

What About Starch

Editor's Note: Frequently when we discuss sugar, we also mention starch especially when discussing diet issues or dieting. In terms of human nutrition, starch is by far the most consumed polysaccharides in the human diet. It constitutes more than half of the carbohydrates even in many affluent diets, and much more in poorer diets. Plants use starch as a way to store excess glucose, and thus also use starch as food during mitochondrial oxidative phosphorylation. In this month's column, we will look at starch and some of the many uses of starch other than those associated with food consumption.

Starch, chemical formula $(C_6H_{10}O_5)_n$, is a mixture of amylose and amylopectin (usually in 20:80 or 30:70 ratios). These are both complex carbohydrate polymers of glucose ($C_6H_{12}O_6$), making starch a glucose polymer as well, as seen by the chemical formula for starch, regardless of the ratio of amylose: amylopectin.

Traditional staple foods such as cereals, roots and tubers are the main source of dietary starch. It is a white powder, and depending on the source, may be tasteless and odorless. The major resources for starch production and consumption worldwide are rice, wheat, corn, and potatoes. Cooked foods containing starches include boiled rice, various forms of bread and noodles (including pasta). Edible beans, such as favas, lentils and peas, are also rich in starch.

Starch is often found in the fruit, seeds, rhizomes or tubers of plants and is what gives us energy when we eat these.

Starches (in particular cornstarch) are typically used as thickeners and stabilizers in foods such as puddings, custards, soups, sauces, gravies, pie fillings, and salad dressings, but have many other uses.

As an additive for food processing, arrowroot and tapioca are commonly used as well. Commonly used starches around the world are: arracacha, buckwheat, banana, barley, cassava, kudzu, oca, sago, sorghum, regular household potatoes, sweet potato, taro and yams.

Non-Food Manufacturing Uses

Paper making is the largest non-food application for starches globally, consuming millions of metric tons annually. In a typical sheet of copy paper for instance, the starch content may be as high as 8%. Both chemically modified and unmodified starches are used in papermaking. In the wet part of the papermaking process, generally called the "wet-end", starches are chemically modified to contain a cationic or positive charge bound to

the starch polymer, and are utilized to associate with the anionic or negatively charged paper fibers and inorganic fillers. These cationic starches impart the necessary strength properties for the paper web to be formed in the papermaking process (wet strength), and to provide strength to the final paper sheet (dry strength). In the dry end of the papermaking process the paper web is rewetted with a solution of starch paste that has been chemically, or enzymatically depolymerized. The starch paste solutions are applied to the paper web by means of various mechanical presses (size press). The dry end starches impart additional strength to the paper web and additionally provide water hold out or "size" for superior printing properties.

Corrugating glues are the next largest consumer of non-food starches globally. These glues are used in the production of corrugated fiberboard (sometimes called corrugated cardboard), and generally contain a mixture of chemically modified and unmodified starches that have been partially gelatinized to form an opaque paste. This paste is applied to the flute tips of the interior fluted paper to glue the fluted paper to the outside paper in the construction of cardboard boxes. This is then dried under high heat, which provides the box board strength and rigidity.

Another large non-food starch application is in the construction industry where starch is used in the wall board manufacturing process. Chemically modified or unmodified starches are added to the rock mud containing primarily gypsum. Top and bottom heavyweight sheets of paper are applied to the mud formulation and the process is allowed to heat and cure to form the eventual rigid wall board. The starches act as a glue for the cured gypsum rock with the paper covering and also provide rigidity to the board. Starch is also used to make some packing peanuts, and some dropped ceiling tiles.

Clothing starch or laundry starch is a liquid that is prepared by mixing a vegetable starch in water (earlier preparations also had to be boiled), and is used in the laundering of clothes. Starch was widely used in Europe in the 16th and 17th centuries to stiffen the wide collars and ruffs of fine linen which surrounded the necks of the well-to-do. During the 19th century and early 20th century, it was stylish to stiffen the collars and sleeves of men's shirts and other apparel as the clothes were being ironed.

Printing industry - in the printing industry food grade starch is used in the manufacture of anti-set-off spray powder used to separate printed sheets of paper to avoid wet ink being set off. Starch is also used in the manufacture of glues for book-binding.