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Original article

Formulation and Evaluation of Cream of Green Tea Extract and Salicylic Acid for Acne Treatment

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ABSTRACT

The aim of this study is to formulate and evaluate four different formulas of vanishing cream prepared with green tea extract and Salicylic acid as active ingredients. Formulation of four different formulas of vanishing cream by different percentages of Stearic acid, E. wax, Almond oil, Glycerin, and Purified water using different percentages of Potassium hydroxide, all formulations prepared with green tea and Salicylic acid as active ingredients, the formulations were preserved by Phenoxyethanol, and Rose oil was used as flavor, all formulations were evaluated by physical examinations, PH measurement, spreadability test, and viscosity measurements. The current finding showed that the change in a composition and percent of components of cream results in change in physicochemical properties of cream like homogeneity, color appearance, after feel, and washability. The range of pH for formulas was 4.3 to 7.4, viscosity range was found 29000 (F1)– 19000 pa.s (F4) at 10 rpm with shear-thinning behavior of formulations, and spreadability was ranged from 4.90 to 7.06 cm². All formulas were accepted when examined for these properties but F4 was more homogeneous, very moist and soft with rabid washability and it was the lower viscosity and higher spreadability compared to other formulas. According to pH value, F1 and F3 were close to physiological pH of skin more than F4 while pH of F2 is compatible with physiological pH (5.6). The formula F2 was homogeneous, smooth with very good washability, moderate viscosity, and very good spreadability in addition to the compatible pH and we can choose it as an optimum formula that will need further modification and examination to formulate an excellent cream.

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INTRODUCTION

Adult acne has become a big issue these days, affecting both sexes equally. There are two forms of acne disorders that can affect a person: acne vulgaris and acne rosacea. Similar to adult acne, acne rosacea is a common, persistent, and medically curable skin condition. The middle third of the face, especially the nose, is usually affected by acne rosacea, which can cause transient aggravation and relief.

The symptoms may appear and disappear, and the skin might be clear for a few days, weeks, months, or even years. Rosacea is characterized by redness of the face, little red pimples, and fine red lines on the skin of the face. With a massive, bulbous crimson nose, Conjunctivitis and swollen, red eyelids are examples of eye issues. Changes in the

pilosebaceous units, or skin structures made up of a hair follicle and the sebaceous gland that sits next to it, are the cause of acne vulgaris, also referred to as acne[1].Three classifications of acne symptoms exist: mild, moderate, and severe. There are two kinds of non-inflammatory lesions: closed comedons, also referred to as white heads, and open comedons, sometimes known as blackheads. Inflammatory lesions include papules, pustules, cysts, and nodules. Comedones, inflammatory lesions, seborrhoea, and the presence of germs. The primary features of acne vulgaris are sebum production in the follicular canal. [2], [3]

Some factors responsible for acne as propionibacterium acnes, modified follicular keratinization; Owing to the Cosmetics Applied, Feelings of stress, hormonal shifts and menstrual cycles, pressing the pimples, nutrition. [4]

To overcome this challenge there are various pharmaceutical industry-produced drugs, including creams, lotions, tablets for acne, and moisturizers. Creams are a kind of semisolid emulsion that are designed to be applied externally. They come in two varieties: water in oil (w/o) and oil in water (o/w).

Cream is classified as an oil and water emulsion. Its key advantage is that it lasts longer at the application site. It is applied to the skin's outermost or most superficial layer. The cream's functions include protecting the skin from the elements, healing infections, removing tans and acne, and soothing the skin.[5] The topical drug delivery mechanism is delivered to the skin when the cream is applied.

