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## Formulation and Evaluation of a Moisturizing Cream using Almond Butter

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### ABSTRACT

Almond butter is one of the moisturizing agents, which has good emollient and moisturizing properties and hence can be well utilized to design a moisturizing cream, which can provide a good moisturizing property and help to maintain the healthy skin. The aim of the present study is to formulate moisturizing cream using Almond Butter and to evaluate its moisturizing property. In the present study, proper cream base was formulated by taking different trials and evaluated. The cream base showing the best results with respect to pH, thermal stability, total fatty matter and specific gravity was used for the incorporation of the active ingredient in different concentration and was evaluated for physical and chemical parameters. The subjective evaluation of the final product was carried out on volunteers of age 20 - 25 years with dry skin and moisturizing capacity was studied using corneometer. The values for pH, thermal stability, total fatty matter and specific gravity of the selected cream base were found to be within the standard limits. From the results of accelerated stability study of cream, it was found that the cream containing 3% Almond Butter was stable and effective with respect to color, odor, pH, viscosity, globule size and centrifugation. This cream was used for subjective evaluation and it was found that all the candidates experienced desired effect without any irritation. Hence it can be concluded that Almond Butter is having excellent moisturizing effect and can be used as moisturizing agent in different cosmetic products.

**Keywords:** Almond butter, moisturizing agent, Corneometer, subjective evaluation.

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### INTRODUCTION

The skin is the heaviest single organ of the body, combines with the mucosal lining of the respiratory, digestive, and urogenital tracts to form a capsule which

separates the internal body structures from external environment. [1] The skin has several layers. The overlaying outer layer is called epidermis; the layer below epidermis is called dermis. It contains a network

of blood vessels, hair follicle, sweat gland & sebaceous gland. Beneath the dermis are subcutaneous fatty tissues. Bulbs of hair project in to these fatty tissues. [2] The skin performs various functions like protection, sensation, heat regulation, absorption, excretion etc. Among these functions protection is important. Intact skin is impervious to air and water and to the bacteria and thus protects our body. The skin forms relatively waterproof layer that protects the deeper and more delicate structures. As an important non-specific defense mechanism it act as a barrier against the invasion by microbes, chemicals, physical agent's e.g. mild trauma, UV light dehydration. It also acts as a water resistant barrier so essential nutrients aren't washed out of the body. [3]

Water is the most important substance for skin smoothness. The water content in the higher horny layer of young skin amounts to 10-20% of total water in the organism. Without the action of natural moisturizing factors, this water would rapidly evaporate, leaving the skin dry and tight. Water supply from the innermost skin layers and normal sweating maintain the skin moisture level. Several factors may increase the outward movement of water, for e.g. deficiency in water retaining substances or excessive environmental dryness. The most exposed areas, such as face and hands, generally suffer the most severe water loss.

The Natural Moisturizing Factor (NMF) is a natural skin protector against dehydration; it also plays a major role in the physical properties of the outermost layer of the skin, the horny layer. Good moisturizing of this layer is essential for skin smoothness. These body natural substances, which fixate the water in the horny layer, are produced during Keratinocytes cornification, sweat and secretion by sebum glands. It is accepted that the skin barrier function is based on these horny cells. Thus, NMF is a mixed complex of water soluble low molecular weight substances, produced within keratinocytes through the degradation of filagrin. Moisturizing Factor is a complex substance aimed at reconstructing the skin Natural Moisturizing Factor. [4]

In day-to-day life we are exposed to different environmental conditions such as sun, cold, wind, or temperature variations etc. All these factors have certain effect on our skin. So, even the normal skin needs protection. The appearance and feel of skin are central of human interpersonal perception and attraction. Therefore our skin plays a vital role in maintaining our physical and mental health. For these reasons the care of skin has always been a priority of human behavior in all races and cultures throughout history. [5] If the skin is to remain smooth and supple, it needs to maintain an adequate moisture level. But the skin loses its natural moisture through epidermis i.e. Trans-epidermal water loss. Thus, to maintain the skin in good and healthy condition use of a moisturizing product with good and effective barrier agent and

moisturizing agent is essential. Moisturizers provide a thin protective film of oil and water over the skin's surface which prevent the evaporation of natural moisture and replace the skin's natural oil when these are depleted by variations in climatic and living conditions. [6-7] Generally moisturizing lotion form a very large segment in terms of production of the cosmetic cream market, as dry skin is common condition.

