

COLLOIDAL OATMEAL: HISTORY, CHEMISTRY AND CLINICAL PROPERTIES

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Abstract

Oatmeal has been used for centuries as a soothing agent to relieve itch and irritation associated with various xerotic dermatoses. In 1945, a ready to use colloidal oatmeal, produced by finely grinding the oat and boiling it to extract the colloidal material, became available. Today, colloidal oatmeal is available in various dosage forms from powders for the bath to shampoos, shaving gels, and moisturizing creams. Currently, the use of colloidal oatmeal as a skin protectant is regulated by the US Food and Drug Administration (FDA) according to the Over-The-Counter Final Monograph for Skin Protectant Drug Products issued in June 2003. Its preparation is also standardized by the United States Pharmacopeia.

The many clinical properties of colloidal oatmeal derive from its chemical polymorphism. The high concentration in starches and β -glucan is responsible for the protective and water-holding functions of oat. The presence of different types of phenols confers antioxidant and anti-inflammatory activity. Some of the oat phenols are also strong ultraviolet absorbers. The cleansing activity of oat is mostly due to saponins. Its many functional properties make colloidal oatmeal a cleanser, moisturizer, buffer, as well as a soothing and protective anti-inflammatory agent.

History of Oatmeal

The oldest oat grains have been found in Egypt, dating back to about 2000 BC. While these ancient plants were probably weeds, cultivated oats were discovered in Switzerland during the Bronze Age period (2000 to 700 BC).¹ Aside from the historical nutritional aspect of oatmeal, it has been recognized since Roman times as a topical cleanser and skin treatment. In Roman medical literature there are numerous references to the use of oatmeal in medicine. Texts by Pliny, Columella, and Theophrastus discuss the use of oatmeal flour as topical therapy for a variety of dermatological conditions.² Oats were brought to North America at the beginning of the 17th century and initially planted on the Elizabeth Island off the coast of Massachusetts.¹ Today, more than 75% of the total cultivated world oats belong to the *Avena sativa* (*A. sativa*) type.³ Aside from its known historic use as food, in the late 19th century oat flour also received attention in nondiet applications.⁴ In the 1930s, finely ground oat flour began to be marketed as an antioxidant for food products sensitive to fat oxidation.^{5,6} During the same time period, literature on the cosmetic benefits of oatmeal formulated in facial masks and bath oils was published, including information about oatmeal relieving itching, its cleansing action, and its function as a skin protectant.⁵

Initially, colloid baths were prepared by boiling oatmeal to extract the gelatinous colloidal material.⁷ In 1945, a ready to use colloidal oatmeal became available.⁸ The colloidal oatmeal consisted of the concentrated starch-protein fraction of the oat grain, in powder form obtained by finely milling the oat.⁷ In the 1950s, colloidal oatmeal was also marketed in a mix form with emollient oils to add lubricating qualities.^{7,9-11} With the introduction of the new ready-to-use preparations, several studies showed the benefits of colloidal oatmeal bath as being a soothing treatment as well as a nonirritating, cleansing formulation for inflamed, itchy skin associated with various xerotic dermatoses.^{7,9-13} It is

interesting to note that studies in the 1950s reported a cosmetic improvement from oatmeal as assessed by the subjects, who said that their skin became "softer" and "silky."¹² Many new products began to add colloidal oatmeal to their formulations and by the 1970s several bath preparations containing oat were commercially distributed.⁴ Lastly, in 1989 the FDA recognized colloidal oatmeal as a safe and effective over the counter skin protectant drug and proposed it as Category I ingredient (safe and effective), pending standardization of its composition and concentration.¹⁴ In June 2003, colloidal oatmeal was approved by the FDA as monograph ingredient to be used as a skin protectant.¹⁵

Today colloidal oatmeal is available in various forms such as bath treatments, cleansing bars, body washes, shampoos, creams, lotions, and shaving gels.

