

PULLULAN

A unique functional Polysaccharide



A Nagase Group Company

Pullulan is an edible linear polysaccharide with unique characteristics such as exceptional adhesiveness, binding and film-forming properties, making it highly useful for innovative new food products.

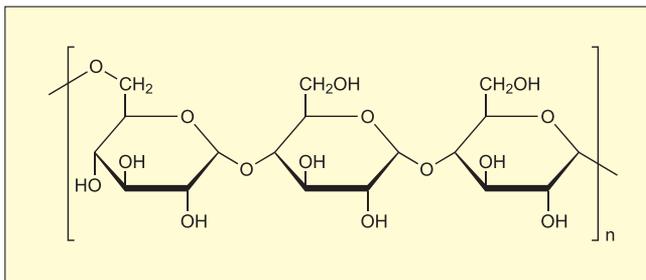
What is Pullulan?

Pullulan is a water soluble polysaccharide commercially produced from a selected non-GMO strain of *Aureobasidium pullulans* using starch syrup as the substrate. It is produced from non-animal source material. Pullulan consists of maltotriose units (α -1,4-linked glucose molecules) polymerized by α -1,6-glucosidic bonds, which forms a stair-step-type structure.



Structure of Pullulan

Name: Poly[6]- α -D-glucopyranosyl-(1 \rightarrow 4)- α -D-glucopyranosyl-(1 \rightarrow 4)- α -D-glucopyranosyl-(1 \rightarrow)
 Chemical formula: $(C_{18}H_{30}O_{15})_n$
 CAS #: 9057-02-7



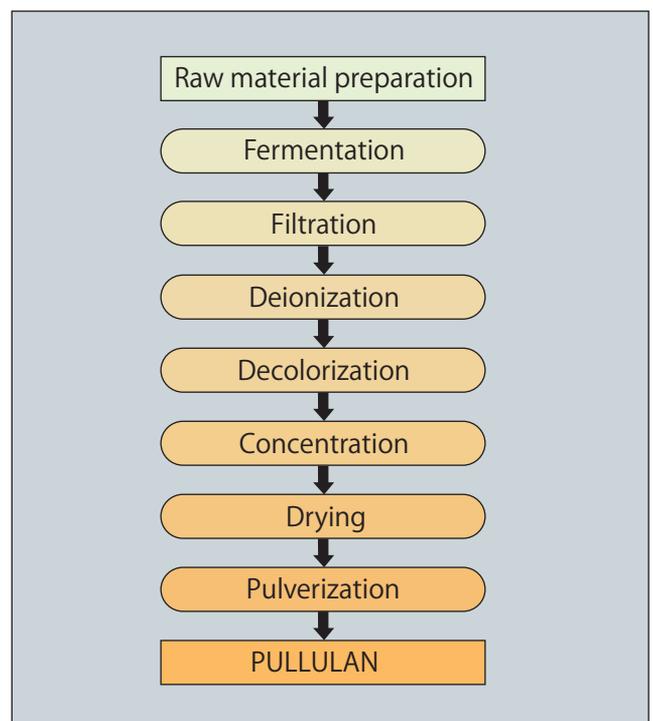
Specifications

Description	White to light yellowish white powder and odorless or a slight characteristic odor
Loss on drying	not more than 6.0%
pH	5.0 ~ 7.0 (10% solution)
Particle size	not more than 1.70 mm
Viscosity	100 ~ 180 mm ² /s (10%, 30 °C)

Specifications subject to change.

Production of Pullulan

Pullulan is manufactured using a fermentation process that is in compliance with good manufacturing practices. After completion of fermentation and filtration, cell-free filtrate is further purified by deionization and decolorization prior to concentration and drying. Dried Pullulan is pulverized to a specific particle size and packaged in PE bags (net 10 kg), which are placed in cardboard boxes.



Physical properties

◆Solubility

Pullulan is freely soluble in water, and practically insoluble in ethanol (99.5).

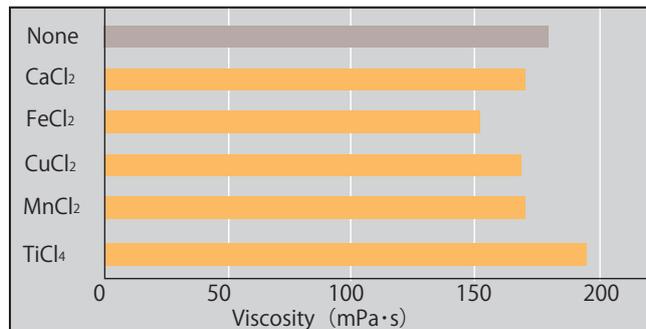
◆Lubricity and adherence

In solution Pullulan is a Newtonian fluid with excellent lubricity and adherence, in spite of low viscosity. This makes Pullulan highly useful for foods requiring thickening.