Need was felt to explore the use of good moisturizing agent to design a product for obtaining desired effect. It is reported that Almond butter is one of the moisturizing agents, which has a good emollient and moisturizing properties. [8] Thus, the moisturizing property of almond butter can be well utilized to design a moisturizing cream, which can provide a good moisturizing property and help to maintain the healthy skin.

## MATERIALS

Almond Butter was procured from NV Organics Pvt. Ltd., Delhi (India), Stearic acid, Cetyl alcohol, Propyl Paraben, Triethanolamine, Methyl Paraben and other excipients were purchased from SD Fine Chemicals Pvt Ltd, Mumbai.

## METHOD

### Analysis of Almond Butter

#### Physical and Chemical analysis

The physical and chemical analysis of Almond Butter was carried out as directed in analytical report of Almond Butter.

- 1) Iodine Value [9]
- 2) Saponification Value [10]
- 3) Acid Value [11]
- 4) Melting Point [12]

#### Iodine Value

The iodine value is the number which expresses in grams the quantity of halogen, calculated as iodine, which is absorbed by 100 g of the substance under the described conditions.

#### *Iodine Monochloride Method or Wijs Method*

Place an accurately weighed quantity of the substance under examination in a dry 500 ml iodine flask, add 10 ml of carbon tetrachloride and dissolve. Add 20 ml of iodine monochloride solution insert the stopper and allow standing in the dark at a temperature between 15° and 25° for 30 minutes. Place 15 ml of potassium iodide solution in the cup top, carefully remove the stopper, rinse the stopper and the sides of the flask with 100 ml of water, shake and titrate with 0.1 M sodium thiosulphate using starch solution, added towards the end of the titration, as indicator. Note the number of ml required (a). Repeat the operation without the substance under examination and note the number of ml required (b). Calculate the iodine value from the expression

$$\text{Iodine value} = 1.269 (b - a)/w$$

Where,  $w$  = weight, in g, of the substance.

### Saponification Value

The saponification value is the number of milligrams of potassium hydroxide necessary to neutralise the free acids and to saponify the esters present in 1 g of the substance.

#### Method

Unless otherwise specified in the individual monograph, introduce about 2 g of the substance under examination, accurately weighed, into a 200 ml flask of borosilicate glass fitted with a reflux condenser. Add 25.0 ml of 0.5 M ethanolic potassium hydroxide and a little pumice powder and boil under reflux on a water-bath for 30 minutes. Add 1 ml of phenolphthalein solution and titrate immediately with 0.5 M hydrochloric acid (*a* ml). Perform a blank determination omitting the substance under examination (*b* ml). Calculate the saponification value from the expression

$$\text{Saponification value} = 28.05 (b - a)/w$$

Where, *w* = weight, in g, of the substance.

### Acid Value

The acid value is the number which expresses in milligrams the amount of potassium hydroxide necessary to neutralise the free acids present in 1 g of the substance.

#### Method

Unless otherwise specified in the individual monograph, dissolve about 10 g of the substance under examination, accurately weighed, in 50 ml of a mixture of equal volumes of ethanol (95 per cent) and ether, previously neutralised with 0.1 M potassium hydroxide to phenolphthalein solution. If the sample does not dissolve in the cold solvent, connect the flask with a reflux condenser and warm slowly, with frequent shaking, until the sample dissolves. Add 1 ml of phenolphthalein solution and titrate with 0.1 M potassium hydroxide until the solution remains faintly pink after shaking for 30 seconds. Calculate the acid value from the expression

$$\text{Acid value} = 5.61 n/w$$

Where, *n* = the number of ml of 0.1 M potassium hydroxide required; *w* = the weight, in g, of the substance.

### Melting Point

Melting point was determined using Thiele tube method. In this the substance under test is placed in the glass capillary tube to form a compact column 4 to 6 mm high. Then the capillary tube is attached using string to a calibrated thermometer such that the base of both the capillary tube and thermometer are in same line. This is placed in Thiele tube containing light liquid paraffin and heated till the substance under test starts melting. This gives the melting point of the substance

### Formulation & Development of Moisturizing Cream [13-21]

In general oil in water type of base was selected. The cream base was formulated by the given procedure: All the ingredients of phase A (Oil phase) & Phase B (Water phase) were taken in separate beakers. They were allowed to melt completely by heating up to a

temperature of 70-80°C. Then the Oil Phase was added to the Water Phase with constant stirring until a cream is formed. Finally it is properly triturated in a mortar & pestle.

