Potential Effect of Avena sativa's Cream on Skin Hydration

Diadora[1], Wianlie Cendana[1], Albert Daniel Saragih[2], Ahmad Raif Martinus[1], Refi Ikhtiari[1,2]
[1]*Laboratory of Biomolecular Chemistry, Graduate School of Biomedical Science*
Universitas Prima Indonesia
[2]*Laboratory of Materials Chemistry, Faculty of Industrial Engineering,*
Universitas Prima Indonesia
Emails: (diadora, wianliecendana, albertdaniel, refiikhtiari)@unprimdn.ac.id

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Abstract: Skin dryness or xerosis is an aging process commonly found in the tropical country especially Indonesia. The process is related to the decrease of skin hydration and the increase of the level of the radical compound known as oxidative stress. This study aims to assess the effectivity of Avena sativa cream formulation in improving skin hydration. The study included a total of 40 female patients with xerosis. The patients were treated with *Avena sativa* cream with various concentrations for 28 days. Results showed a significant improvement ($p < 0.05$) with an increase in the mean difference in dryness scores from baseline to the end of each treatment interval of 28 days. Cream formulation of *Avena sativa* extract is proven to improve skin hydration.

1 INTRODUCTION

Dry skin or xerosis is defined as the loss or reduction of moisture level in the stratum corneum located in the epidermal layer of the skin (Goldsmith.et al, 2015). Epidermal layer is the thinnest and outermost layer of the skin. Very important in cosmetics because this layer provides texture, moisture. and skin color. The main constituent cells of the epidermal layer are keratinocytes. Keratinocytes are produced by basal cell layers. When mature keratinocytes will move to the layer above it is called the process of keratinization (Goldsmith et al., 2015).

There are two major factors that play a role in the occurrence of dry skin. The first is due to physical or chemical factors such as free radicals originating from the sun's UV rays, pesticides and pollution. Free radicals on the skin can cause premature aging which is characterized by dry skin conditions. The second factor is an increase in transepidermal water loss (TEWL) due to a disturbance in the skin that causes a lot of water to evaporate from the skin (Baumann, 2009).

Symptoms of dry skin can be treated by increasing hydration of the stratum corneum with a moisturizing composition that is occlusive and/or humectant and added emollients to smooth rough skin surfaces. Moisturizers that are widely used are oil-in-water emulsions, such as creams and lotions (Farris, 2014).

Moisturizer is a complex formula created to maintain water content in the skin between 10% - 30%, designed to improve the hydration mechanism of the skin and maintain the structure and function of the skin from various influences such as dry air, sunlight, old age, temperature, various skin diseases as well as diseases that can accelerate water evaporation. Moisturizers are generally divided into 3 classes, namely humectants, occlusives and emollients (Farris, 2014).

Humectants are water-soluble ingredients with high water absorption ability that help the skin retain moisture. Examples of humectants that are often used are glycerin, sorbitol, propylene glycol, pyrrolidone carboxylic acids, sodium lactate, urea, sodium hyaluronate, a-hydroxy, and certain natural lipid mixtures. Humectants can draw water from the atmosphere (when the atmospheric humidity is more than 80%) and the epidermal layer. Humectants will penetrate the stratum corneum and are related to lipids or stratum corneum proteins to increase moisture in the skin. In certain circumstances, such as low humidity fluid will occur in the deeper layers of the epidermis and the dermis. Humectants are not

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as effective as occlusive, so they need to be combined with occlusive materials (Farris, 2014).

Occlusive is a substance that lines the skin to inhibit transepidermal water loss (TEWL). Generally, occlusive substances are oily so they can dissolve fat. Examples of occlusive ingredients, namely paraffin, squalene, dimethicone, soybean oil, propylene glycone, lanolin, olive oil, petrolatum, cocoa butter, and mineral oil. After water evaporates from an occlusive moisturizer, the occlusive material will protect the skin from the outside environment (Farris, 2014).

Emollients are added to moisturizing ingredients to soften and soften the skin. Emollients fill the space between corneocyte desquamation. Many humectants and occlusives also function as emollients. Like lanolin, mineral oil, and petrolatum (Farris, 2014).