◆Stability

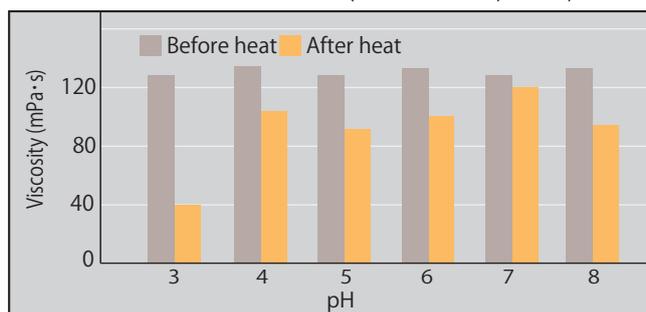
As compared to other polysaccharides, Pullulan solutions do not gel and have a lower viscosity. The viscosity of Pullulan solutions are stable even when metal salts are added. Prolonged heating at pH 3 leads to a decrease in viscosity, which is indicative of a hydrolytic depolymerization.

Viscosity of Pullulan solutions in the presence of metal salts
(10% solutions, 10 mmol/L metal salts)



Cone-plate viscometer(30°C)

Viscosity of Pullulan solutions at each pH before and after heating
(10% solutions, 100°C, 30 min)



Cone-plate viscometer(30°C)

◆Digestibility

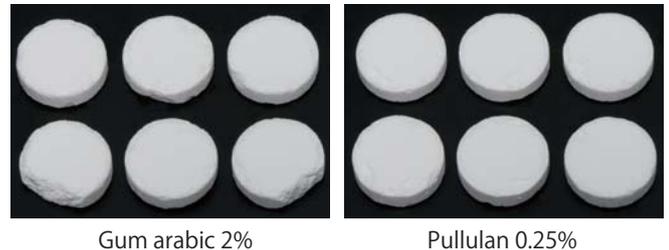
Pullulan is poorly digested and is listed as having an energy conversions factor of 2 kcal/g (Japanese Ministry of Health and Welfare Notice, 1999).

Functional properties

◆Binding property

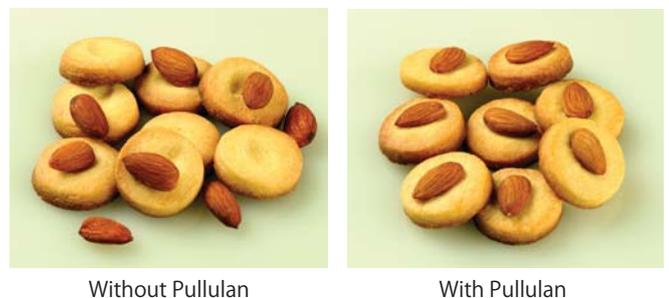
Pullulan is effective at binding ingredients in finished products, such as granola bars. Pullulan can also be used as a binding agent in granulation and tablet formulations. It has lower friability than gum arabic even at a lower concentration, which is important in the handling and transportation of finished tablets.

Pullulan and gum arabic friability test



Tablets were made using granulated microcrystalline trehalose, sugar ester, and Pullulan or gum arabic. The friability test was carried out with a friabilator at 22 rpm for 4 min.

Binding properties using almonds and cookies



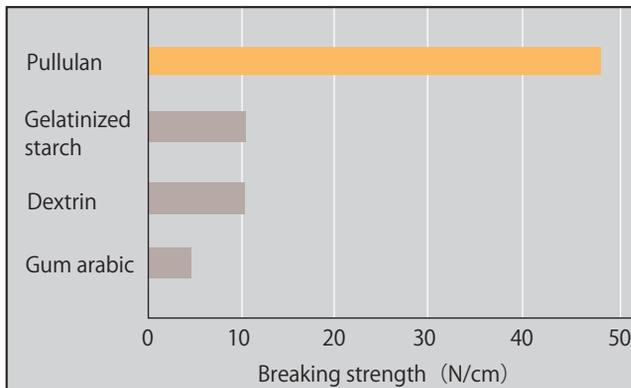
Whole almonds were soaked in a 1% Pullulan solution for 10 seconds. The excess solution was drained, and the almonds were placed on the cookies, and baked in an oven. The samples shown above were shaken mechanically in a container for 30 seconds (approximately 90 shakes).