### Analysis of Cream Base

The analysis of product was carried out by following methods [22]:

- a) Determination of pH
- b) Determination of Thermal Stability
- c) Determination of Total Fatty Matter
- d) Determination of Specific gravity

### Determination of pH

The pH of the developed cream base was measured on a standardized digital pH meter at room temperature by taking adequate amount in a 50 ml beaker.

### Determination of Thermal Stability

The thermal stability of the product was determined as per procedure described in BIS (I.S. No.6608-2004).

### Determination of Total Fatty Matter

The Total Fatty Matter of the product was determined as per procedure described in BIS (I.S. No. 6608-2004) for skin cream.

### Determination of Specific gravity

Select a thoroughly clean and dry pycnometer (specific gravity bottle) and weigh it. Fill the pycnometer with the substance under test and weigh. Subtract the tare weight of the pycnometer (i.e. empty) from the filled weight of the pycnometer. Determine the weight per millilitre by dividing the weight in g, of the quantity of substance which fills the pycnometer at the specified temperature, by the capacity expressed in ml, of the pycnometer at the same temperature.

### Incorporation of Active in Cream Base

The final formulations of cream with almond butter was prepared by adding varying concentration of almond butter as 1%, 2% and 3% in formulation 1, 2 and 3 respectively. The formulation table is given in Table 6.

### Analysis of Cream with Active [22]

The analysis of product was carried out by following methods

- 1) Determination of pH
- 2) Determination of Thermal Stability
- 3) Determination of Total Fatty Matter
- 4) Determination of Specific gravity

### Total Microbial Count [23]

1ml of test sample dilution (1g of test sample in 9ml of isopropyl myristate) was pipetted out, and transferred in sterile plate. 18-20ml of molten nutrient agar media was poured at 44°C to the same plate; it was rotated to mix thoroughly. Plate for negative control sample was prepared without test sample. The plates were allowed to solidify for around 20 minutes at room temperature. The Petri plates were inverted and kept in incubator at 37°C for 48 hours. After 48 hours the plates were observed for colony count.

### Accelerated Stability Studies [24]

Formulation of a safe, effective, stable and cosmetically elegant product is the most difficult and challenging

job. Once the formulation is over successfully, it is important for any formulator to determine how the product will behave in its shelf life at different environmental conditions. For the moisturizing cream, the accelerated stability studies were carried out for month by keeping the samples under room temperature, refrigerator (4°C) and oven (50°C). The Parameters for stability study are: Color, Odor, pH and Viscosity.

#### Subjective Evaluation <sup>[25]</sup>

Evaluation of moisturizing property of moisturizing cream is done by using Corneometer. The Corneometer shows a broad range of sensitivity from 20 to 100 A.U and is very sensitive for measurement at low hydration and less sensitive in the range of very high hydration value. When measurements of reproducibility were carried out on a large heterogeneous groups of male and female in the same age group a relative standard deviation of 10% was observed for most of the sites.

**Table 1: Analytical test observation for Almond butter**

| S. No | Test                 | Specification                    | Results  | Inference   |
|-------|----------------------|----------------------------------|----------|-------------|
| 1     | Color                | Soft ivory to greenish solid fat | Complies | Passed test |
| 2     | Odour                | Slight Waxy odour                | Complies | Passed test |
| 3     | Iodine Value         | 60-80                            | 63.45    | Passed test |
| 4     | Saponification Value | 175-200                          | 196.35   | Passed test |
| 5     | Acid Value           | <2.0%                            | 1.9      | Passed test |
| 6     | Melting point        | 44-54°C                          | 44.5°C   | Passed test |

**Table 2: Formulation of Cream Base <sup>[25]</sup>**

| S. No.         | Ingredients     | Quantity (100 g) |         |         |
|----------------|-----------------|------------------|---------|---------|
|                |                 | Trial 1          | Trial 2 | Trial 3 |
| <b>Phase A</b> |                 |                  |         |         |
| 1              | Stearic acid    | 7                | 6       | 6       |
| 2              | Cetyl alcohol   | 4                | 4       | 4       |
| 3              | Bees-wax        | 3.5              | 2       | 2       |
| 4              | Mineral oil     | 6                | 7       | 7       |
| 5              | Propyl Paraben  | 0.5              | 0.5     | 0.5     |
| <b>Phase B</b> |                 |                  |         |         |
| 1              | Glycerin        | 6                | 6       | 6       |
| 2              | Triethanolamine | 1                | 1       | 1       |
| 3              | Methyl Paraben  | 0.5              | 0.5     | 0.5     |
| 4              | Water           | 70.05            | 73.05   | 71      |