Ingredients that contain antioxidants such as vitamin E, lipoic acid and coenzyme Q10 are included in moisturizing compositions that act as anti-aging. Antioxidants can reduce the number of free radicals that play a role in the skin's aging process. Other components that are often used are used, namely vitamin A, vitamin B, vitamin C, vitamin D, linoleic acid (Farris, 2014)

Basic ingredients that are often used for moisturizers commonly come from natural ingredients, synthetic or a combination of both (Kurtz & Wallo, 2007). The synthetic ingredients commonly used as moisturizers are glycerin, propylene glycol, and lanolin. The use of synthetic materials such as lanolin and propylene glycol as emollients and emulsifiers is known to cause allergic reactions (Hitayezu et al., 2015).

The use of synthetic ingredients that can endanger the health of the human body encourages research to look for new natural compounds as moisturizers with natural antioxidants that are safer for human health. Therefore we need natural ingredients as substitutes with the same or better bioactivity. Development in the field of medicine needs to be directed into the pharmaceutical industry on the basis of natural ingredients obtained from medicinal plants, with the consideration that the development towards the utilization of natural materials has a high enough competitiveness, beneficial in improving the quality of health. One of the natural ingredients that can be used as a basis for moisturizers is oats (Avena sativa) (Hitayezu et al., 2015).

Avena sativa is a plant that is included in cereal species which is widely used as food and animal feed. The structure of oat seeds is almost similar to wheat. Both have a layer covering the seed coat that protects endospermic starch and germ in the seed core (Grundy, 2018).

At present, demand for oats for human consumption has increased because of its many health benefits and can be used as a staple food (Kulp, 2000). This is because oats have primary compounds such as carbohydrates, proteins, and fiber. In particular, oats also contain a variety of natural antioxidant compounds and fibers that are good for digestion, regulation of blood sugar, lowering cholesterol, preventing asthma. In the field of dermatology, oats are carried out for the management of various skin diseases such as eczema, atopic dermatitis, and as an antibiotic (Sangwan et al., 2014).

The nutrient contents of 100g Avena sativa (Chu, 2014) is showed in the table 1 below:

Table 1 : Nutrients composition of Avena sativa.

Nutrients	Amount	%
Energy	389 Kcal	19 %
Carbohydrate	55 g	3%
Protein	13 g	32%
Fat	6.4 g	10%
Fiber	5 g	
Total Fat	6,9 Gms	348 %
Vitamin E	1,09 mg	~
Thiamin	0,763 mg	99%
Riboflavin	0,139 mg	21 %
Folacyn	56 mg	47 %
Potassium	429 mg	18 %
Calsium	54 mg	86 %
Phosphor	523 mg	82 %
Magnesium	177 mg	40 %
Fe	4,72 mg	48 %
Zinc	3,97 mg	50 %
Pantotenate acid	1,349 mg	41 %
Copper	0,626 mg	44 %
Mn	4,916 mg	23%

The results of studies reported by ((Hitayezu et al., 2015) in oats contained a variety of natural antioxidant compounds including Avenanthramides which belong to the group of N-cinnamoylanthrannilic acid derivatives, B-glucan, phenolic acid derivatives, cinnamic acids derived from the class aldehydes and Vitamin E.

Oats have high concentrations of β-glucan (dissolved fiber) bonds as components of endosperm cell walls. Several studies conducted on human and animal experiments show that a diet using oat-glucan can reduce cholesterol so that it will reduce the risk of liver disease. Several other studies have shown that β-glucans contained in oats can slow the increase in blood sugar when linked to diabetes (Kulp, 2000).

β-glucans are found on the oat skin produced by grinding techniques. Usually, β-glucans are used in medical fields such as wound healing and as a protection for the skin (Sangwan et al., 2014).

In the field of dermatology, the β-glucan compound is used as an anti-irritant, moisturizing and anti-aging because it can increase collagen production. Studies also show that β-glucans have the same antioxidant activity as vitamin E in maintaining glutathione levels in the skin after exposure to UV light (Schar et al., 2017).