Worldwide tea is the most widely consumed beverages due to its unique aroma, taste and certain health promotion properties. It is reported that tea contains almost 4000, bioactive compounds among one third part is contributed by polyphenols. These polyphenols are bonded benzene rings with multiple hydroxyl groups. Usually Polyphenols are either flavonoids or non-flavonoids but most of the chimicals in tea are flavonoids [3]. Catechins (polyphenols) are main active constituents found in tea [4]. Environmental oxidative damages are among major risk factor to all living organisms. Increased production of free radicals gives rise to these damages. Sources for these radicals are either endogenous such as inflammation exogenous source such as pollution, radiation and cigarette smoking. Radicals with unpaired electron tend to react with other molecules to trap electron away from them thus starting a chain reaction. Almost all types of organ and tissues are subjected to radical damages but intensity of damage may vary. Plant secondary metabolites gained lot of attention of researchers to combat these degenerative diseases [5]. Tea preparations have shown to trapping activity against various reactive oxygen species (ROS) such as singlet oxygen, hydroxyl radical, superoxide radical, nitric oxide, peroxynitrite and nitrogen dioxide and were helpful in reducing damage to proteins, lipid membranes and nucleic acid in cell-free systems [6].

Around the world, green tea is a highly popular beverage. It is made by drying or boiling fresh Camellia sinensis leaves without allowing them to ferment. A number of the catechin family's polyphenols are found in green tea, primarily epigallocatechin-3-O-gallate (EGCG), epicatechin, and epicatechin-3-O-gallate.[6] With almost 50% of all the polyphenols in green tea coming from EGCG, it is the primary polyphenol found in the tea. The European Food Safety Authority states that there are 126 mg of catechin per 100 mL of green tea.[7] According to the Food and Drug Administration, there are 71 mg of EGCG in every 100 millilitres of green tea.[8]. Subsequently it has been proposed that green tea extract, particularly EGCG, could be used as an alternate medicinal drug for the management of acne vulgaris [9]. Recent years have seen a surge in research on catechin, a polyphenolic component found in green tea, because of its various benefits, including its ability to protect against UV rays, reduce inflammation, and function as an antioxidant. The primary catechin in green tea, epigallocatechin-3-gallate (EGCG), has been demonstrated to have ant melanogenesis, moisture retention, and skin-protecting properties. According to recent research EGCG might also help in wound healing [10].

Salicylic acid is a chemical substance that belongs to the class of aromatic hydroxy carboxylic acids ($C_7H_6O_3$). Salicylic acid's local action on skin is based on its ability to reduce pH, which enhances the skin's defenses against bacterial, viral, or fungal pathogens. Depending on the concentration, this process exfoliates the skin's superficial layers and eliminates the pathogens in question from the skin while also hastening the keratinocytes that make up the epidermis. Salicylic acid is often employed for acne that is both inflammatory and non-inflammatory, as well as greasy skin [11].

However, plants known as herbs have been utilized by people for a wide range of needs, such as food, medicine, and beatification. In the past, numerous natural and herbal components were employed in beauty treatments. Ready-made cosmetic treatments were available over time as technology advanced. These days, a broad variety of substances from various sources are found in cosmetics. The use of botanical ingredients in creams is becoming more common [12]. Nowadays, herbal creams are more often used than synthetic treatments that are sold in stores. Herbal-infused creams will soon rule the market. The aim of this study to formulate four different formulas of vanishing cream for treatment of acne by different percentages of Stearic acid, E. wax, Almond oil, Glycerin, and Purified water using different percentages of Potassium hydroxide, all formulations prepared with (Green tea ,and Salicylic acid) as active

ingredients , the formulation was preserved by Phenoxyethanol , and Rose oil was used as flavor and to evaluate all formulations by physical examinations, PH measurement, spreadability test, and viscosity measurements.

MATERIAL AND METHODS

Materials

Stearic acid (BDH, England), E. wax (Smart solutions, USA), Almond oil (HEMANI, Pakistan) Purified water, Glycerin (T-Baker, India), Potassium hydroxide (Panreac, E.U), Green tea (from the local market at Albaiyda City), Salicylic acid (Panreac, E.U), Castor oil (HEMANI, Pakistan), Phenoxyethanol (NADUS, UK), and Rose oil (HEMANI, Pakistan). All materials were of laboratory grade and used as such without further purification.

