Volume:1 Issue:3
Year: 2020

International Journal of Traditional and Complementary Medicine Research

Publisher
Duzce University

ORIGINAL RESEARCH

Use of Sunflower Seed Lecithin as an Emulsifier in Herbal Cream Preparation

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Received: 17.08.2020 Accepted: 05.10.2020

Abstract

Objective: Lecithin is a commercially used emulsifier. Generally, lecithin used in foodstuffs is obtained from soybean oil. In recent years, lecithin obtained from sunflower seeds is also used as an emulsifier in the food industry. In this study, the use of lecithin obtained from sunflower seeds was tested the cosmetics industry.

Material-Method: Considering the widespread production of sunflower oil, together with lecithin obtained from this source the aim of this study is a) To produce a cream containing sunflower lecithin and St. John's Wort oil b) To bring a new product to the market by performing microbiological tests of the produced cream. Lecithin can be separated from crude oil by the method of hydration. In addition to antimicrobial efficacy test, the artificial contamination created on the sample, the logarithmic calculation of the number of viable microorganisms remaining in the product is performed on the 7th, 14th and 28th days and the antimicrobial effectiveness of the sample is determined. The products obtained have been dermatologically tested in accredited laboratories whether they cause irritation or not.

Results: Dermatological, antimicrobial and microbiological tests of the herbal cream that the products have been tested and its reliability and authenticity have been proved. As a result of the evaluations and calculations made at the end of the 72th hour, it was evaluated as "not an irritant/not a cause of irritation" dermatologically. According to the results of the antimicrobial analysis, the sample was determined to be protected against microbial growth.

Conclusion: A commercial emulsifier was used in the herbal cream formulation with St. John's Wort, which was previously developed by our group. In this study, lecithin obtained from sunflower seeds was used instead of commercial emulsifiers. The dermatological tests and the antimicrobial efficacy tests of the obtained herbal cream were carried out in accredited laboratories. It has been proven by tests that the resulting cream formulation meets the necessary criteria.

Keywords: Lecithin, Sunflower Oil, Cream, Formulation/Stability

INTRODUCTION

Lecithin is a compound commonly derived from egg yolk, soybeans and recently sunflower, with another name being phosphatidylcholine (Figure 1). Lecithin is essentially a phospholipid, and phospholipids are generally substances that form, protect, and maintain cell building blocks and keep them healthy[1,2]. It is also reported that they prevent hardening of the cell membrane and protect cells against oxidation. Sunflower is a good source of lecithin in countries where it is grown[3,4]. Lecithin released during degumming is one of the important industrial wastes in the oil industry during the production of refined oils. The adhesive materials separated from the crude oil by degumming process are treated as 'process waste'. The most important component in this waste is lecithin. Lecithin is widely used in the food, textile, paint and cosmetic industries. Lecithin has been recognized by the FAO in "GRAS" (generally recognized as safe) status, meaning no limitation has been imposed for the amount of lecithin to be used in foods[5-7]. Because of its molecular structure, commercial lecithin has both lipophilic and hydrophilic properties, and its use as an emulsifier depends on this property[8]. The most important function of lecithin, which is emulsification, is holding two different liquids together and forming oil in water or water emulsions in oil. With these amphoteric

properties, lecithins are indispensable additives in food and cosmetic systems[5,9]. The first function that comes to mind of emulsifiers is their function in the emulsions formed by oil – in water, water – in oil. Oil in water can be expressed by "o/w", water in oil by "W/O" [10].