**Table 3: Observation of Cream base**

| Trial no. | Changes to be made   | pH   |
|-----------|--|------|
| Trial-1   | The base was hard. It gives slightly whitening effect while rubbing, so to reduce its hardness and whitening effect, the concentration of stearic acid and bees-wax has been decreased and the percentage of water and mineral oil has been increased. | 6.20 |
| Trial-2   | The base has certain lotion like consistency. So to maintain its consistency the percentage of water has been decreased.   | 6.23 |
| Trial-3   | The cream obtained has a very good consistency due to slight decrease in concentration of water. Hence this trial was selected for further study.  | 6.24 |

## RESULT AND DISCUSSION

### Physical and Chemical Analysis of Almond butter

The result of physical and chemical analysis of Almond Butter is given in Table 1 which shows that the active ingredient Almond butter passes the test.

### Formulation of Moisturizing Cream Base

For the incorporation of the active in the formulation & for a proper release of active from the formulation, base plays an important role. A Cream base is formulated by trial method by the below mentioned formula (Table 2) and the observations of the trial cream base is given in Table 3.

**Table 4: Selected Cream base**

| S. No.         | Ingredients     | Quantity (100g) |
|----------------|-----------------|-----------------|
| <b>Phase A</b> |                 |                 |
| 1              | Stearic acid    | 6               |
| 2              | Cetyl alcohol   | 4               |
| 3              | Bees-wax        | 2               |
| 4              | Mineral oil     | 7               |
| 5              | Propyl Paraben  | 0.5             |
| <b>Phase B</b> |                 |                 |
| 1              | Glycerin        | 6               |
| 2              | Triethanolamine | 1               |
| 3              | Methyl Paraben  | 0.5             |
| 4              | Distilled Water | 71              |

**Table 5: Common analytical results of cream base**

| S. No. | Parameter          | Requirement As per BIS | Result  |
|--------|--------------------|------------------------|---------|
| 1      | pH                 | 5 to 9                 | 6.24    |
| 2      | Thermal stability  | To pass the test       | Passed  |
| 3      | Total Fatty Matter | Min 15%                | 20.075  |
| 4      | Specific gravity   | -                      | 1.13752 |

**Table 6: Formulation of Moisturizing Cream with varying concentration of Almond Butter**

| S. No.         | Ingredients     | Quantity (100g)  |                  |                  |
|----------------|-----------------|------------------|------------------|------------------|
|                |                 | Base + 1% Active | Base + 2% Active | Base + 3% Active |
| <b>Phase A</b> |                 |                  |                  |                  |
| 1              | Stearic Acid    | 6                | 6                | 6                |
| 2              | Cetyl alcohol   | 4                | 4                | 4                |
| 3              | Bees-wax        | 2                | 2                | 2                |
| 4              | Mineral oil     | 7                | 7                | 7                |
| 5              | Propyl Paraben  | 0.5              | 0.5              | 0.5              |
| <b>Phase B</b> |                 |                  |                  |                  |
| 1              | Glycerin        | 6                | 6                | 6                |
| 2              | Triethanolamine | 1                | 1                | 1                |
| 3              | Methyl Paraben  | 0.5              | 0.5              | 0.5              |
| 4              | Distilled Water | 71               | 71               | 71               |
| <b>Phase C</b> |                 |                  |                  |                  |
| 1              | Almond Butter   | 1                | 2                | 3                |

**Table 7: Common analytical results of Cream with Active**

| S. No | Parameter          | Requirement As per BIS | Cream with 1% active | Cream with 2% active | Cream with 3% active |
|-------|--------------------|------------------------|----------------------|----------------------|----------------------|
| 1     | pH                 | 5 to 9                 | 6.46                 | 6.56                 | 6.88                 |
| 2     | Thermal stability  | To pass the test       | Passed               | Passed               | Passed               |
| 3     | Total Fatty Matter | Min 15%                | 20.328               | 19.98                | 20.028               |
| 4     | Specific gravity   | -                      | 1.14401              | 1.14229              | 1.13552              |

### Selection of Cream Base

From the above observation, it was found that trial no. 3 of cream base has a very good consistency. Hence the

trial no. 3 is selected as base for the further study. The formulation of selected base is given in Table 4.