Extraction of Green tea

Green tea leaves were purchased from the market and processed in blender to create a powder. One gram of the green tea powder is mixed with 20 ml of purified water in a conical flask. For the purpose of extracting the active components from the green tea leaves, the sample was heated in a water bath at 80°C for 60 minutes then washed with 15 ml of water and filtered using filter paper to remove all impurities. The filtrate in which a clear extract of green tea was obtained and used in the preparation [13].

Formulation of creams

Step1: Preparation of oil phase:

Stearic acid, E. wax, and almond oil were taken into one porcelain dish and the mixture was melted at 70°C on water bath.

Step2: Preparation of aqueous phase:

Water, glycerin, and potassium hydroxide were taken into a beaker and this mixture was heated at 70°C on water bath (to be at the same temperature of oil phase)

Step3: Addition of aqueous phase to oil phase:

The aqueous phase was added into the oil phase with continuous stirring at 70°C until a very elegant cream was produced.

Step 4: addition of active ingredients:

Once the formation of cream was completed it was allowed to stand at room temperature, after this we start adding the active ingredients (green tea extract) and (salicylic acid) which is melted in castor oil by heating in it before adding.

Step5: addition of preservative and flavoring agents:

Antimicrobial agent Phenoxyethanol in appropriate percent was added, Rose oil (perfume oil) was added at last just before the finished product was transfer to suitable container. Every adding step was carried out while continuously stirring to ensure that all of the components were thoroughly mixed [14] (Table 1).

Table 1. Composition of four cream formulations: All formulas prepared to 100g

S.no	Ingredients	F1	F2	F3	F4
1	Stearic acid	8g	7g	6g	5g
2	E.wax	8g	7g	6g	5g
3	Almond oil	16g	16g	16g	16g
4	P.water	51.25 mL	52.5 mL	54.25 mL	56 mL
5	Glycerin	2.5g	2.5g	2.5g	2.5g
6	KOH	0.25g	0.5g	0.75g	1g
7	Green tea extract	10 g	10 g	10 g	10 g
8	Salicylic acid	1 g	1 g	1 g	1 g
9	Castor oil	3g	3g	3g	3g
10	Phenoxyethanol	0.5g	0.5g	0.5g	0,5g
11	Rose oil	2drops	2drops	2drops	2drops

Evaluation Tests of cream formulations

1. ***Physical Examination***

Homogeneity Test

The formulations were tested for the homogeneity by visual appearance and by touch.

Appearance test
The appearance of the cream was judged by its color, pearlscence and roughness and graded
After feel test
Emollience, slipperiness and amount of residue left after the application of fixed amount of cream was checked.
Type of smear test
After application of cream, the type of film or smear formed on the skin were checked.
Removal test
The ease of removal of the cream applied was examined by washing the applied part with tap water [10].

2. Measurement of pH
About 1g of the cream was weighed and dissolved in 10ml of purified water and its pH was measured using pH meter (Sevenmulti, Mettler Toledo, Germany).

3. Spreadability test
Is performed by the parallel-plate method, 1 g of the sample prepared in 48 h before the test is placed between two glass plates 14 x 14 cm. A weight (230 g is placed on top plate for one minute then the diameter of the sample between the plates is measured.[15]. Spreadability is determined by the formula:
$Si = d^2 \times \pi/4$,
Si=spreading area (cm^2) depending on mass.
d=spreading area diameter (cm)

4. Measurement of Viscosity
The viscosity of cream was evaluated using a Brookfield Digital viscometer (model DV-II Viscometer). The sample was placed between the gap of cone and plate, and the gap was closed gradually, the sample was subjected to dynamic shear rate from (10, 30, 60 rpm) and the viscosity was measured [5]. All measurements were performed at isothermal condition of room temperature (25˚C ± 2).

RESULTS
1. Physical Examination
Physical examination parameters of cream formulations including, homogeneity, appearance/ color, after feel, type of smear and removal/washability test are shown in table 2.

