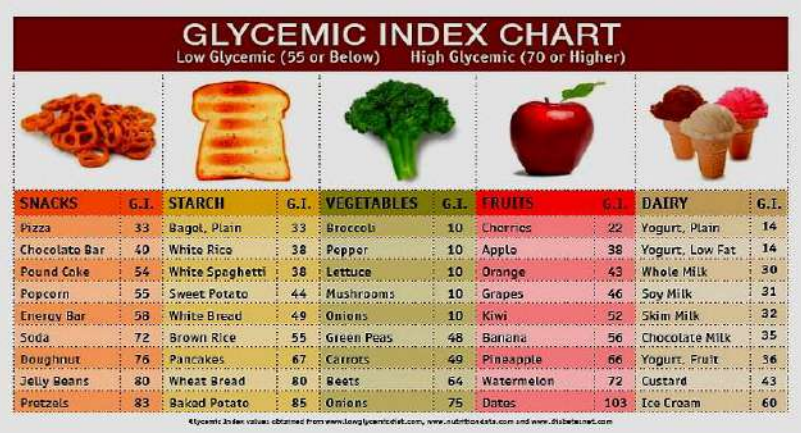


What are Starches?

- Starches are Carbohydrates and are present in foods along with sugars and dietary fibres
- Starches are polymers of glucose, so when digested they form into glucose with the help of enzymes, amylases
- Different foods have different amounts and types of starch
- Chemically there are two types of starch molecules: amylose and amylopectin
- Digestibility-wise three types: Rapidly Digestible Starch (RDS), Slowly Digestible Starch (SDS) & Resistant Starch (RS)
- Amylose gets digested and absorbed slowly. Thus starchy foods with higher amylose have lower glycemic index (GI) and provide sustained energy.
- About 70-80% of natural starch is amylopectin that digests rapidly (RDS). This tends to make high GI foods. They provide energy quickly especially in athletic performance and recovery.
- There is also Resistant Starch (RS) which is not digested by our enzymes but could be used by colon bacteria. So they act like dietary fibre. Some foods like whole grains, potatoes & green bananas have good amounts of RS

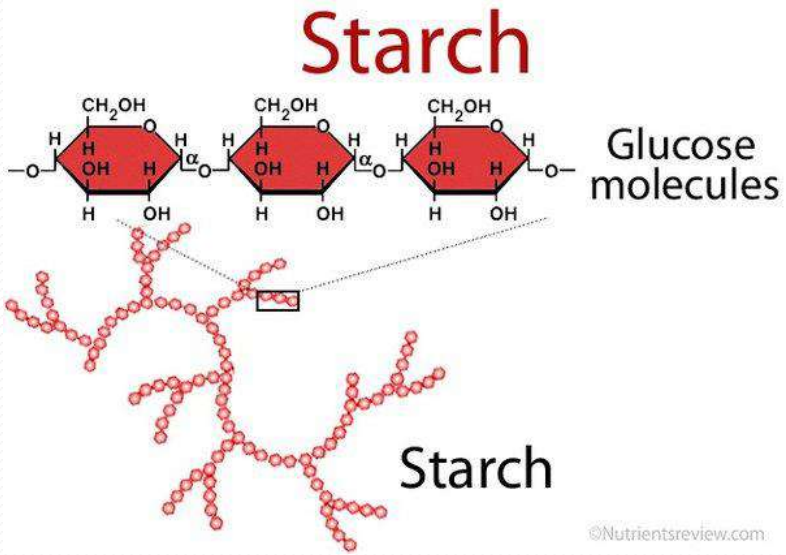
Benefits of Starches

- Although Rapidly Digested starch may increase GI and may not be suitable in large amounts to diabetics or for weight reduction, RDS are very useful for athletes who need quick energy and also for recovery after a very vigorous workout
- Infants and patients recovering may need easily digested energy providing nutrients and RDS starch is the best
- Slow digesting (SDS) starch is better for sustained energy for long distance runners and also for weight loss.
- Both SDS and Resistant (RS) starch give low GI to food and are good for diabetics.
- RS also works as prebiotic and helps probiotics grow; it improves insulin sensitivity; it lowers LDL and helps HDL cholesterol levels



