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The effect of topical oatmeal (*Avena sativa*) on hydration-related skin disorders: A systematic review

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Abstract

Background: In recent years, interest in developing cosmetics and beauty products based on natural ingredients has increased. The addition of herbal extracts to products could improve the effectiveness of therapy. One of the natural ingredients that can be found is oatmeal. Oatmeal has been used for a long time and has been approved by the U.S. Food and Drug Administration as a skin protective agent since 2003. This study aims to systematically review the literature to determine the effect of topical oatmeal (*Avena sativa*) on hydration-related skin disorders.

Methods: A total of 9,538 studies were found in the database sources such as PubMed, ProQuest, Clinical Key, Cochrane, Clinical Trial, and EBSCO. The inclusion criteria were all randomized controlled trials published from 2010 to 2020 that evaluated the effect of oatmeal-contained moisturizers on hydration-related skin disorders. The risk of bias was assessed using the Cochrane risk-of-bias tool for randomized trials (RoB2).

Results: A total of five studies were included in this systematic review. These studies were published in 2015-2020. The forms of oatmeal in the five studies differ, such as emollient, lotion, and cream extracts. The skin disorders in the literature also vary, such as chronic pruritus, uremic pruritus, atopic dermatitis, irritant hand eczema, and dry skin.

Conclusion: Although the form of oatmeal, skin disorders, and age range in each literature differ, it can be concluded that an oatmeal-contained moisturizer could improve the clinical assessment and the objective measurement of various hydration-related skin conditions.

Keyword: *Hydration-related skin disorders, moisturizer, oatmeal*

Background

The skin is the largest organ in the human body that functions as a barrier between the external environment and the internal tissue of the body.¹ The skin has three layers: epidermis, dermis, and hypodermis.^{2,3} The skin, especially the epidermis, consists of lipid and protein components that maintain skin hydration.⁴ If there are deficiencies in skin lipids or proteins, then fluid evaporation from the skin will occur more rapidly, causing dry skin characterized by the formation of scales and may be accompanied by itch.⁵ Lim et al.⁶ in 2013 stated that about 85 million Americans, or 26.98% of the

American population, suffered from some type of skin disorder. Common skin disorders are hydration-related disorders, such as dry skin or eczema.⁷⁻⁹

Treatment of hydration-related skin disorders is done by maintaining the skin barrier so that there is no increase in transepidermal water loss (TEWL).¹⁰ This can be done by avoiding irritants, choosing a suitable soap, and using a moisturizer.⁵ Moisturizers are topical products that can repair and/or maintain skin barrier function, help prevent dry skin, and work by preventing or reducing fluid evaporation from the skin.¹¹ Many different

moisturizer options can be found. The newest generation of moisturizers contain additives to repair the skin barrier, some have additional herbal extracts such as aloe or oats.^{12,13} In recent years, interest in developing cosmetics and beauty products based on natural ingredients has increased. Adding herbal extracts to biochemical ingredients can increase therapeutic effectiveness, minimize toxicity and/or side effects, and are not detrimental to the environment.¹⁴ In this study, the reviewer will focus more on discussing oatmeal as an additional herbal extract on skin moisturizers.

Oats (*Avena sativa*) are a cereal plant from the *Poaceae* family that can be consumed as food and used in the pharmaceutical industry.¹⁵ Several studies, such as those by Reynertson *et al.*¹⁶ and Ilnytska *et al.*¹⁷ stated that oatmeal can improve skin barrier function. However, there were also studies, such as by Pootongkam and Nedorost,¹⁸ that reported oatmeal to confer a risk of allergies or sensitization. Due to the contradictive statements, the reviewer decided to conduct a systematic review to determine the effect of oatmeal on hydration-related skin disorders.

Methods

Literature search

Databases such as PubMed, ProQuest, Clinical Key, Cochrane, Clinical Trial, and EBSCO were searched for studies according to the PICO (population, intervention, comparator, outcome) described in Table 1. The studies of interest were publications or literature that focused on the effect of oatmeal (*Avena sativa*) on hydration-related skin disorders.

Study selection

The literature included in this systematic review was limited to articles using the English language

that were published between 2010 - 2020 and all literature regarding oatmeal and hydration-related skin disorders using the Randomized Controlled Trial (RCT) method. The exclusion criteria were studies with no full text available.

Data extraction

Data were extracted by searching the databases using the keywords in Table 2. The literature obtained was screened quickly to see if there were any duplicates, and if so, the duplicate was removed. After that, the titles and literature abstracts were read and filtered one by one by the reviewer to assess the quality of the literature. Literature that has been evaluated and found to be relevant to the topic was then read thoroughly to match the inclusion and exclusion criteria of the study; then, the literature will be determined by the reviewer whether to use it or not in the review (Figure 1).