**Table 8: Result for microbial analysis**

| Parameter                   | Specification as per BIS                               | Result                                |
|-----------------------------|--|---------------------------------------|
| Microbiological Examination | Microbial content limit is not more than 1000 c.f.u/gm | Test sample passed the microbial test |

**Table 9: pH changes of cream kept at room, refrigerator and oven temperature.**

| S. No. | Time in days | Room temperature   |      |      |      |
|--------|--------------|--------------------|------|------|------|
|        |              | Base               | 1%   | 2%   | 3%   |
| 1      | 0            | 6.24               | 6.46 | 6.56 | 6.88 |
| 2      | 7            | 6.24               | 6.47 | 6.57 | 6.88 |
| 3      | 14           | 6.26               | 6.47 | 6.57 | 6.88 |
| 4      | 21           | 6.26               | 6.48 | 6.55 | 6.89 |
| 5      | 28           | 6.25               | 6.47 | 6.59 | 6.89 |
| 6      | 35           | 6.25               | 6.49 | 6.57 | 6.88 |
| 7      | 42           | 6.24               | 6.48 | 6.58 | 6.88 |
| 8      | 49           | 6.26               | 6.49 | 6.58 | 6.88 |
| 9      | 56           | 6.25               | 6.48 | 6.57 | 6.89 |
| 10     | 63           | 6.24               | 6.48 | 6.56 | 6.89 |
| 11     | 70           | 6.26               | 6.47 | 6.59 | 6.88 |
| 12     | 77           | 6.26               | 6.49 | 6.58 | 6.88 |
| 13     | 84           | 6.27               | 6.49 | 6.55 | 6.88 |
| 14     | 90           | 6.27               | 6.48 | 6.57 | 6.88 |
| S. No. | Time in days | Refrigerator (4°C) |      |      |      |
|        |              | Base               | 1%   | 2%   | 3%   |
| 1      | 0            | 6.25               | 6.45 | 6.56 | 6.87 |
| 2      | 7            | 6.22               | 6.44 | 6.53 | 6.87 |
| 3      | 14           | 6.22               | 6.44 | 6.52 | 6.87 |
| 4      | 21           | 6.23               | 6.45 | 6.53 | 6.88 |
| 5      | 28           | 6.21               | 6.44 | 6.54 | 6.88 |
| 6      | 35           | 6.24               | 6.44 | 6.55 | 6.87 |
| 7      | 42           | 6.22               | 6.45 | 6.54 | 6.88 |
| 8      | 49           | 6.23               | 6.47 | 6.55 | 6.88 |
| 9      | 56           | 6.22               | 6.45 | 6.53 | 6.87 |
| 10     | 63           | 6.25               | 6.43 | 6.54 | 6.87 |
| 11     | 70           | 6.24               | 6.42 | 6.53 | 6.87 |
| 12     | 77           | 6.24               | 6.43 | 6.54 | 6.87 |
| 13     | 84           | 6.23               | 6.44 | 6.53 | 6.87 |
| 14     | 90           | 6.23               | 6.44 | 6.52 | 6.87 |
| S. No. | Time in days | Oven (50°C)        |      |      |      |
|        |              | Base               | 1%   | 2%   | 3%   |
| 1      | 0            | 6.25               | 6.45 | 6.56 | 6.88 |
| 2      | 7            | 6.27               | 6.45 | 6.59 | 6.88 |
| 3      | 14           | 6.27               | 6.47 | 6.59 | 6.91 |
| 4      | 21           | 6.28               | 6.47 | 6.61 | 6.91 |
| 5      | 28           | 6.26               | 6.48 | 6.61 | 6.91 |
| 6      | 35           | 6.29               | 6.49 | 6.61 | 6.89 |
| 7      | 42           | 6.27               | 6.48 | 6.59 | 6.89 |
| 8      | 49           | 6.29               | 6.48 | 6.61 | 6.91 |
| 9      | 56           | 6.29               | 6.49 | 6.59 | 6.91 |
| 10     | 63           | 6.27               | 6.49 | 6.61 | 6.91 |
| 11     | 70           | 6.28               | 6.49 | 6.59 | 6.91 |
| 12     | 77           | 6.27               | 6.48 | 6.59 | 6.91 |
| 13     | 84           | 6.29               | 6.49 | 6.61 | 6.91 |
| 14     | 90           | 6.28               | 6.49 | 6.61 | 6.91 |

### Analysis of Cream Base

The cosmetic should have an aesthetic appeal but more important is its stability during shelf life. Indian Standards has given the specifications and requirements of cream. Tests were performed according to BIS (I.S. No. 6608-2004) for skin cream. The results for analysis of product along with the specifications are given in Table 5. The pH of cream was found to be 6.24; the cream base passes the thermal

stability test as no oil separation was observable, total fatty matter of base was found to be 20.075% by mass and Specific gravity of cream base was found to be 1.13752 gm /ml.