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Functional properties

Breaking strength of Pullulan almond bar

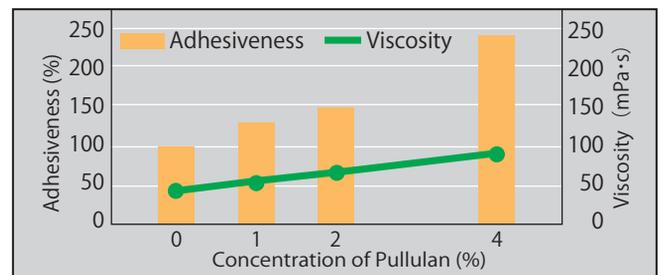


15 g of crushed almonds were added to 20 mL of 10% solutions of Pullulan or three other polysaccharides. After 10 seconds the excess solutions were drained, and the coated almonds were formed into bars in a 1×1.5×5 cm container. The bars were dried at 40°C for 6 hours before testing the breaking strength using a rheometer.

Adhesiveness

Pullulan solutions have high adhesiveness, providing added value in dressings and sauces.

Pullulan adhesiveness (with xanthan gum)



Adhesiveness was calculated from the weight of the solution that adhered to a glass stick dipped in the 0.25% xanthan gum solutions formulated with 0-4% Pullulan.

Film-forming properties

A special feature of Pullulan is that it can be made into an edible, transparent film. Pullulan film is highly adaptable and has numerous applications in food and pharmaceutical development, as well as industrial use. Pullulan film is useful for product development as it can be formulated with multiple ingredients, such as colors, flavors, aromas and functionally active ingredients. Also other thickeners can be added for texture control.

● Pullulan film properties include:

1. Highly water soluble (insoluble in oils)
2. Edible
3. Odorless and flavorless
4. Low oxygen permeability
5. Excellent luster and transparency
6. Excellent printability

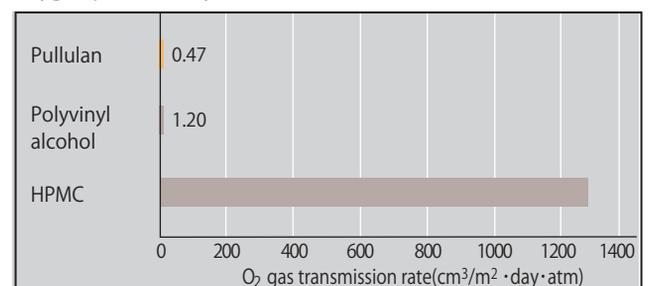
Comparison of film properties

	Pullulan	Polyvinyl alcohol
Tensile strength (MPa)*	41.5	20.5
Coefficient of extension (%)**	2.4	203
Elastic modulus (MPa)*	1910	93
Pensile hardness	6B	less than 6B
Friction factor	0.28	0.74

Film thickness: 30 μm *25°C, 75% RH



Oxygen permeability of various films



Film thickness: 30 μm

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Pullulan application for food

◆ Enhancement of water retention

Pullulan inhibits the release of water and helps maintain the texture of egg products.



◆ Texture improvement (Soft candy)

Soft candy formulated with Pullulan adheres less to teeth. The candy is soft but stable.



◆ Thickening agent

Pullulan is useful as a thickening agent in salad dressings and sauces.



◆ Binding agent

The high adhesiveness and low viscosity of Pullulan make it excellent as a binding agent in such foods as granola bars, and tablets and as a granulation aid.



◆ Binding agent for sugar coatings

Pullulan is an excellent multi-purpose binder for sugar coatings because of its low viscosity. It provides a smooth coating that is resistant to cracking.



◆ Film-forming properties

Pullulan has exceptional film-forming properties. It forms thin films that are transparent, oil resistant, have low oxygen permeability, and can also incorporate colors, flavors, aromas, and active ingredients. Pullulan film can also be printed on, which is useful for many kinds of novelty food applications.

◆ Glazing agent for processed sea food

Pullulan is a good glazing agent and can be used to create a transparent glaze. It has good workability due to its low viscosity.



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It is the customers' responsibility to determine that the ingredient meets all legal requirements in the countries where it is used, and that it does not infringe on any third party patents.



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