Quality of reporting

The risk of bias was reviewed in each literature using the Cochrane risk-of-bias tool for randomized trials (RoB 2).

Results

From the search using the databases mentioned above, the reviewer obtained 9,538 reports. There were 1,709 that were eliminated due to duplication, leaving 7,829 reports. After exclusion based on eligibility criteria, five studies were identified, filtered, and assessed the eligibility and risk of bias using the Cochrane risk-of-bias tool for randomized trials (RoB 2), presented in Figure 2.^{17,19-22} The selected studies were published between 2015-2020, with the whole age range of the subjects being 6 months-89 years.

Table 1. PICO

Population	General population and hydration-related skin disorders patients
Intervention	Oatmeal extract in moisturizers
Comparator	Other topical intervention, no intervention
Outcome	Clinical assessment, measurement using skin disorder measurement tools

Table 2. Keyword search in the online database

Database	Keyword	Study
PubMed	("Oat" OR "Oatmeal" OR "Avena sativa") AND ("Skin Hydration" OR "Dry Skin" OR "Xerosis" OR "Skin Dehydration" OR "Skin Barrier" OR "TEWL" OR "Trans Epidermal Water Loss" OR "Transepidermal Water Loss")	27
ProQuest	("Oat" OR "Oatmeal" OR "Avena sativa") AND ("Skin Hydration" OR "Dry Skin" OR "Xerosis" OR "Skin Dehydration" OR "Skin Barrier" OR "TEWL" OR "Trans Epidermal Water Loss" OR "Transepidermal Water Loss")	8,468
Clinical Key	("Oat" OR "Oatmeal" OR "Avena sativa") AND ("Skin Hydration" OR "Dry Skin" OR "Xerosis" OR "Skin Dehydration" OR "Skin Barrier" OR "TEWL" OR "Trans Epidermal Water Loss" OR "Transepidermal Water Loss")	258
Cochrane	("Oat" OR "Oatmeal" OR "Avena sativa") AND ("Skin Hydration" OR "Dry Skin" OR "Xerosis" OR "Skin Dehydration" OR "Skin Barrier" OR "TEWL" OR "Trans Epidermal Water Loss" OR "Transepidermal Water Loss")	2
Clinical Trial	("Oat" OR "Oatmeal" OR "Avena sativa") AND ("Skin Hydration" OR "Dry Skin" OR "Xerosis" OR "Skin Dehydration" OR "Skin Barrier" OR "TEWL" OR "Trans Epidermal Water Loss" OR "Transepidermal Water Loss")	1
EBSCO	("Oat" OR "Oatmeal" OR "Avena sativa") AND ("Skin Hydration" OR "Dry Skin" OR "Xerosis" OR "Skin Dehydration" OR "Skin Barrier" OR "TEWL" OR "Trans Epidermal Water Loss" OR "Transepidermal Water Loss")	782