### Incorporation of Active in Cream Base

The final formulations of cream with almond butter was prepared by adding varying concentration of almond butter as 1%, 2% and 3% in formulation 1, 2 and 3 respectively.

### Analysis of Cream with Active

The results for analysis of cream with active ingredient Almond butter along with the specifications are given in Table 7.

### Total Microbial Count

After the incubation period, all the plates were counted showing colonies by using suitable colony counter. The number of colonies on plate was multiplied by the reciprocal of the dilution used and the results were expressed as standard plate count per gram of cream. As there were 3 colonies on the plate, these are multiplied by the reciprocal of dilution used i.e. 10. Thus the microbial count is found to be 30 c.f.u /gm which were found to be in the specification range as per BIS.

### Accelerated Stability Study

#### Determination of color change of product

There were no remarkable changes observed in color of cream for all concentrations at different temperature, but slight changes occurred in cream containing 2% concentration of active at room temperature and oven.

#### Determination of odor change of product

There were no changes observed in odor of cream for all concentrations at different temperature.

#### Determination of pH change of product

The pH values of sample products were found to be neutral to basic as evident from Table 9. There were no remarkable changes observed in pH of creams containing 1% and 3% concentrations of Almond Butter at different temperature, but major changes occurred in cream containing 2% concentration of Almond Butter.

#### Determination of viscosity change of product

There were no considerable changes observed in viscosities of all creams of varying concentration of Almond Butter at different temperature as evident from Table 10.

#### Determination of globule size of product

There were no considerable changes observed in globule size of all creams as evident from Table 11.

#### Globule size analysis

The average globule size of the sample products were found to be increasing with time as evident from Table 12, 13, 14.

#### Determination of Centrifugation of product

There were no considerable changes observed in centrifugation of all creams as evident from Table 15.

From the above observations and results of accelerated stability study of cream, it was concluded that the cream containing 3% Almond Butter was stable and effective with respect to color, odor, pH, viscosity,

globule size and centrifugation. Hence Cream containing 3% Almond Butter was selected for further subjective evaluation.

**Table 10: Viscosity changes of Cream kept at room, refrigerator and oven temperature. (Viscosity in cps)**

| S. No. | Time in week | Room temperature |       |       |       |
|--------|--------------|------------------|-------|-------|-------|
|        |              | Base             | 1%    | 2%    | 3%    |
| 1      | 1 week       | 14230            | 14230 | 14230 | 14230 |
| 2      | 2 week       | 14230            | 14230 | 14230 | 14230 |
| 3      | 3 week       | 14220            | 14230 | 14220 | 14230 |
| 4      | 4 week       | 14220            | 14230 | 14220 | 14230 |
| 5      | 5 week       | 14220            | 14220 | 14220 | 14230 |
| 6      | 6 week       | 14210            | 14210 | 14220 | 14230 |
| 7      | 7 week       | 14210            | 14210 | 14210 | 14220 |
| 8      | 8 week       | 14210            | 14210 | 14210 | 14220 |
| 9      | 9 week       | 14210            | 14210 | 14210 | 14220 |
| 10     | 10 week      | 14200            | 14200 | 14210 | 14220 |
| 11     | 11 week      | 14200            | 14200 | 14210 | 14220 |
| 12     | 12 week      | 14200            | 14200 | 14200 | 14220 |

| S. No. | Time in week | Refrigerator(4°C) |       |       |       |
|--------|--------------|-------------------|-------|-------|-------|
|        |              | Base              | 1%    | 2%    | 3%    |
| 1      | 1 week       | 14240             | 14240 | 14240 | 14230 |
| 2      | 2 week       | 14240             | 14240 | 14230 | 14240 |
| 3      | 3 week       | 14240             | 14240 | 14230 | 14240 |
| 4      | 4 week       | 14230             | 14240 | 14230 | 14240 |
| 5      | 5 week       | 14230             | 14240 | 14240 | 14240 |
| 6      | 6 week       | 14230             | 14230 | 14240 | 14250 |
| 7      | 7 week       | 14230             | 14230 | 14240 | 14250 |
| 8      | 8 week       | 14230             | 14230 | 14240 | 14250 |
| 9      | 9 week       | 14230             | 14230 | 14230 | 14240 |
| 10     | 10 week      | 14220             | 14240 | 14240 | 14240 |
| 11     | 11 week      | 14220             | 14240 | 14240 | 14240 |
| 12     | 12 week      | 14220             | 14240 | 14240 | 14240 |