Table 2. Physical examination parameters of cream

Parameters	F1	F2	F3	F4
Homogeneity test **By visual** **By touch**	Less homogenous Smooth	Homogenous Smooth	More homogenous smooth	More homogenous Smooth
Appearance/ color test	Off white	Yellowish white	Slightly Yellowish green	Yellowish green
After feel test	No residue, soft	No rresidue, very soft	No residue, softer	No residue, the softest
Type of smear test	Less Moist	Mild Moist	Moderate Moist	Very moist
Removal test	Good washability	Very Good washability	Very Good and rapid washability	Best and rapid washability

2. Measurement of pH of Formulations
The formulations were tested using pH meter to determine pH value of formulas. pH value should be compatible with physiological skin pH (4.5- 5.5), values of pH were 4.3, 5.6, 6.3, and 7.4 for F1, F2, F3, and F4 respectively as shown in figure 1.

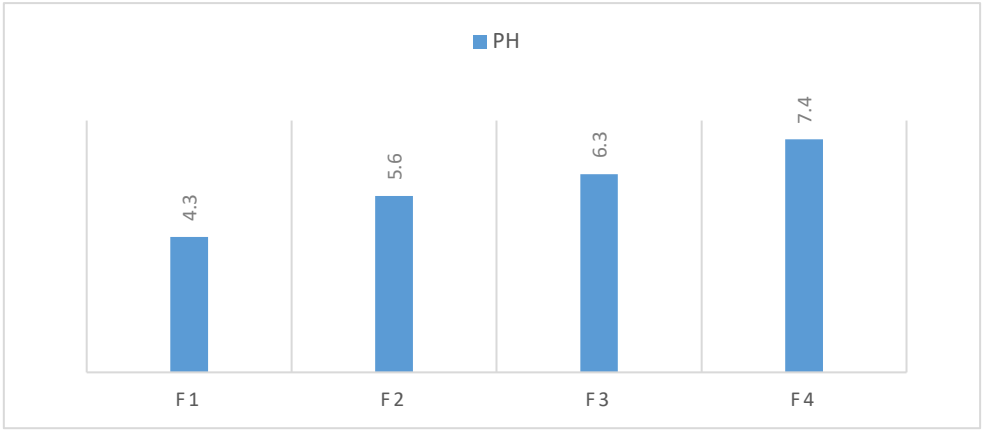

Figure 1. Chart of pH of formulations

3. Spreadability test

The spreadability test showed that the formulations have a good spreadable property, spreading area for formula was 4.90, 5.72, 6.60, 7.06 cm² for F1, F2, F3, and F4 respectively. Figure 2 provided results of spreadability of the cream.

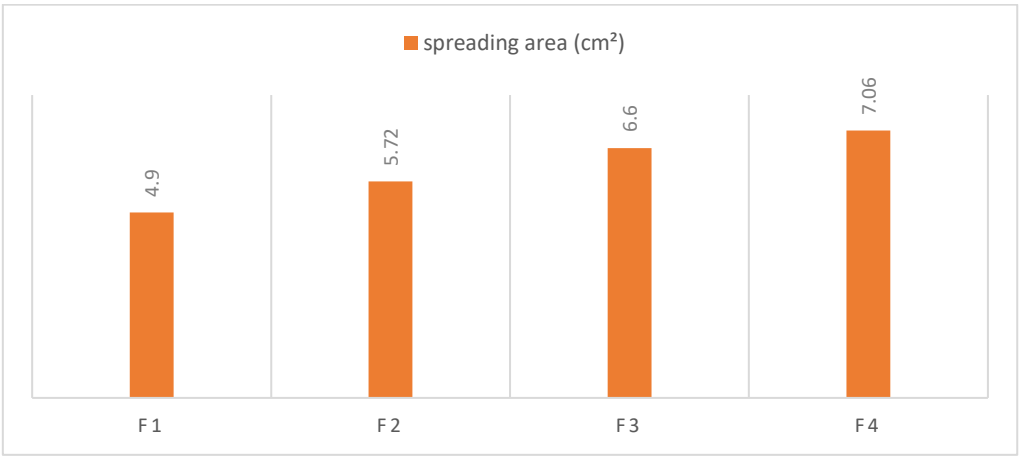

Figure 2. Chart of Spreadability of formulations

4. Measurement of Viscosity

Viscosity measurements were determined by applying increasing values of shear rate in continuous shear rheology study, the results are demonstrated in figure 3.