Avenanthramides (Anthranilic acid amides) or AVA belongs to the group of phenol alkaloids which are generally found in oats. Various studies show that avenanthramide has antiinflammatory, antioxidant and antiproliferative activities. The compound Avenanthramide was first discovered by Collin through extraction from oats in 1989. The antioxidant activity of AVA is 10-30 times more potent than the common cereal antioxidant compounds such as ferulic acid, gentisic acid, vanillic acid, and vanillin. Until now, there are 6 AVA subtypes namely Avenanthramide 2, AVA A, AVA C, AVA B, AVA E, AVA D, Z- AVA E. AVA-c has the highest antioxidant activity followed by AVA-B and AVA-A (Hitayezu et al., 2015).

Tocols (tocopherol and tocotrienol) or vitamin E are natural antioxidants contained in oats in the form of fat-soluble compounds and are found in endosperm oats. Tocols compounds work as antioxidants by transferring hydrogen atoms from phenol groups to free radicals, thus breaking the chain of oxidation processes. Tocols compound is also beneficial for reducing cholesterol levels and inhibiting the growth of cancer cells (Schar, 2017).

The benefits of oats in cosmetic preparations in vivo have been investigated for their benefits in increasing skin moisture, healing wounds, anti-microbial and anti-inflammatory properties (Baumann, 2009). Currently, oats are mostly consumed orally but for topical use as a cosmetic preparation is still very rare.

From the description above, this research will tests the potential of avena sativa as moisturizer formulated in the cream. The results of the cream formulation were then tested with a patch test for 48 hours on sample to assess allergies. In non-allergic samples, the cream was applied twice a day for 4 weeks on the left forearm.

2 MATERIALS AND METHODS

2.1 Study Population

The females within 18-25 years old with atopic dermatitis/xerosis, eczema, acne, psoriasis and other types of skin infections; and willing to give an informed consent were enrolled in the study. Subjects with an allergy to any of the product ingredients, having any uncontrolled medical illness such as diabetes mellitus, hypertension, liver disease or history of alcoholism, human immunodeficiency virus (HIV), hepatitis or any other serious medical illness were excluded. Pregnant women or nursing mothers were also excluded from the study

2.2 Preparation of Extracts

Avena sativa in the form of simplisia was macerated using 96% ethanol with a sample: solvent: 1:10 ratio for 5 x 24 hours. The maserate product is filtered and then evaporated to remove the solvent using a rotary evaporator at 50 ° C until a thick extract is obtained.

2.3 Formulation of Topical Cream

The oil phase ingredients (stearic acid, acetyl alcohol, and propyl paraben) and the water phase (TEA, glycerin, methyl paraben and distilled water) are separated. The oil phase and the water phase are heated to a temperature of 700C-800C. After everything is mixed, put the water phase little by little into a hot mortar containing the oil phase, mixed with an intermittent shaking to form a cream base. Avena sativa extract was put into a mortar, mixed with a cream base little by little, mixed until homogeneous and put in a container. The concentration of each ingredient is shown in Table 2.

Table 2: Standard formulas for cream preparations (Young, 1972) with modification of the addition of avena sativa extract.

Ingredients	F0	F1	F2	F3
Avena sativa Extract (g)	-	2,5	5,0	7,5
Acetyl alcohol (%b/b)	4	4	4	4
Glycerin (%b/v)	15	15	15	15
TEA (%b/v)	1,5873	1,5873	1,5873	1,5873
Stearate Acid (%b/b)	6	6	6	6
Methyl paraben (%b/b)	0,2	0,2	0,2	0,2
Propyl paraben (%b/b)	0,02	0,02	0,02	0,02
Aquadest	100	100	100	100

2.4 Evaluation of Physical Quality of Cream

The Evaluation of the physical quality includes observing the homogeneity of the preparations, determining the type of preparation emulsions, measuring the pH of the preparations, observing the stability of the preparations.

2.5 Determination of the Cream Homogeneity

A certain amount of creamwas applied to a piece of glass or other suitable transparent material, the preparation must show a homogeneous arrangement and no visible grain.

