MesoOrganiSil II™
Silicon-Maltodextrin Benefits White Paper

With Related Research References

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MesoOrganiSil II™ Organic Silicon with Maltodextrin
White Paper with Research References

Contents

1. Background Information about Silicon for Supplements

Silicon—specifically in the form of a Mesoporous Silica Nanoparticle (MSN)—has emerged as a promising active ingredient in nutraceutical formulations. Food-grade amorphous silica, the form most commonly used in nutraceuticals, is recognized as safe for consumption by regulatory authorities, including the U.S. Food and Drug Administration (FDA, as GRAS) and the European Food Safety Authority (EFSA, 2016). The German Federal Institute for Risk Assessment (BfR, 2021) has identified a safe maximum level of 10 mg per daily recommended dose of silicon in the form of monomethylsilanetriol and choline-stabilized orthosilicic acid of a food supplement.

Although Silicon is readily available and absorbed from different foods (Sripanyakorn et al., 2009), we highlight here an advantage of MesoOrganiSil II™ as a supplement for standardization, research, and health benefits with dietary Silicon.

2. Silica Health Benefits

Silicon—specifically in the form of a Mesoporous Silica Nanoparticle (MSN)—has emerged as a promising active ingredient in nutraceutical formulations. Food-grade amorphous silica, the form most commonly used in nutraceuticals, is recognized as safe for consumption by regulatory authorities, including the U.S. Food and Drug Administration (FDA, as GRAS) and the European Food Safety Authority (EFSA).

Silicon is necessary for the synthesis of collagen and elastin, and it is important for the health of the connective tissues, bones, cartilage, tendons and joints. The collagen acts as a scaffold that provides support to the tissues, whereas elastin gives elasticity to tissues, skin, hair and blood vessels. Silicon as a supplement supports multiple health areas.

2.1. Silicon Health Benefit Listing:

- Skin
- Hair
- Cartilage
- Bones
- Blood vessels
- Tissue Elasticity
- Connective tissues
- Tendons and joints

2.2. Silicon for Health, Summary:

Silicon (Si) is an essential trace element for human health, contributing to the growth and maintenance of nails, hair, bone, and skin tissue. It is generally well tolerated, with no significant toxicity reported at typical supplemental doses. Clinical studies have demonstrated that silicon supplementation can improve skin roughness, hair strength, and nail brittleness in women with photo-damaged skin (Barel et al., 2005). Dietary silicon also supports bone integrity and immune function by facilitating the synthesis of collagen, a critical protein in bone and connective tissue. This effect has been shown to be particularly relevant in premenopausal women (Jugdaohsingh et al., 2004).

3. Background Information about Elemental Silicon

Elemental silicon itself is not bioavailable. The most common form encountered is silicon dioxide (SiO_2), commonly referred to as silica. In the presence of water, silica can be converted into orthosilicic acid (OSA), the bioavailable form.

Hydrophilic fumed silica is widely used in the food and animal feed industries and has been identified as a suitable source of elemental silicon in nutraceutical applications. Fumed silica is amorphous and is produced by hydrolysis of chlorosilane in an oxygen–hydrogen flame at temperatures above 1000 °C:

$$\mathbf{SiCl_4 + 2H_2O \rightarrow SiO_2 + 4HCl}$$

The resulting product is a white, low-density powder with pore sizes in the nanometer range. This material, often classified as mesoporous silica, affects the polymerization and aggregation behavior of silica species. The nanometer-scale pore size reduces polymerization, facilitating conversion into monomeric orthosilicic acid. This conversion occurs more readily than with larger-pore silica, particularly under physiological or environmental conditions. Enhanced conversion to orthosilicic acid improves silicon bioavailability and subsequent absorption in the human body.

3.1. Evidence Supporting Transformation in the Digestive System

Research indicates that the Mesoporous Silica Nanoparticle (MSN) undergo biodegradation under physiological conditions, releasing orthosilicic acid (OSA) as a primary degradation product. A recent study by Moya et al. (2024) demonstrated that mesoporous silica materials dissolve at physiological pH, producing silicic acid species, including OSA. This process is driven by the hydrolytic cleavage of siloxane (Si–O–Si) bonds, as described by Poscher and Salinas (2020), who reported that the MSN degrades into “biocompatible and excretable orthosilicic acid ($Si(OH)_4$)” in aqueous solutions consistent with digestive conditions.

Additional evidence supports these findings. Studies by Lin et al. (2012) and He et al. (2010) confirmed that MSN degrades into silicic acid in simulated body fluids and under simulated physiological conditions. The rate of degradation is influenced by factors such as pH, particle size, and surface area.

3.2. Considered Mechanisms of Conversion to Bioavailable Form of Silica

The degradation of the MSN into OSA occurs via hydrolysis, in which water molecules interact with the silica surface and cleave Si–O–Si bonds. Poscher and Salinas (2020) reported that the mesoporous structure of MSN is particularly susceptible to this hydrolytic breakdown, yielding OSA as the degradation product. The reaction is represented as:

$$\mathbf{SiO_2 + 2H_2O \rightleftarrows Si(OH)_4}$$

Hydrolysis is more pronounced under neutral to alkaline conditions, such as those found in the small intestine, compared to the acidic gastric environment, where conversion proceeds more slowly. This has been confirmed in studies employing simulated gastric fluid (SGF, pH 1.2) and simulated intestinal fluid (SIF, pH 6.5).

