

TECHNICAL DATA SHEET

Product Name: Inulin

INCI Name: Inulin

CAS: 9005-80-5

Chemical Class: Polysaccharide; fructan (polymer of fructose with a terminal glucose unit); plant-derived carbohydrate

Functional Category: Humectant; Skin conditioning agent; Hair conditioning agent; Prebiotic component; Texture stabilizer

IUPAC Name: Poly(β -D-fructofuranosyl)-(2 1)- α -D-glucopyranoside (the name depends on the degree of polymerization and does not define a single molecular structure)

Description: Inulin is a natural plant-derived polysaccharide chemically defined as a fructan, meaning a chain of fructose molecules linked by $\beta(2\ 1)$ glycosidic bonds with a terminal glucose unit. In cosmetic formulations it functions as a mild, skin-compatible ingredient that contributes to hydration, microbiome stabilization, and improvement of the sensory profile of the product. It is most commonly obtained from chicory root, although other plant sources may also be used. The ingredient represents a natural raw material with good biocompatibility and a low irritation potential. Due to its hygroscopic properties, inulin acts as a humectant by binding water in the superficial layers of the skin, thereby helping to maintain hydrolipid balance. Compared with classical humectants such as glycerin, its effect is milder and less sticky, which makes it particularly suitable for formulations intended for sensitive skin as well as products designed for sensitive areas such as the skin around the eyes. On the skin it forms a light, non-occlusive film that improves softness and smoothness without leaving a greasy or heavy residue. A distinctive feature of inulin is its prebiotic effect. As a selective substrate for beneficial microorganisms, it supports the balance of the skin microbiome and helps maintain the physiological barrier function of the skin. In formulations designed for problematic, dry, or reactive skin it contributes to reducing sensations of tightness and discomfort while indirectly strengthening the skin's resistance to environmental stressors. This effect is particularly valuable in modern formulations aimed at restoring and protecting the skin barrier. In hair care products, inulin improves hair conditioning, reduces static electricity, and facilitates easier combing without weighing down the hair

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TECHNICAL DATA SHEET

or compromising volume. Its ability to form a thin protective layer on the hair shaft enhances softness and slightly improves shine, especially when combined with other polysaccharides or proteins. Chemically, it is stable within moderate pH ranges typical of dermocosmetic products. It is soluble in water, although its solubility depends on the degree of polymerization: shorter chains show better solubility, while longer chains may contribute to slight turbidity in systems. It does not tend to clog pores and is considered suitable for formulations intended for oily and combination skin. Within the context of modern formulation philosophy, inulin represents a multifunctional ingredient combining moisturizing, sensory, and microbiological benefits while maintaining a favorable safety profile and good compatibility with other hydrophilic active substances. Its use is particularly justified in products designed to preserve the integrity of the skin barrier and maintain long-term skin balance.

Physicochemical Properties: Inulin is a fine white to slightly cream-colored powder with no pronounced odor and a mild neutral taste, making it technologically suitable for a wide range of cosmetic formulations. It is a hydrophilic polysaccharide with a high molecular weight. The actual molecular weight and physical properties depend on the degree of polymerization, that is, the length of the fructose chain. The raw material is well soluble in water, particularly warm water, and solubility increases as chain length decreases. In cold water dissolution may be slower and requires more intensive mixing; however, once fully dispersed it forms a stable, slightly viscous solution. Aqueous inulin solutions have a mild ability to increase viscosity but do not act as classical thickeners. Their influence on the rheology of the system is moderate and depends on concentration and interactions with other polymers. At higher concentrations inulin may contribute to slightly turbid systems, especially when the polymerization degree is higher. Chemically it is stable within the typical pH range of cosmetic products, approximately from slightly acidic to neutral conditions. Under strongly acidic conditions combined with elevated temperatures partial hydrolysis into shorter fructose chains may occur. Thermally it is stable under conditions typical for cosmetic manufacturing, although prolonged exposure to high temperatures in aqueous environments may reduce molecular weight. Inulin is hygroscopic, meaning it binds moisture from the environment. Therefore it should be stored in tightly closed containers in a dry place protected from humidity. It contains no fats or oil fractions and is practically insoluble in oils and non-polar organic solvents. However, it shows good compatibility with other hydrophilic ingredients including humectants, polysaccharides, and certain protein derivatives. From the perspective of safety and stability, inulin is chemically inert in most cosmetic systems. It does not react with common active ingredients and does not exhibit oxida-

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TECHNICAL DATA SHEET

tive instability. Its physicochemical properties allow easy incorporation into the water phase of formulations without the need for special dissolution conditions, making it a technologically reliable and predictable ingredient for professional use.