2.6 Determination of the Type of Emulsion

A certain number of creamwas placed on the beaker, 1 drop of methyl blue is added to the preparation and then stirred. If the methyl blue is spread evenly it means that the preparation is a type of emulsion m / a, but if only the blue spots means the preparation is a type of emulsion a / m.

2.7 Measuring the pH of the Preparation

Determination of the pH of the preparation is done using a pH meter. The instrument is calibrated using a neutral solution (pH 7.01) and an acidic buffer (pH 4.01) until the instrument shows the pH value. Then the electrodes are washed with distilled water. Then dried with tissue. Samples were made in a concentration of 1%, weighing 1 gram of the preparation and dissolved in 100 ml distilled water. Then the electrode is dipped in the water solution. Leaving the device shows the pH value to a constant. The number indicated by the pH meter is the pH of the preparation. Observations were made at room temperature (15 ° C-30 ° C) for 12 weeks.

2.8 Observation of Cream Stability

A total of 100 g of each preparation formula is put into a plastic pot. Furthermore, observations were made in the form of changes in consistency, color and aroma when the preparation was made and in storage for 12 weeks. In this study, the stability of the preparation at room temperature (15 ° C-30 ° C) was observed for 12 weeks of storage.

2.9 Moisturizing Activity Test of *Avena sativa* Extract

2.9.1 Irritation Test

All samples that met the criteria were tested patched. Patch test is done by applying the results of the formulation of Avena sativa extract cream on the back of the right ear and the back of the left ear to base F0 as a comparison. Testing is carried out for 24 hours for each volunteer. Symptoms that arise are observed, the existence of skin reactions shortly after sticking and touching the skin, such irritations are called primary irritations, but if these reactions occur several hours after touching and sticking to the skin, then these irritations are called secondary irritations.

2.9.2 Moisturizing Activity Test

Samples that did not experience allergies and irritations, then tested the application of Avena sativa extract cream for 4 weeks. The grouping is divided into: Group I: 10 people testing for the blank formula (F0).Group II: 10 people testing for the formula 2.5% (F1).Group III: 10 people testing for the 5% formula (F2). Group IV: 10 people testing

for the 7.5% formula (F3).Avena sativa extract cream was applied to 1 ml of the left zygomaticum area with a size of 3 x 4 cm (using a syringe). To reduce bias, samples are asked not to use cosmetic products in the test area 2 weeks before the study and protect the test area from direct sunlight. Skin hydration measurements were performed at the beginning of the study using a skin analyzer on day 0 (before the application of extract cream), day 7, day 14, day 21 and day 28. Before measurement all samples were asked to be in the lab for 15 minutes at 25ºC so that the skin can acclimatize at room temperature.

3 RESULTS AND DISCUSSSION

Based on the extraction of *Avena sativa* samples conducted by maceration technique with 96% ethanol for five daysdays started fromadried simplisia 2000 gr will resulted a green brownish thick extract 160 gr (8% w/w) with sticky consistency and odorless.

Figure 1. Avena sativa green-brownish thick extract.

The cream was made by a modified standard formula. Avena sativa's extract was used to make cream preparations in a concentration of 2.5%; 5%; 7.5% and blank. Cream preparations obtained in the form of a green brownish cream with no odor.

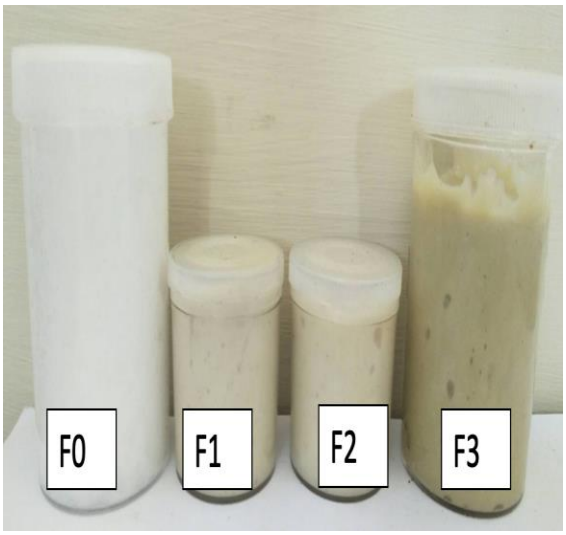

Figure 2. Cream preparation of blank (F0), Oats extract 2.5 % (F1), 5% (F2), 7.5% (F3).