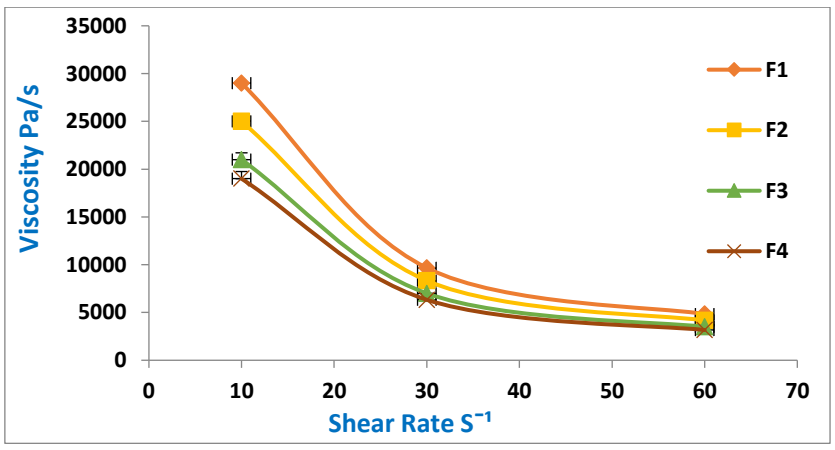

Figure 3. Viscosity of cream formulations

DISCUSSION

Four formulation was subjected for physical examination, homogeneity, appearance, color, after feel, type of smear and removal or washability test. The current outcomes found that the homogeneity and smoothness of cream is increased from F1 to F4 which may be attributed to increase in a percent of water from F1 to F4. Color of formulas was ranged from off white to yellowish green from F1 to F4 which might be because of decrease in a percent of wax and increase of a percent of water which can easily clarify the color of green tea extract. Residue after rubbing cream on skin is reduced also from F1 to F4 which may be attributed to decrease in percent of wax and stearic acid. All formulas were moist and F4 was the moistest one which is because the higher percent of water in it and as we try from F1 to F4 the washability is increased because of decrease in a percent of waxes and increase in percent of water.

All formulation were tested using pH meter to determine pH value of formulas which is very important parameter in skin cream formulation since it plays a role in product safety, stability, and performance of preservative system. pH value should be compatible with physiological skin pH (4.5- 5.5). Topical products should be acidified and possess pH values in the range of 4 to 6 [16].

As shown in figure 1, the values of pH were 4.3, 5.6, 6.3, and 7.4 for F1, F2, F3, and F4 respectively and this elevation was because of increase in percent of KOH in formulas as shown in table 1. pH of F1 and F3 were close to physiological pH of skin more than F4 while pH of F2 is compatible with physiological pH.

The efficacy of topical product depends on the patient spreading of the formulation in layer on the skin to deliver a drug, that is why spreadability is important property of semi-solid dosage forms, because it determines the distribution of product, delivery of drug, and extrudability from the package, despite its role in patient compliance [17,18]. The higher spreadability was in F4, and it decreases among F3 and F2 to the lowest value in F1, which is caused by difference in composition.