Benefits:

- Provides effective hydration by binding water in the superficial layers of the skin.
- Helps maintain and stabilize the natural skin microbiome.
- Supports strengthening of the skin barrier and reduces the sensation of tightness.
- Improves skin softness and smoothness without leaving a greasy feel.
- Enhances the sensory texture of formulations and reduces stickiness.
- Improves hair conditioning and facilitates easier combing in hair care products.
- Reduces static electricity and contributes to natural hair shine.
- Does not clog pores and is suitable for oily and combination skin.

Method of Use: In cosmetic formulations, inulin is incorporated exclusively into the water phase of the system. It is recommended to add it to demineralized water with continuous mixing, preferably at temperatures between 40–70 °C to ensure faster and more complete dissolution, particularly when using grades with higher polymerization. It can also be incorporated at room temperature, although this requires stronger mixing and longer dispersion time. Because it is practically insoluble in oils, it is not compatible with the oil phase without an emulsion system. In hydrating serums and toner formulations it is typically used at concentrations between 0.5% and 2%, where it contributes to hydration and microbiome stabilization without significantly affecting viscosity. In creams, emulsions, and lotions typical concentrations range from 1% to 3%, depending on the desired moisturizing and prebiotic effect. In formulations intended for dry or sensitive skin, concentrations may reach 4–5%, provided that rheological properties and system clarity are monitored. In hair care products including shampoos, conditioners, and masks, it is commonly used between 0.5% and 2%, where it improves conditioning and reduces static electricity without weighing down the hair. In mild dermocosmetic formulations intended for reactive skin, it is generally used at lower levels around 1% to provide a prebiotic effect with minimal influence on product texture. The formulation pH should preferably be maintained within a slightly acidic to neutral range, approximately 4.5–7, to ensure optimal stability and preserve the integrity of the polysaccharide chain. Inulin can be combined with other humectants such as glycerin or sodium

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TECHNICAL DATA SHEET

hyaluronate, as well as mild polysaccharide thickeners, without the risk of destabilizing the system.

Comparative Advantages: Compared with classical humectants such as glycerin, inulin provides hydration with significantly lower stickiness and a more pleasant sensory profile, which is particularly important in light serums and emulsions. Unlike strong occlusives, it does not create a heavy occlusive film but allows preservation of the natural barrier function without a feeling of congestion. Compared with synthetic conditioning polymers, it shows better biocompatibility and natural origin, making it suitable for formulations following a clean label concept. Unlike certain prebiotic ingredients that may destabilize systems or increase viscosity, inulin demonstrates predictable behavior in formulations and minimal influence on rheology. Compared with more aggressive barrier-repair actives, it acts gently and is suitable for long-term use without the risk of irritation. Unlike some polysaccharides that may leave a sticky or film-forming sensation, inulin improves product texture while maintaining a light feel on skin and hair.

Natural or Synthetic Ingredient: Inulin is a natural ingredient. It is obtained by extraction from plant sources, most commonly chicory root (*Cichorium intybus*), without chemical synthesis of the core molecular structure. Although processing involves purification and drying steps, the chemical structure remains identical to that found in nature. Therefore it is classified as a natural raw material rather than a synthetic ingredient.

Animal Testing: In accordance with current European legislation (Regulation (EC) No. 1223/2009 on cosmetic products), the substance has not been tested on animals. The safety assessment of the raw material is based on available toxicological data, scientific literature, and validated alternative testing methods (in vitro and in silico). "In silico" refers to testing and evaluation methods performed using computer models and simulations rather than laboratory testing on living organisms (in vivo) or cell cultures (in vitro). This statement confirms compliance with the prohibition of animal testing and serves informational purposes for the further use of the ingredient in cosmetic formulations.

GMO: Non-GMO

Vegan: Does not contain ingredients of animal origin.

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