Homogenity examination results on Avena sativa cream were found to be homogeneous, there were no coarse grains. The results of the type of cream emulsion test showed that the methyl blue color could be homogeneous or spread evenly in the cream so that it could be proven that the cream preparations made had an oil-type emulsion in water (m/a).

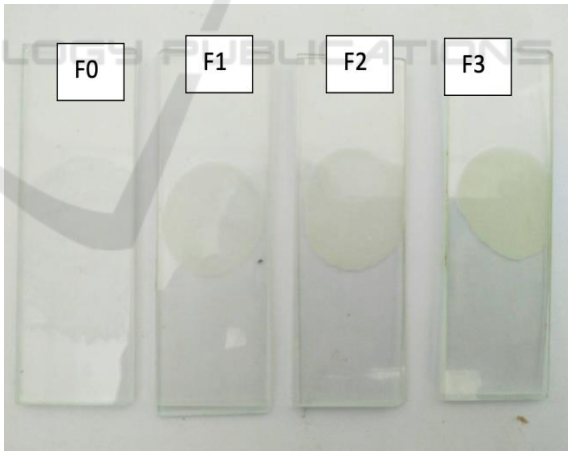

Figure 3. Cream homogenity of blank (F0), oats extract 2.5 % (F1), 5% (F2), 7.5% (F3).

Instability of the formulation can be detected in several ways with a change in physical appearance, color, odor and phase separation from the formulation. Generally, an emulsion is considered physically unstable if all or part of the inner phase liquid is not emulsified and forms a different layer on the surface or base of the emulsion. Therefore, it

needs to do an evaluation test for 3 months and is considered as the minimum stability that must be had by an emulsion.

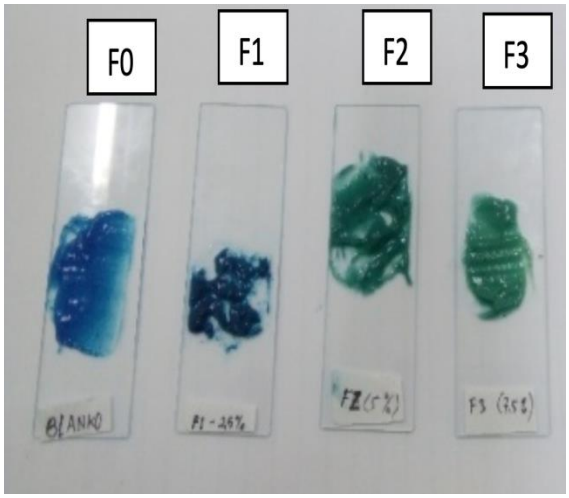

Figure 4. Cream emulsion test of blank (F0), oats extract 2.5 % (F1), 5% (F2), 7.5% (F3).

The pH measurement of the preparation is done after completion, then after storing the first week until the 12th week. The results of the measurement of the pH of each formula showed that with increasing concentrations of Avena sativa extract, the pH of the preparations was getting lower, but the change was still within the standard pH requirements for cream preparations, namely between 5-8 pH(Tranggono, 2007).

Table 3. pH of blank (F0), oats extract 2.5 % (F1), 5% (F2), 7.5% (F3) observed during 12 weeks.

pH in Avg for 12 weeks	Formula			
	F0	F1	F2	F3
0	7.7	7.3	7.2	7.2
1	7.5	7.3	7.2	7.2
2	7.2	7.3	7.2	7.2
3	7.0	7.3	7.1	7.2
4	7.1	7.3	7.1	7.2
5	7.2	7.2	7.1	7.1
6	7.1	7.2	7.1	7.1
7	7.2	7.2	7.1	7.1
8	7.1	7.1	7.0	7.1
9	7.0	7.1	6.9	7.0
10	7.0	7.0	6.9	7.0
11	7.0	7.0	6.9	7.0
12	7.1	7.0	6.9	6.9

Table 4. Stability of blank (F0), oats extract 2.5 % (F1), 5% (F2), 7.5% (F3) observed during 90 days. Change of stability indicated by (-) symbol.