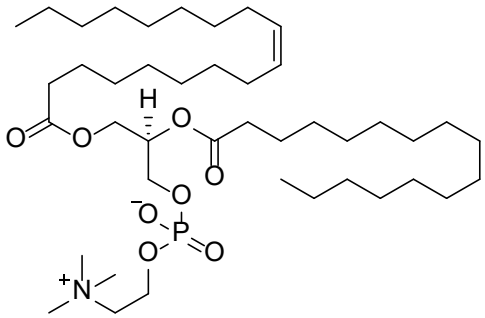

Figure 1. Lecithin molecule

The surface activity of sunflower lecithin is similar to that of soybean, but the amount of phosphatidylcholine of sunflower is higher than that of soy lecithin. Sunflower lecithin is more viscous and difficult to use than soybean lecithin. Sunflower lecithin can be added to the food or used as an additive for animal feed[11]. Sunflower lecithin is used in many commercial products thanks to its emulsifying properties and viscosity reducing effect. In recent years, the sunflower lecithin industry has grown in many countries. Special crushing plants are used for the production of sunflower lecithin because its seeds are smaller than soybeans. Sunflower lecithin is preferred as an alternative to soybean in Europe due to its good hazelnut flavor, suitable fatty acid content and emulsifying properties[12]. The emulsifying properties of modified sunflower lecithins are determined in O / W emulsions. The backscatter evolution, particle size distribution and mean particle diameters were examined for stability[13]. The PC enriched fractions of lecithins, alcohol fractions and enzymatically modified forms showed their best emulsifier properties in the main cream and destabilization processes.

The process of incorporating lecithin into cream formulations dates back to a long time. Among the products that use the product, creams, cleansers, moisturizing liquid make-up materials, beauty lotions and skin penetration enhancers can be listed[14]. The functions of lecithin in cosmetics can be listed as the ease of application in lipsticks, adding to creams to maintain softness, protecting hair, adding synergist against shampoos phenolic antioxidants and using it as emulsifier in prosthetic pastes[15,16]. The inclusion rate of lecithin in products is in the range of 0.5-1 %.

When lecithin is added to oil-based suspensions, it causes adsorption on the surface of the particles used in surfactant components, thus reducing surface roughness. With the addition of lecithin concentration, it causes an increase in flowing stress and does not cause further decrease in viscosity[17]. Lecithin is added to the formulations in small amounts as an emulsifier, which does not create an effect on the product in terms of color, smell and taste[18].

Considering the widespread production of sunflower oil, together with lecithin obtained from this source the aim of this study is a) To produce a cream oil phase containing sunflower lecithin and St. John's Wort oil b) To bring a new product to the market by performing microbiological tests of the produced cream.

MATERIALS AND METHODS

Cream formulation

St. John's Wort and sunflower extract lecithin cream was prepared according to the formulation given in Table 1[19].

Table 1. Cream formulation

St. John's Wort and sunflower extract herbal cream (400 g)	
Ingredients	**Amount (g)**
Aqua	290-350
Sodium Polyacrylate (and) Dicaprylyl Carbonate (and) Polyglyceryl-3 Caprate	6-10
Glycerin	8-16
Sorbitan Caprylate (and) Propanediol (and) Benzoic Acid	2.5-6.8
Coco-Caprylate	20-30
Hypericum perforatum Oil	11.6-17.5
Parfume	5-10.5
Helianthus annuus Seed Oil	11.6-17.5

Sunflower oil production

The oil extraction of 300 grams of sunflower seeds was carried out by cold squeezing and then crude oil was obtained by straining with vacuum. The resulting crude oil is 25 grams. Sunflower oil was obtained by cold tightening with 8.33% yield.

Production of lecithin

Lecithin can be separated from crude oil by the method of hydration. For this purpose, after the crude oil is heated for 2 hours at 60 ºC, 3% of the crude oil is added to the distillated water. Then it is mixed violently on the magnetic mixer. Lecithin swells and collapses with water. With the simple centrifuge process, the collapsed part is separated and heated at 80 ºC and spread as a thin film layer and the heating is continued and drying process is carried out. Lecithin is maintained at room temperature. It was determined by gravimetric analysis that lecithin content was obtained with 0.5% yield[20].