Chemistry

Colloidal oatmeal derives from the whole dehulled oat grain (the whole grain consists of a hull enclosing a groat or kernel). The United States Pharmacopeia defines colloidal oatmeal as the powder obtained from the grinding and processing of whole oat grain, meeting the US Standards for number 1 and number 2 oats. The percentage of fat should not be less than 0.2%. Additionally, no more than 3% of the total particles in the powder should exceed 150 μm and no more than 20% should exceed 75 μm in size.¹⁶ As a result of the small particle size and the dispersion in water, the fine particles deposit on the skin and form an occlusive barrier.¹⁴ Oat is a member of the *Gramineae* (grass) family, but it has some important chemical and structural differences from other cereals, such as the high level of total proteins.¹⁷ Among the oat polysaccharides, starches and β -glucan are the most important.^{18,19} Other carbohydrates consist mostly of araban and xylan gums.²⁰ Oat also contains much higher levels of lipids than any

other cereal grain.^{21,22} The most abundant lipids are highly unsaturated triglycerides.²²

Enzymes, such as lipase, lipoxygenase, and superoxide dismutase, have also been found in oats.^{23,24} Because oat grains are rich in lipids with a high content in unsaturated fatty acids, they contain various compounds with antioxidant activity to protect the lipids from oxidation.²⁵ This activity is mostly derived by the presence of phenolic esters.^{25,26} The oat plant at various growth stages has been found to contain a large number of phenolic compounds including all major classes: benzoic and cinnamic acids, quinones, flavones, flavonols, chalcones, flavanones, anthocyanidines, and aminophenolics.²⁵ The most important antioxidant phenols in oat flour are the glyceryl esters of hydroxycinnamic, ferulic, *p*-coumaric, and caffeic acids.²⁷

Oats also contain flavonoids (phenolic structure) with strong absorption of ultraviolet A (UVA) in the 320 to 370 nm range.²⁵ Other phenolic esters, called avenacins (structurally belonging to saponins), have also been isolated.²⁵ These have a large lipophilic region and a short chain of sugar residues, which interact with nonlipid components. Because of this structure saponins have a soap-like action.²⁸ Lastly, oats contain a variety of minerals and vitamins.²⁹ Among these, vitamin E, present mostly as α -tocopherol, is the most clinically relevant.^{23,27}

Clinical Properties

Because of its chemical polymorphism, colloidal oatmeal presents many functional and dermatological clinical properties such as cleansing, buffering, moisturizing, protecting, soothing, anti-irritant, and antioxidant. As a skin protectant, colloidal oatmeal is regulated by the FDA as an over the counter drug, and can be included in tub baths at a minimum concentration of 0.007% if alone, or at a minimum concentration of 0.003% when combined with mineral oil (30%-35%).¹⁵ The monograph defines a skin protectant as a "drug product that temporarily protects injured or exposed skin or mucous membrane surfaces from harmful or annoying stimuli, and may help provide relief to such surfaces."¹⁵

Skin hydration is one of the most important factors involved in preserving the integrity of the stratum corneum barrier. A reduction in stratum corneum water content, from changes in the lipid bilayer³⁰ or from reduction of the "natural moisturizing factor" (NMF),³¹ prevents degradation of desmosomes, leading to a build-up of scales or dry skin and the formation of micro-fissures. When severe, dry skin can lead to itch and inflammation.

When colloidal oatmeal is dispersed in water, it deposits fine particles on the skin and forms a viscous occlusive barrier, important for protection from external irritants and for sustained therapeutic efficacy.¹⁴ The great viscosity of colloidal oatmeal when mixed with water³² derives from the high concentration of highly hydrophilic polysaccharides.^{18,33} The hydrocolloid β -D-glucan, in particular, exhibits viscosities in solutions, which can exceed those of

other biological hydrocolloids,³³ and significantly contributes to the water-binding properties of oat (emollient).³⁴ The occlusive and water-binding colloidal film holds moisture in the stratum corneum, thus improving dry skin conditions.³⁵ Colloidal oatmeal has also been shown to act as a buffer system, helping restore the normal pH of the skin.¹² These different moisturizing properties of colloidal oatmeal help maintain the barrier integrity, prevent water loss, and alleviate itch. Oat also has important antioxidant, UV absorbent, and anti-inflammatory activity. Ferulic and caffeic acids are among the strongest antioxidants in oats, the former also being a strong UV absorber.²⁶ Since oxidative stress is implicated in many diseases and radical reactions are produced during inflammation, antioxidants may protect against different inflammatory conditions.^{36,37}