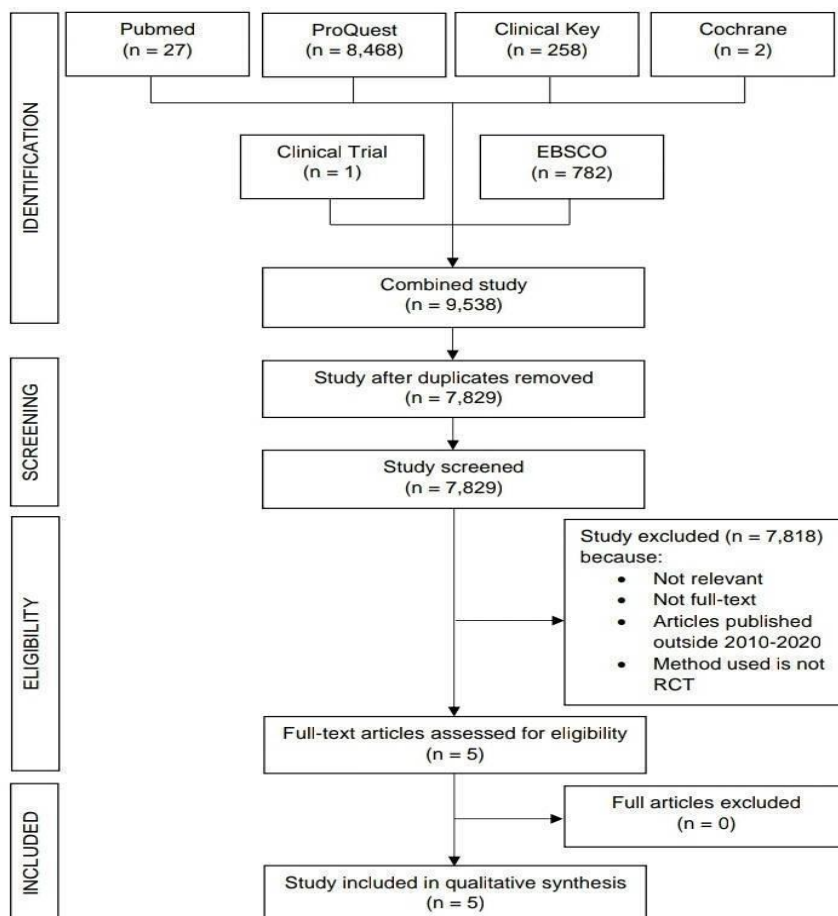


Figure 1. PRISMA flow diagram

	Risk of bias arising from the randomization process	Risk of bias due to deviations from the intended interventions (effect of assignment to intervention)	Risk of bias due to deviations from the intended interventions (effect of adhering to intervention)	Risk of bias due to missing outcome data	Risk of bias in measurement of the outcome	Risk of bias in selection of the reported result
Theunis (2016)	+	?	?	+	+	+
Nakhaee (2015)	?	?	-	+	+	?
Lisante (2017)	+	+	+	+	+	+
Sobhan (2020)	+	+	+	+	+	+
Illytska (2016)	+	?	?	-	+	+

+ Low risk
 ? Some concerns
 - High risk

Figure 2. Cochrane risk-of-bias tool for randomized trials (RoB2).

Theunis et al.¹⁹ in 2016, conducted a study to determine the effect of an oatmeal-based emollient on chronic pruritus in elderly outpatients in France. Subjects were divided into two groups—the intervention and non-intervention groups. Subjects in the non-intervention group were asked not to apply any product for two weeks, while subjects in the intervention group were asked to apply oat extract-based emollient (A-Derma Xera-Mega Confort®, Pierre Fabre Dermo-Cosmétique, Boulogne, France) to the skin twice a day for two weeks. Subjects in the intervention group were asked not to apply anything to the skin for two weeks (wash-out period), then proceed to the non-intervention phase.¹⁹

The main objective of this literature was to study the effectiveness of oat-based emollients on the intensity of pruritus. This was measured by comparing the Visual Analog Scale (VAS) between the non-intervention and intervention groups. In addition, subjects were also assessed using the French version of the 5D itch scale. Other objectives of this study were to measure the degree of dry skin using Overall Dry Skin Score (ODSS), measure hydration index using Corneometer®, measure desquamation using D-Squame Tape, and measure TEWL using Aquaflux® AF200.¹⁹

In 2015, Nakhaee et al.²⁰ conducted a study to compare the effects of *Avena sativa*, vinegar, and hydroxyzine on uremic pruritus in hemodialysis patients in Birjand, Iran. There are 25 subjects divided into three groups in this study. The intervention for group 1 was to apply *Avena sativa* lotion twice daily for two weeks. Group 2 used vinegar solution (30 mL 5% white vinegar + 500 mL water) twice a day for two weeks. Group 3 was given hydroxyzine tablets every night for two weeks. After two weeks, the three groups were asked to fill out a pruritus questionnaire to see the improvement of pruritus. Then, the subjects were not given any intervention for 72 hours (wash-out period). After that, the intervention was changed. Group 1 was assigned vinegar solution, group 2 was assigned hydroxyzine, and group 3 was given *Avena sativa* lotion for two weeks. After that was the wash-out period again, followed by the change of intervention for the last time, with group 1 being given hydroxyzine, group 2 being assigned *Avena sativa* lotion, and group 3 being given vinegar solution.²⁰

Pruritus intensity was measured using VAS as well as additional questionnaires that include the frequency of pruritus, verbal description of pruritus (sense of tingling, prickling, burning, etc.),

consequences of pruritus (presence of lesions due to scratching, disturbed activities, disturbed sleep, and decreased concentration). The pruritic surface is measured using a percentage of the total body surface area by Land and Browder.²⁰

Lisante et al.²¹ in 2017, conducted a study to determine the effect of 1% colloidal oatmeal cream on mild to moderate atopic dermatitis in children in Florida and Ohio, USA. There are 90 subjects in this study divided into two groups, with 45 subjects in the intervention group and 45 in the control group. The intervention group was given over-the-counter 1% colloidal oatmeal cream (formula 19306-127; Johnson & Johnson Consumer Inc.), while the control group was assigned prescription skin barrier cream (formula 19306-137; EpiCream® Skin Barrier Emulsion). Examination was performed at baseline (day 0), day 7 (week 1), 14 (week 2), and 21 (week 3), or the day the subject stopped using the product.²¹