The main use of topical dosage form additives was to control the extent of absorption, maintain the viscosity and increase the bulk of the formulation. all creams exhibited shear-thinning behavior which is preferred to facilitate diffusion of the active ingredient. This occurs when the oil droplets of an o/w emulsion are deformed into ellipsoidal shapes and start to form layers with the same plane of the shear resulting in less resistance to flow [19]. Viscosity is decreased among formulas from F1 to F4. Viscosity of F1 is highest and viscosity of F4 is lowest which is may interpreted by the increase of water content and decrease of stearic acid and E. wax contents which are responsible for emulsifying and binding the ingredients together to build the body and consistency of cream. Figure 6 illustrated the viscosity of creams which in the range of 29000 (F1)– 19000 pa.s (F4) at 10 rpm, and shear-thinning behavior of formulations.

CONCLUSION

We have observed change in a composition and percent of component of cream results in change in physicochemical properties of cream like homogeneity, color appearance, after feel, washability, pH, viscosity, and spreadability. All formulas were accepted when examined for these properties but F4 was more homogeneous, very moist and soft with rabid washability and it was the lower viscosity and higher spreadability compared to other formulas. According to pH value, F1 and F3 were close to physiological pH of skin more than F4 while pH of F2 is compatible with physiological pH (5.6), also F2 was found homogeneous, smooth with very good washability, moderate viscosity, and very good spreadability and we can choose it as an optimum formula that will need further modification and examination to formulate an excellent cream.

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صياغة وتقييم كريم مستخلص الشاي الأخضر وحمض الساليسيليك لعلاج حب الشباب

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المستخلص

الهدف من هذه الدراسة هو صياغة وتقييم أربع صيغ مختلفة من كريم التلاشي المحضر بمستخلص الشاي الأخضر وحمض الساليسيليك كمكونات نشطة. صياغة أربع صيغ مختلفة من كريم التلاشي بنسب مختلفة من حامض دهني ، E.wax ، زيت اللوز ، الجلسرين ، والمياه النقية باستخدام نسب مختلفة من هيدروكسيد البوتاسيوم ، جميع التركيبات المحضرة بالشاي الأخضر وحمض الساليسيليك كمكونات نشطة ، تم حفظ التركيبات بواسطة Phenoxyethanol ، وتم استخدام زيت الورد كنكهة ، وتم تقييم جميع التركيبات عن طريق الفحص الفيزيائئ، قياس درجة الحموضة واختبار قابلية الانتشار وقياسات اللزوجة. كما وجدنا في دراستنا لصياغة الكريم ، فإن التغيير في تكوين ونسبة مكونات الكريم يؤدي إلى تغيير في الخصائص الفيزيائية والكيميائية للكريم مثل التجانس ومظهر اللون وبعد الشعور وقابلية الغسل. كان نطاق الأس الهيدروجيني للصيغ 4.3 إلى 7.4 ، وتم العثور على نطاق اللزوجة 29000 (F4) pa.s - 19000 (F1) عند 10 دورة في الدقيقة مع سلوك ترقق القص للتركيبات ، وتراوحت قابلية الانتشار من 4.90 إلى 7.06 سم². تم قبول جميع الصيغ عند فحصها لهذه الخصائص ولكن F4 كان أكثر تجانسا ورطبا جدا وناعما مع قابلية غسل مسعورة وكان اللزوجة المنخفضة وقابلية الانتشار الأعلى مقارنة بالصيغ الأخرى. وفقا لقيمة الأس الهيدروجيني ، كان F1 و F3 قريبين من درجة الحموضة الفسيولوجية للجلد أكثر من F4 بينما يتوافق الرقم الهيدروجيني ل F2 مع الرقم الهيدروجيني الفسيولوجي (5.6). كانت الصيغة F2 متجانسة وناعمة مع قابلية جيدة جدا للغسل ولزوجة معتدلة وقابلية انتشار جيدة جدا بالإضافة إلى درجة الحموضة المتوافقة ويمكننا اختيارها كصيغة مثالية ستحتاج إلى مزيد من التعديل والفحص لصياغة كريم ممتاز.

الكلمات الدالة. شكل جرعات شبه صلبة، تركيبة كريمية، حب الشباب، حمض الساليسيليك، الشاي الأخضر.