Antimicrobial activity test

In the antimicrobial efficacy test, after the artificial contamination created on the sample, the logarithmic calculation of the number of viable microorganisms remaining in the product is performed on the 7th, 14th and 28th days and the antimicrobial effectiveness of the sample is determined. In this analysis, ISO11930:2012 standard[21] was taken as reference. Microorganisms used in the test; *Pseudomonas aeruginosa* ATCC 9027, *Staphylococcus aureus* ATCC 6538, *Escherichia coli* ATCC 8739, *Candida albicans* ATCC 10231 and *Aspergillus brasiliensis* ATCC 15404. Briefly, the preparation of the experiment; Working cultures were created by making subculture from stock cultures. Microorganisms were suspended in diluent and calibrated to 10^6-10^7 cfu/ml. Tenfold dilutions were made and bacteria were incubated at TSA, yeast SDA and mold PDA at 32.5 ± 2.5 C for 24-48 hours. 20 grams of cream samples containing lecithin were placed in sterile containers, and 0.2 ml of different microorganisms were added to each container to ensure homogeneity. The inoculated containers were incubated at 22.5 ± 2.5 C. For the 7th day enumeration; 1 g cream sample was taken from the containers and homogenized in 9 ml neutralizer. The mixtures, which were kept at room temperature for 30 ± 15 minutes, were diluted to correspond to 1/10 and 1/100. These dilutions are planted on TSA for bacteria, SDA for yeast and PDA for mold. The colonies in the petri dishes incubated under appropriate conditions were counted and logarithmic evaluation was done and interpreted. The same procedures were carried out on the 14th and 28th days.

Dermatological analysis

The aim of the study was to evaluate the skin compatibility of cosmetic products or raw materials on humans. Check whether cosmetic products or raw materials cause irritation on the skin. A sample of 0.02 mL of cosmetic product applied to the Volunteers ' back area is removed after remaining on the back for 48 hours. After half an hour, the first evaluation is done. Under the same conditions, a second evaluation is made at the end of 72 hours. Results are evaluated by dermatologists and responsible researchers. After calculations are made according to the results, the result is interpreted between "not irritating / not cause of irritation" and "very irritating/cause of high irritation". Deionized water is used as negative control in the study.

RESULTS AND DISCUSSIONS

In this study, a natural emulsifier used in herbal creams produced and which can be used instead of a commercially purchased emulsifier was used. Lecithin, which we want to benefit from the emulsifier feature, has been obtained in abundance from Sunflowers. St. John's Wort oil[22], used in the cream we produced as a cosmetic product, was taken from naturally grown plants in Düzce region. By making use of the thickener feature of lecithin, the thickener additive is also removed in the cream formulation. Thanks to the herbal cream produced, the effects of lecithin protecting the moisture of the skin, anti-blemish and strengthening the cell wall are also benefited. Dermatological, antimicrobial and microbiological tests of the herbal cream that we produced have been tested and its reliability and authenticity have been proved.

Dermatological analysis

Sunflower and St. John's Wort herbal cream is a product that is applied directly. The patches were closed for 48 hours so volunteers remained in the ridge area. The first measurements were made half an hour after the patches were removed. The area left open for 24 hours was reassessed at the 72nd hour. Test results at the end of 48 hours showed that the cream "was not an irritant / cause of irritation". As a result of the evaluations and calculations made at the end of the 72 hour, it was evaluated as "not an irritant/not a cause of irritation". In line with the above, the required parameters are shown in the tables below (Table 2-5). The tests were conducted within the scope of the Human Skin Compatibility Assessment dated European Cosmetics Association (COLIPA)-1997.