The main objective of this literature was to compare the Eczema Area Severity Index (EASI) between the baseline and the third week. Other objectives include comparing the Investigator's Global Atopic Dermatitis Assessment (IGADA) and severity of pruritus (using VAS) between baseline and weeks 1, 2, and 3, as well as product evaluation and performance for atopic dermatitis.²¹

Sobhan et al.²² in 2020, conducted a study to determine the effect of 1% colloidal oatmeal cream as an adjunct therapy in the treatment of chronic irritant hand eczema in Hamadan, Iran. There are 63 subjects in this study divided into two groups, the intervention and the control groups. The intervention group (n = 32) received 0.025% fluocinolone ointment (Najo Pharmaceutical Company, Tehran, Iran) and 1% colloidal oatmeal cream (Alvand Pharmed Pars Pharmaceutical Company, Hamadan, Iran), while the control group (n = 31) received 0.025% fluocinolone ointment and base cream. Subjects were asked to use 0.025% fluocinolone twice daily for two weeks. After that, subjects in the intervention group were asked to use colloidal oatmeal cream four times a day for six weeks (two weeks combined with fluocinolone, four weeks to be applied as monotherapy), and subjects in the control group were asked to use regular cream for the same length of time as the intervention group.²²

The main objective of this study was to compare the degree of hand eczema between baseline and weeks 2, 4, and 6 of intervention. Hand eczema was assessed using the Hand Eczema Severity Index (HECSI, an instrument for objectively

measuring hand eczema based on clinical symptoms). Other objectives of this study were to assess the pruritus intensity between baseline and weeks 2, 4, and 6 of intervention using VAS. In addition, the subject's quality of life was evaluated using the Persian version of the Dermatology Life Quality Index (DLQI). This study also considers whether there were any adverse events during the study, such as itching, burning sensation, erythema, and exacerbation of the underlying disease.²²

Illynska et al.¹⁷ in 2016 conducted a study to determine the effectiveness of colloidal oatmeal lotion in improving the skin barrier function in moderate to severely dry skin. Examination of dry skin is done by an expert grader, and instrumental analysis—examining TEWL using Dermalab and examining the moisture of the skin using *Skicon 200 EX*. There are 50 subjects in this study. Subjects were asked to apply colloidal oatmeal lotion to the lower leg twice a day (with a span of 8 hours) for three weeks. After that, the subject cannot use any products for two weeks.¹⁷

This study aimed to determine colloidal oatmeal's mechanism of action on the skin barrier. This study is conducted in vitro and in vivo.¹⁷

Discussion

The literature by Theunis et al.¹⁹ found that the oat-based emollient significantly reduced pruritus in subjects in the intervention group throughout the study, even lasting up to 4 weeks after the study ended. In addition, the emollient can also significantly reduce the degree of dry skin in subjects in the intervention group through clinical assessment and measurements using D-Squame Tape. This emollient can also improve skin hydration in subjects with the intervention group measured using a Corneometer. There was no significant change in the TEWL, while the skin hydration value increased in the intervention group. This was congruent with the theory that dry skin can be the leading cause of pruritus even though the skin barrier function is not impaired. The emollient was well tolerated by the subjects, with only one adverse event reported, which was mild pruritus following the application of the emollient. The mild pruritus disappeared after a few minutes, which did not make the subject discontinue participating.¹⁹

Research by Nakhaee et al.²⁰ showed that hydroxyzine, *Avena sativa* lotion, and vinegar solution significantly reduced the intensity of pruritus. Hydroxyzine should be consumed

cautiously because one of the side effects of hydroxyzine is an anticholinergic effect that can reduce sweat production and increase the risk of developing dry skin and pruritus. The statement that *Avena sativa* lotion can significantly reduce the intensity of pruritus is in line with other studies that state that *Avena sativa* lotion can reduce the intensity of pruritus significantly in pruritus patients with different underlying diseases.²⁰

Research by Lisante et al.²¹ showed that the intervention using 1% colloidal oatmeal cream was as effective as regular creams in improving children's signs and symptoms of mild-moderate atopic dermatitis. At week 3 of the study, there was a significant improvement in the signs and symptoms of atopic dermatitis in both study groups compared to baseline EASI values. There was no significant improvement in VAS examination between baseline and the examination at week 3. This statement was ambiguous since some inconsistencies in the pruritus questionnaires may confuse the subjects. The pruritus assessment on the case report form measures the pruritus intensity with 0 experiencing no itching and 10 unbearable itchings. In contrast, the Quality of Life (QoL) questionnaire measures pruritus, with 1 being very itchy and 10 being not itchy. Measurement of the pruritus intensity using the QoL questionnaire showed an improvement at week 3 compared to the baseline in the two intervention groups. The IGADA examination also improved at week 3 compared to the baseline. Both intervention creams were well tolerated and had no adverse events.²¹