Other types of phenols in oat are responsible for different functional properties. In fact, the oat flavonoids are strong UVA-screens,²⁵ and the avenacins have potent antifungal activity as well as a soap-like function.^{25,28}

Tocopherols (vitamin E) have anti-inflammatory and antiphotodamage activities. They have been found to prevent or reduce UV-mediated damage in the skin and to inhibit the biosynthesis of prostaglandin E₂.³⁸

The anti-inflammatory properties of oat have been substantiated in several investigations. A study using extracts of *Avena sativa* showed strong inhibition of prostaglandin biosynthesis *in vitro*.³⁹ Another *in vitro* investigation found that the oat extract decreased mobilization of arachidonic acid from phospholipids, suggesting value for ameliorating inflammatory skin disorders.⁴⁰

A few investigations have also been conducted *in vivo*. Vie et al⁴¹ used the sodium lauryl sulfate (SLS) irritation model to study the anti-inflammatory effect of oatmeal. They pretreated the test sites on the arms with oatmeal extracts (*Avena sativa* or *Avena rhealba*) under occlusion for 2 hours and then applied a 1% SLS solution under a patch for 24 hours. The results showed a significant decrease in irritation with both extracts, demonstrating a preventive effect of these compounds on SLS-irritated skin.

A recent investigation in burn patients demonstrated the soothing benefit of a shower/bath oil containing 5% colloidal oatmeal in liquid paraffin. The results showed that the group using colloidal oatmeal had a significant reduction in itch compared to the group using paraffin oil alone.⁴²

Many older studies have demonstrated the soothing properties of colloidal oatmeal.^{7,9-13} In a study with 139 patients (aged 21-91) suffering from various pruritic dermatoses, colloidal oatmeal was used as a bath and regular cleanser for 3 months. Complete or marked itch relief was experienced by over 71% of the group.¹² Another investigation involving 152 pediatric patients, mostly presenting with atopic dermatitis, contact dermatitis, fungous infections, or seborrheic dermatitis concluded that baths with colloidal oatmeal in

an oil form were excellent adjuncts to therapy, with soothing and cleansing properties and lack of irritation.¹⁰

To confirm the safe use of colloidal oatmeal a study was conducted to determine the incidence of allergy to the product.⁴³ Sixty-five children (6 months to 2 years), atopic or nonatopic, with and without previous exposure to colloidal grain suspensions were tested openly for 15 minutes and under patch for 24 hours and 48 hours. The results showed neither immediate urticarial nor allergic reactions in any of the subjects tested. This latest study, together with the long history of use in all age groups and in various dermatoses, corroborates the safety of colloidal oatmeal for topical treatments.

Oatmeal is a natural product, recognized since ancient times as a skin cleanser and a dermatological medicament. Its enriched chemical composition is responsible for a variety of clinical properties, from cleansing to moisturizing, antioxidant, and anti-inflammatory properties. Because of its long history of safe use and its many skin care benefits, colloidal oatmeal is widely used in dermatological practice as an adjunctive therapy in many pruritic skin conditions such as cercarial dermatitis (swimmer's itch),⁴⁴ chickenpox,⁴⁵ poison ivy, oak and sumac,¹⁵ insect bites,¹⁵ winter itch,^{7,12} atopic dermatitis,^{7,9,10,13} dry skin,^{7,9,11,13} allergic or irritant contact dermatitis,^{9-11,13} and ichthyosis.^{7,10,13} Other indications for colloidal oatmeal products include prickly heat, hives, sunburn and rashes.⁸

New technology in the formulation of oatmeal products has allowed more cosmetically appealing topicals for improved moisturization, cleansing, and shaving, and new products are constantly being developed to address different skin types, skin conditions, and age groups.⁸

Acknowledgment

We thank Dr. Alessandra Pagnoni for providing her expert opinion and critical help in the organization and preparation of the manuscript.

Disclosure

Ellen S. Kurtz PhD and Warren Wallo are employees of Johnson & Johnson Consumer Companies, Inc, the manufacturer of Aveeno® products. The preparation of this manuscript was sponsored in full by Johnson & Johnson Consumer Companies, Inc.

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