Table 2. Irritation classification criteria

Cosmetic Product Irritation Score	Classification
0-0.08	Not an irritant
0.08-0.16	Very mild irritation
0.16-0.56	Little irritation
0.56-1.0	Moderate to mild irritation
1.0-1.6	Cause of irritation
>1.6	Cause of high irritation

Table 3. Cosmetic product irritation test results in volunteers

No	Volunteer ID	Gender	Age	Skin Structure	Situations Encountered During the Study
1	CL401	M	34	Normal Skin	No reaction, No retreat
2	CL402	F	38	Normal Skin	No reaction, No retreat
3	CL403	M	27	Normal Skin	No reaction, No retreat
4	CL408	F	33	Normal Skin	No reaction, No retreat
5	CL413	F	36	Normal Skin	No reaction, No retreat
6	CL414	F	23	Normal Skin	No reaction, No retreat
7	CL415	F	22	Normal Skin	No reaction, No retreat
8	CL417	F	25	Normal Skin	No reaction, No retreat
9	CL423	M	23	Normal Skin	No reaction, No retreat
10	CL429	M	44	Normal Skin	No reaction, No retreat
11	CL440	M	30	Normal Skin	No reaction, No retreat
12	CL442	F	34	Normal Skin	No reaction, No retreat

Table 4. Calculations of dermatological patch test data

	48th Hour	72th Hour
Total Volunteer Data	0	0
Number of Reading	2	2
Total Volunteer Data / Number of Reading	0	0
Irritation Index	0	0
Results	Not irritating Not the cause of irritation	Not irritating Not the cause of irritation

Table 5. Dermatological patch test measurement results at 48 and 72 hours

No	Volunteer ID	Gender	Age	Negative Control	48. Hour Ratings			72. Hour Ratings		
					Erythema	Dryness	Edema	Erythema	Dryness	Edema
1	CL401	M	34	-	0	0	-	0	0	-
2	CL402	F	38	-	0	0	-	0	0	-
3	CL403	M	27	-	0	0	-	0	0	-
4	CL408	F	33	-	0	0	-	0	0	-
5	CL413	F	36	-	0	0	-	0	0	-
6	CL414	F	23	-	0	0	-	0	0	-
7	CL415	F	22	-	0	0	-	0	0	-
8	CL417	F	25	-	0	0	-	0	0	-
9	CL423	M	23	-	0	0	-	0	0	-
10	CL429	M	44	-	0	0	-	0	0	-
11	CL440	M	30	-	0	0	-	0	0	-
12	CL442	F	34	-	0	0	-	0	0	-

Antimicrobial efficacy

For antimicrobial effectiveness of samples; logarithmic reduction rates were calculated from the reduction equation ($R_x = lgN_0 - lgN_x$). The lg cfu / g value, which had been between 7.38 and 5.28 on day 0, was measured between 3.7 and 2.5 lg cfu / g on day 7 by making logarithmic calculations It was <10 on the 14th and 28th days (Table 6). The analysis made corresponds to Criterion A in ISO11930: 2012 standard and according to the results of the analysis, the sample was determined to be protected against microbial growth.

Table 6. Antimicrobial efficacy test logarithmic results

Microorganisms	0 hours		7th day			14th day	28th day
	cfu/g	lg cfu/g	cfu/g	lg cfu/g	lg reduction	cfu/g	cfu/g
Staphylococcus aureus ATCC 6538	2.41E+07	7.38	5.00E+03	3.7	3.68	<10	<10
Pseudomonas aeruginosa ATCC 9027	2.35E+07	7.37	4.00E+03	3.6	3.77	<10	<10
Escherichia coli ATCC 8739	2.28E+07	7.36	4.00E+03	3.6	3.76	<10	<10
Candida albicans ATCC 10231	2.60E+06	6.41	1.00E+03	3.0	3.41	<10	<10
Aspergillus brasiliensis ATCC 15404	1.90E+05	5.28	3.00E+02	2.5	2.80	<10	<10

CONCLUSION

Natural emulsifier used in herbal creams produced and which can be used instead of a commercially purchased emulsifier was used in this study. Lecithin, which we want to benefit from the emulsifier feature, has been obtained in abundance from Sunflower. The dermatological test results were showed that the cream was “not an irritant/not a cause of irritation". Antimicrobial efficacy test results indicate the sample was determined to be protected against microbial growth.

ACKNOWLEDGEMENTS

This study was supported by Düzce University with DÜBAP project number 2019.01.01.1043.

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