| S. No. | Time in week | Oven (50°C) |       |       |       |
|--------|--------------|-------------|-------|-------|-------|
|        |              | Base        | 1%    | 2%    | 3%    |
| 1      | 1 week       | 14230       | 14230 | 14220 | 14220 |
| 2      | 2 week       | 14230       | 14230 | 14220 | 14220 |
| 3      | 3 week       | 14230       | 14230 | 14220 | 14220 |
| 4      | 4 week       | 14230       | 14220 | 14210 | 14220 |
| 5      | 5 week       | 14220       | 14220 | 14210 | 14220 |
| 6      | 6 week       | 14220       | 14220 | 14210 | 14210 |
| 7      | 7 week       | 14220       | 14220 | 14210 | 14210 |
| 8      | 8 week       | 14210       | 14210 | 14210 | 14210 |
| 9      | 9 week       | 14210       | 14210 | 14200 | 14210 |
| 10     | 10 week      | 14210       | 14210 | 14200 | 14210 |
| 11     | 11 week      | 14210       | 14200 | 14200 | 14210 |
| 12     | 12 week      | 14210       | 14200 | 14200 | 14210 |

**Table 11: Actual globule size in room temperature for base**

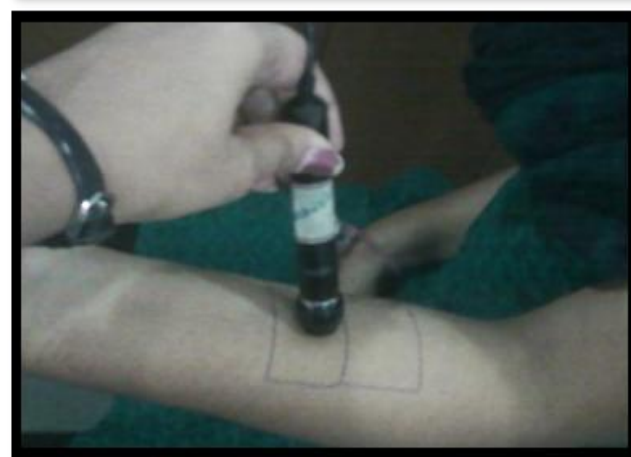
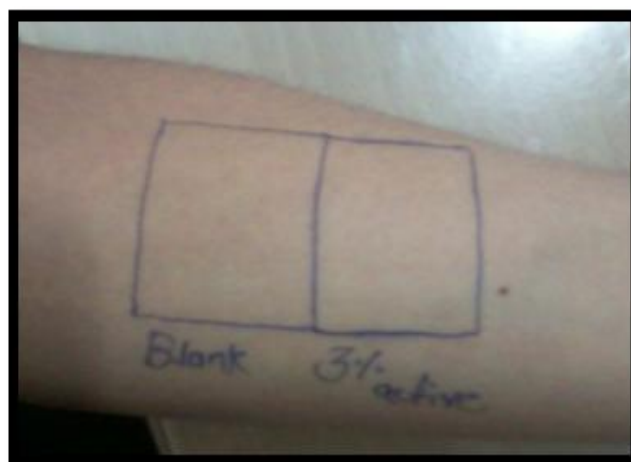
|      |      |      |      |      |      |      |      |      |      |
|------|------|------|------|------|------|------|------|------|------|
| 0.09 | 0.09 | 0.09 | 0.08 | 0.08 | 0.09 | 0.08 | 0.09 | 0.09 | 0.09 |
| 0.08 | 0.1  | 0.09 | 0.08 | 0.09 | 0.1  | 0.08 | 0.1  | 0.08 | 0.1  |
| 0.08 | 0.09 | 0.1  | 0.09 | 0.08 | 0.09 | 0.08 | 0.09 | 0.1  | 0.08 |
| 0.08 | 0.09 | 0.1  | 0.08 | 0.08 | 0.09 | 0.08 | 0.1  | 0.09 | 0.09 |
| 0.09 | 0.09 | 0.09 | 0.09 | 0.09 | 0.08 | 0.1  | 0.09 | 0.1  | 0.08 |
| 0.08 | 0.08 | 0.08 | 0.1  | 0.08 | 0.1  | 0.09 | 0.08 | 0.08 | 0.09 |
| 0.09 | 0.08 | 0.09 | 0.1  | 0.09 | 0.09 | 0.08 | 0.1  | 0.08 | 0.08 |
| 0.08 | 0.09 | 0.1  | 0.09 | 0.1  | 0.09 | 0.08 | 0.08 | 0.08 | 0.1  |
| 0.08 | 0.1  | 0.1  | 0.09 | 0.1  | 0.09 | 0.1  | 0.09 | 0.1  | 0.09 |
| 0.1  | 0.09 | 0.09 | 0.08 | 0.09 | 0.08 | 0.08 | 0.09 | 0.09 | 0.1  |

**Subjective Evaluation**

The following values are valid for healthy skin and normal room conditions (20°C and 40-60% air humidity).