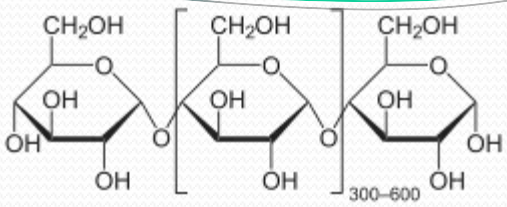
What are Starches

- Starch is a polymer of glucose chains
- Straight chain as in amylose
- Branched chain in amylopectin
- Any starch contains both in different proportion
- Amylose & amylopectin have different properties so their combinations in different starches give them different properties

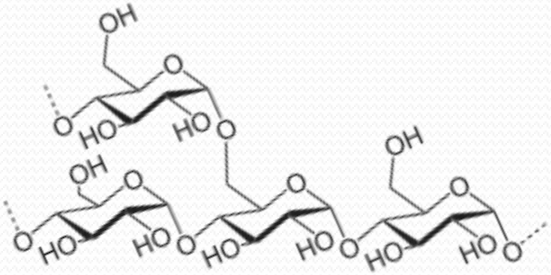


Chemical Structure of Starches

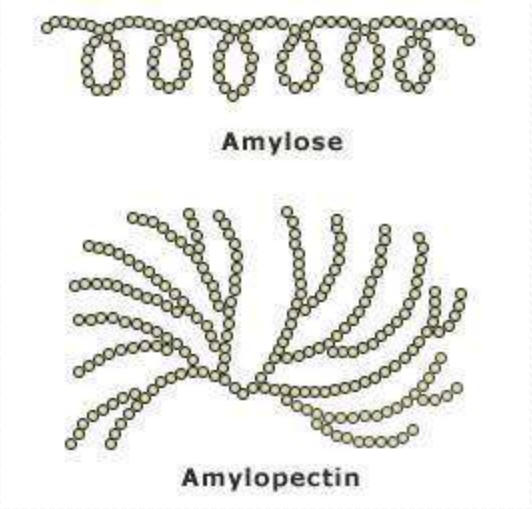
- Structure of Amylose



- Structure of Amylopectin



- Structure of Starches



- Resistant Starch

Amylose Content of Various Starches

Starch Source	% Amylose
Waxy Rice	0
High Amylose Corn	70
Corn	28
Cassava	17
Waxy Sorghum	0
Wheat	26
Sweet Potato	18
Arrowroot	21
Sago	26
Potato	20

Resistant Starches

Types of RS	Examples of occurrence
RS_1: Physically inaccessible	Whole or partly-milled grains and seeds
RS_2: Resistant granules	Raw potato, green banana, some legumes and high-amylose starches
RS_3: Retrograded	Cooked and cooled potato, bread and cornflakes
RS_4: Chemically modified	Etherised, esterified or cross-bonded starches (used in processed foods)

Properties of Starches

Functional Properties of Starches in Foods

- specific viscosity (hot and cold)
- thin boiling (faster canning heat transfer)
- viscosity resistance acid/mechanical sheer
- freeze-thaw stability (natural / modified)
- gel texture, body at various temperatures
- clarity, opacity
- processing conditions tolerance
- oil retention, high or low
- resistance to . setback. (gel formation)
- high sheen
- flow properties
- emulsion stabilizing capacity
- mouthfeel, lubricity, palate-coating
- suspension characteristics
- adhesiveness
- crystallinity
- bland taste
- long shelf-life stability
- hygroscopicity
- colour
- anti-caking
- cold-water swelling or dispersibility
- swelling and resistance to swelling
- film-forming properties

Properties of Native Starches

- Amylose is very difficult to solubilise and tends to retrograde
- Amylopectin is easier to solubilise and holds its hydrated and gelatinised structure better
- Properties of starch is combination of two fractions
- Most starches contain amylopectin 70 to 80% or more
- Some corn & barley varieties have more amylose

Why Modified Starches

- Starch in water is a colloidal solution
- Industrial applications depend on physico-chemical properties & functionality
- Native starch has limited functionality & applications
- Wide range of modification for different purposes
- Starch can be modified by hydrolysis, esterification, etherification & oxidation
- These modifications make starch suitable for baked foods, confectioneries, soups and salad dressings etc.
- Gelatinization, Enzymic Hydrolysis or Chemical Modification

Chemical Modification

- Esterification
- Ethrification
- Oxidation
- Cross-linking

Modified starches including physical, enzymic and chemical modified starches have properties for thickening, gelling, emulsification etc far superior than native starches. They have been used in canned foods, baked goods, frozen foods, salad dressings, baby foods, beverages etc.


Thank You