3.3. Factors Influencing Conversion

Several factors affect the rate and extent of mesoporous silica degradation and conversion into OSA:

- **pH:** Conversion is pH-dependent, occurring more slowly in the stomach (pH 1.5–3.5) and more rapidly in the intestines (pH 6–7.4). This trend has been documented in a review on MSN biodegradability (Hu et al., 2021).
- **Specific Surface Area:** Increased surface area enhances hydrolysis by providing more reactive sites. Narayan et al. (2018) reported that the MSN with higher specific surface area show faster degradation.
- **Morphology and Pore Size:** Particle shape and pore architecture influence degradation kinetics. Smaller and more porous particles exhibit faster conversion rates (Braun et al., 2016).
- **Surface Functionalization:** Chemical modification of the MSN surface can alter hydrolytic behavior. Certain coatings reduce degradation rates, as demonstrated in studies on surface-modified mesoporous silica nanoparticles (López et al., 2010).

4. Maltodextrin

Maltodextrin by Vesta is Non-GMO Project Verified, and Certified Kosher and Halal. Vesta utilizes a proprietary blend and ratio making the Maltodextrin carrier even better for the supplement industry. The Maltodextrin enhances the stability of active compounds and can improve their bioavailability, thereby supporting consistent delivery and efficacy.

4.1. Introduction

Maltodextrin is a polysaccharide derived from starch that provides multiple functional benefits in nutraceutical formulations. Common starch sources include corn, potato, rice, tapioca, and wheat. At Vesta, Maltodextrin is sourced from non-GMO corn. It is produced through partial hydrolysis of starch and purified into a fine, white, odorless, nearly tasteless powder that dissolves readily in water.

In food manufacturing, maltodextrin functions as a filler, preservative, and energy source. In nutraceutical applications, it is primarily used as a carrier or stabilizer (Xiao et al., 2022). As a carrier, maltodextrin facilitates the incorporation of active ingredients into a stable, usable form, improving both handling and bioavailability (Parikh et al., 2014). It enables uniform blending of small quantities of active compounds by increasing bulk volume, allowing accurate measurement, mixing, and encapsulation.

Maltodextrin also contributes to formulation stability by protecting sensitive active ingredients from oxidation, heat, light, oxygen exposure, pH variation, and other environmental stressors. This protection helps maintain efficacy over time. Additionally, maltodextrin may shield supplements from gastric fluids and support controlled release during gastrointestinal transit.

4.2. Microencapsulation

Maltodextrin, due to its high water-solubility, neutral flavor, and colorless nature, is well suited for encapsulating active compounds within a protective matrix. During encapsulation, maltodextrin forms a dense, amorphous matrix that serves as a physical barrier, reducing exposure of sensitive actives to degrading agents such as light, heat, moisture, and oxygen.

The Functional Mechanisms of Maltodextrin Encapsulation include:

- **Barrier protection** – shields active compounds from environmental stressors.
- **Moisture control** – limits water activity and prevents hydrolytic degradation.
- **Thermal stability** – improves resistance of actives to heat during processing and storage.
- **Solubility and dispersibility** – enhances reconstitution and bioavailability of active compounds.

(Parikh et al., 2014; Mazar et al., 2025)

4.3. Controlled Release Properties of Maltodextrin Matrices

Controlled release, ensuring that active compounds are liberated at the appropriate site and rate, is critical for both functional efficacy and product safety in nutritional supplements (Todorovic et al., 2022).

4.4. Bioavailability Improvement via Maltodextrin Encapsulation

Bioavailability—the fraction of an administered dose that reaches systemic circulation—is critical to the functional value of nutritional supplements. Encapsulation with maltodextrin can improve bioavailability through multiple mechanisms:

- **Solubility enhancement:** Maltodextrin increases dissolution rates of poorly soluble actives (e.g., fat-soluble vitamins, polyphenols), thereby improving intestinal absorption.
- **Protection from gastric degradation:** The maltodextrin matrix shields sensitive compounds from the acidic gastric environment and digestive enzymes, allowing delivery to targeted absorption sites such as the small intestine or colon (Poopan et al., 2025).
- **Gastrointestinal delivery of probiotics:** When co-formulated with whey protein and prebiotic fibers (e.g., corn fiber), maltodextrin significantly enhances probiotic survival during transit through gastric acid and bile, maintaining viable counts exceeding FAO/WHO thresholds for efficacy (Poopan et al., 2025).
- **Targeted release:** Modified maltodextrin matrices (e.g., through cross-linking, blending, or enzyme-sensitive bonds) enable site- and time-specific release, supporting optimized systemic uptake.

5. Silica-Maltodextrin Stability Benefits

Quantitative analyses demonstrate that actives encapsulated with maltodextrin can achieve 2- to 5-fold higher bioavailability, as evidenced by increased antioxidant activity in food matrices, higher plasma concentrations in pharmacokinetic studies, and improved outcomes in in vitro digestion models (Zhao et al., 2022).

Maltodextrin does not directly alter the chemical rate of mesoporous silica conversion to OSA. However, it plays a critical role in stabilizing OSA once formed, thereby indirectly enhancing its bioavailability and functional usability in nutritional supplements. Previous studies have demonstrated that maltodextrin can stabilize bioavailable OSA and prevent polymerization (Ferreira et al., 2018).

Vesta's innovative manufacturing with MesoOrganiSil II™ uses maltodextrin as a coating for mesoporous silica. Upon exposure to aqueous environments, the silica undergoes hydrolytic conversion to OSA. The maltodextrin matrix then encapsulates and stabilizes the resulting OSA, limiting polymerization and preserving bioavailability.

For more information about MesoOrganiSil II™ Silicon-Maltodextrin, contact Vesta Nutra below.

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