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Food Testing News

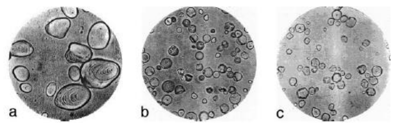
STARCH

Determination of total, resistant, damaged and gelatinized starch and maltodextrins

Introduction

Starch is a natural vegetable polysaccharide. It serves as a storage form of glucose, and thus energy, in plants. Therefore starch is an important constituent in seeds and grains (corn, wheat, rice), tubers (potato) and root vegetables (e.g. tapioca or cassava). But it is also present in immature fruits as bananas. The main starch crops are cereals, potatoes, and tapioca.

In plant material, starch is present as small white granules insoluble in cold water. Both shape and size of the starch granules are characteristic to its botanical source. Depending upon the botanical origin, starch granule sizes range from less than 1 µm up to 50-60 µm.



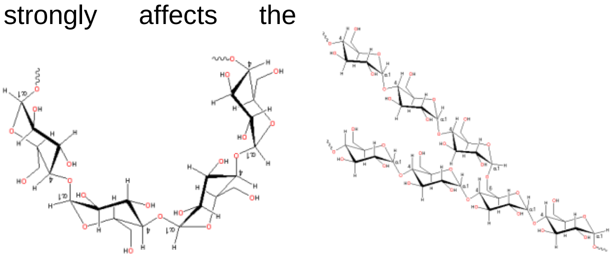
Starches of different botanical origin
a = potato, b = tapioca, c = corn

Chemical structure and physiological forms of starch

From a chemical viewpoint, starch is a homopolymer of glucose. It consists of long linear unbranched chains of 1→4-α-D-glucose units (amylose) and/or long α-1→6 branched chains of 1→4-α linked D-glucose units (amylopectin). The repeating unit in starch is the disaccharide maltose.

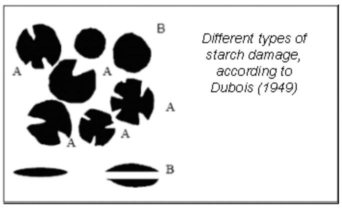
Starch

Starch can be present in raw materials, semi finished products, food, feed, and pet food in different physiological forms, being as native starch granules, as resistant starch, as damaged starch or gelatinized starch. The physiological state of the starch in a food and/or feed product strongly affects the



digestibility of the starch by human and animal and therefore its energy value.

Damaged starch



Damaged starch granules hydrate rapidly and are susceptible to amylolytic hydrolysis and, therefore contribute significant to water absorption of a dough. The level of damaged starch in flours determines amongst others the baking capability of the flour and is therefore an important quality parameter for flours.

Gelatinized starch

Due to process conditions as heat, pressure and moisture (e.g. extrusion, drum, drying), starch granules can gelatinize. Gelatinized starch is accessible for digestive enzymatic hydrolyses, native granular starches are more or less inaccessible for those enzyme activities. For this reason, pet food contains significant levels gelatinized starch.

Resistant starch

By definition resistant starch is the total amount of starch, and the products of starch degradation that resists digestion in the small intestine of healthy people. (EURESTA, 1991). It enters the large intestine where it is partially or wholly fermented. Resistant starch is nowadays considered as dietary fibre.

Maltodextrin

Maltodextrin is produced by partial hydrolysis of starch. Maltodextrins are classified by DE (dextrose equivalent) and have a DE between 3 to 20. The higher the DE value, the shorter the glucose chains, the higher the sweetness, the higher the solubility and the lower heat resistance. Above DE 20, the European Union's CN code calls it glucose syrup, at DE 10 or lower the customs CN code nomenclature classifies maltodextrins as dextrins.

Analytical methods

Different analytical methods are available for the different physiological forms of the starch.

The enzymatic starch determination according ISO 15914 is applied for the determination of the total (native + damaged/gelatinized + resistant) starch content. The method is very specific and selective for starch. Other non-starch polysaccharides/ oligosaccharides/monosaccharai des do not interfere.

In the enzymatic maltodextrin determination the total content of maltodextrins, starch and malto-oligosaccharides are quantified, excluding the free glucose.

For the quantitative determination of resistant starch in food a specific enzymatic analytical method is available (AOAC 2002.02). Specific digestive enzymes and physiological conditions are applied in this protocol, approximately mimicking the digestive tract.

Damaged starch is enzymatically determined by the AACC 76-31 protocol and the determination of the gelatinized starch content is based on the same protocol.

Overview Methods

	Total starch	Resistant starch	Damaged/gelatinized starch	Maltodextrins
Analytical protocol	ISO 15914	AOAC 2002.02	AACC 76-31	Own method
Principle	enzymatic	enzymatic	enzymatic	enzymatic
Statistics	LOQ = 0.4 % Range 0.4 – 100 % RSD_r < 2 % RSD_R < 5 % Recovery > 98 ±2 %	LOQ = 0.5 % Range 1 – 75 % RSD_r < 2 % RSD_R < 4 %	LOQ = 0.3% Flour - range 0.3 – 20 % - RSD_r = 0.9 % - RSD_R < 4 % Petfood - Range 10 – 35 % - RSD_r = 2.2 % - RSD_R = 3.9 %	LOQ = 0.4 % Range 0.4 – 100 % RSD_r < 2 % RSD_R < 5 % Recovery > 98 ±2 %

Contact
Eurofins CarbohydratesTesting
Leeuwarderstraatweg 129
8441 PK Heerenveen
The Netherlands
Tel. +31 88 8310000
Fax +31 88 8310010
Email: carbohydrates@eurofins.com
Web: www.eurofins.nl
Web: www.carbohydratestesting.com