The QoL questionnaire showed that both intervention creams could improve signs and symptoms of atopic dermatitis in children. This questionnaire stated that there was an improvement in skin appearance, skin hydration, pruritus, and moisture. In addition, patients and/or caregivers stated that the creams used in the study were more satisfactory than the creams they used as therapy. Most patients and/or nurses indicated they did not mind if the products they usually used as therapy were replaced with intervention creams. Patients and/or nurses in both groups stated that it was easy to apply the cream and preferred to use the cream every day.²¹

The literature by Sobhan et al.²² showed that 1% colloidal oatmeal cream that was used as adjuvant therapy in the treatment of chronic irritant hand eczema could improve hand eczema intensity, eczema-related pruritus, and the subject's quality of life.²²

The study by Ilnytska et al.¹⁷ showed that keratinocyte treatment with colloidal oatmeal extract could induce skin biomarker gene expression and production of involucrin (a protein required for keratin cell formation). This study showed that the topical application of colloidal oatmeal lotion could increase the expression of genes that play a role in keratinocyte differentiation (TGM1), lipid production (PPAR β / δ , HMGCR, and UGCC), and tight junctions (TJ) formation (CLDN4 and CLDN7) in human skin models, indicating the increase of keratin cell maturation, more permeable skin barrier, and increased TJ integrity in normal skin. The ingredients that cause the most induction of skin barrier gene expression in colloidal oatmeal are methanol and acetone extracts which contain phenolic components such as flavonoids and aventhramides, as well as alcohol-soluble albumin.¹⁷

This study showed that colloidal oatmeal can protect the epidermal skin barrier from damage caused by exogenous cytokine therapy in atopic dermatitis skin models. Th2 cytokine therapy combined with TNF- α can disrupt the skin barrier by inhibiting keratinocyte differentiation, inducing changes in cytoskeletal formation. There was a significant reduction in transepithelial electrical resistance (TEER) after treatment with Th2 cytokines and TNF- α , and colloidal oatmeal lotion was found to suppress the effect of cytokines on the skin barrier. A decrease in the inflammatory process and an increase in the skin barrier by colloidal oatmeal may be induced by the upregulation of the nuclear hormone receptor PPAR β / δ and the ANGPTL4 gene. PPAR α and PPAR β / δ activators can inhibit the Th2-mediated inflammatory process and reduce the generation of IL-1 α and TNF α in a mouse dermatitis model. Results of in vitro studies suggest that colloidal oatmeal lotion may be helpful for dry or compromised skin conditions such as dry skin or atopic dermatitis.¹⁷

The acid layer on the skin of patients with atopic dermatitis or compromised skin can be disturbed, causing an increase in skin pH. Previous studies have suggested that colloidal oatmeal can act as a skin pH buffer system in subjects with dry skin conditions or atopic dermatitis. The ability of oatmeal as a buffer system can be demonstrated by water fraction (WCO), which is rich in water-soluble proteins (globulin and prolamin) and carbohydrates. This study shows that colloidal oatmeal can increase the expression of genes against proteins in the skin barrier and skin lipids that can improve skin barrier function. Colloidal oatmeal lotion can improve the appearance of dry

skin and decrease TEWL, thereby increasing the skin barrier.¹⁷

Conclusion

Based on the literature reviewed systematically, oatmeal was proven to affect hydration-related skin disorders. The form of oatmeal in those five of literature was different. The literature by Theunis et al.¹⁹ used oat-based emollients, the literature by Nakhaee et al.²⁰ and Ilnytska et al.¹⁷ used colloidal oatmeal lotion, and the literature by Lisante et al.²¹ and Sobhan et al.²² used 1% colloidal oatmeal cream. Skin disorders in the five literatures also varied; subjects suffered from chronic pruritus, uremic pruritus, mild-moderate atopic dermatitis, irritant hand eczema, and moderate-severe dry skin.^{17,19,20,21} In addition, the age range of subjects also differed, with the overall age range being six months to 89 years. Therefore, although the skin disorders and age range of the subjects were different, it could be concluded that a moisturizer containing oatmeal extract could improve various hydration-related skin conditions.

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Conflicts of Interest

None declared.

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