Stability for 90 days	Formula			
	F0	F1	F2	F3
0	-	-	-	-
7	-	-	-	-
14	-	-	-	-
21	-	-	-	-
28	-	-	-	-
90	-	-	-	-

Each formula that has been observed for 90 days gives good results that is not experiencing changes in color, odor and phase separation. It means that cream showed a good long-term stability.

Irritationtest results carried out on the skin of volunteers show no visible side effects in the form of redness, itching and coarseness. Similar results were reported in a study conducted by Goujon in France. The study evaluated immediate and delayed allergic reactions in the use of oats extract containing cream for 45 days in 12 adult samples. The result is cream with oat extract does not give an allergic reaction in all samples (Goujon C, 2009).

There is a significant increase in skin hydration after the use of Avena sativa extract cream for 4 weeks. There are differences in the mean skin hydration in the examined groups (F0 and F1, F0 and F2, F0 and F3, F1 and F2, F2 and F3). An increase in water content in each of the volunteer skins, but highest in formula F3. The results of

measurements of moisture (moisture) on the skin of volunteers can be seen in Table 5 below:

Table 5: Data from the measurement of water content ofoats extract cream on the faces area of volunteers after using cream for 4 weeks. Where as the indication of dehidration 0-29; Normal 30-50; Hidrated 51-100 (Aramo, 2012).

Formula	Average Hydration (%)				
	Initial	DuringApplication(Weeks)			
		I	II	III	IV
F0	31,5	31,8	31.9	32,2	32,5
F1	31,4	33,2	33,8	35	36.3
F2	31,7	34,4	36	37.8	39,4
F3	31	34,8	37,1	39.1	40.5

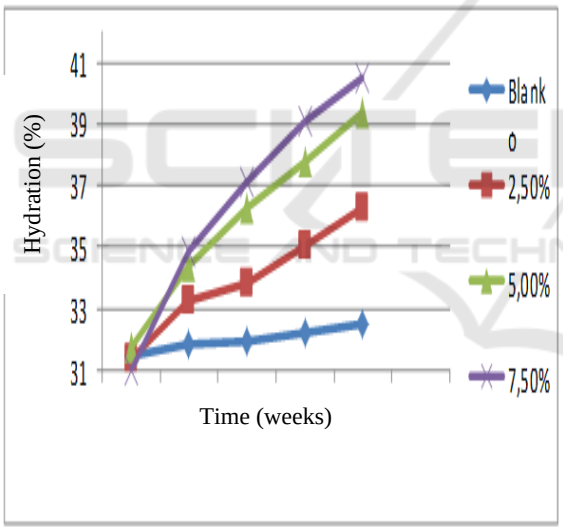

Figure 5.Representation of the increase on the hydration due to the topical application of modified cream of oats extract observed for 4 weeks.

The mechanism of hydrated effects is proposed by the B-glucan compounds contained in oats which play a role in storing water and forming a barrier in the stratum corneum layer on the skin. This reduces the reduction in Transepidermal water loss (TEWL) which plays a role in increasing skin hydration (Reynertson et al, 2015).

The same thing was reported in research conducted by Reynertson while measurements were made with a corneometer on 29 samples that experienced skin dryness in the lower limbs. At the measurement of 14 days after the use of the cream formula with oats extraction, a significant increase in skin hydration was obtained ($p < 0.05$) (Reynertson et al, 2015).

4 CONCLUSIONS

The improvement of skin hydration by *avena sativa* formulated creamshowed a significant improvement ($p < 0.05$) with an increase in the mean difference in dryness scores from baseline to the end of each treatment interval of 28 days. Cream formulation of *avena sativa* extract is proven to improve skin hydration.

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