**Images of Testing on Volunteer Using Corneometer**

This table is only approach for the interpretation of the results. This interpretation should be valid for other body parts but this should be checked by the user.



**Table 12: Globule Size in room temperature in µm**

| Time in days | Cream Base | Cream with 1% active | Cream with 2% active | Cream with 3% active |
|--------------|------------|----------------------|----------------------|----------------------|
| 0            | 1.36       | 1.38                 | 1.35                 | 1.36                 |
| 7            | 1.37       | 1.38                 | 1.36                 | 1.37                 |
| 14           | 1.41       | 1.41                 | 1.40                 | 1.42                 |
| 21           | 1.44       | 1.46                 | 1.41                 | 1.44                 |
| 28           | 1.96       | 1.98                 | 1.94                 | 1.95                 |
| 35           | 2.11       | 2.16                 | 2.13                 | 2.13                 |
| 42           | 2.45       | 2.45                 | 2.42                 | 2.42                 |
| 49           | 2.52       | 2.51                 | 2.56                 | 2.51                 |
| 56           | 2.72       | 2.79                 | 2.72                 | 2.72                 |
| 63           | 2.86       | 2.85                 | 2.83                 | 2.83                 |
| 70           | 2.91       | 2.92                 | 2.95                 | 2.93                 |
| 77           | 3.11       | 3.12                 | 3.11                 | 3.12                 |
| 84           | 3.23       | 3.25                 | 3.26                 | 3.29                 |
| 90           | 3.38       | 3.29                 | 3.35                 | 3.30                 |

**Table 13: Globule size in refrigerator in µm**

| Time in days | Cream Base | Cream with 1% active | Cream with 2% active | Cream with 3% active |
|--------------|------------|----------------------|----------------------|----------------------|
| 0            | 1.36       | 1.38                 | 1.36                 | 1.36                 |
| 7            | 1.38       | 1.39                 | 1.37                 | 1.37                 |
| 14           | 1.40       | 1.40                 | 1.41                 | 1.41                 |
| 21           | 1.42       | 1.47                 | 1.41                 | 1.45                 |
| 28           | 1.96       | 1.98                 | 1.94                 | 1.95                 |
| 35           | 2.11       | 2.16                 | 2.12                 | 2.13                 |
| 42           | 2.45       | 2.45                 | 2.42                 | 2.42                 |
| 49           | 2.52       | 2.50                 | 2.56                 | 2.51                 |
| 56           | 2.70       | 2.80                 | 2.71                 | 2.72                 |
| 63           | 2.85       | 2.85                 | 2.83                 | 2.84                 |
| 70           | 2.91       | 2.92                 | 2.95                 | 2.92                 |
| 77           | 3.10       | 3.12                 | 3.11                 | 3.11                 |
| 84           | 3.23       | 3.24                 | 3.27                 | 3.29                 |
| 90           | 3.37       | 3.28                 | 3.32                 | 3.37                 |

**Table 14: Globule Size in oven in  $\mu\text{m}$**

| Time in days | Cream Base | Cream with 1% active | Cream with 2% active | Cream with 3% active |
|--------------|------------|----------------------|----------------------|----------------------|
| 0            | 1.37       | 1.37                 | 1.36                 | 1.35                 |
| 7            | 1.37       | 1.38                 | 1.37                 | 1.36                 |
| 14           | 1.41       | 1.41                 | 1.40                 | 1.41                 |
| 21           | 1.44       | 1.46                 | 1.41                 | 1.44                 |
| 28           | 1.96       | 1.95                 | 1.94                 | 1.98                 |
| 35           | 2.10       | 2.16                 | 2.13                 | 2.13                 |
| 42           | 2.45       | 2.45                 | 2.42                 | 2.42                 |
| 49           | 2.52       | 2.50                 | 2.51                 | 2.51                 |
| 56           | 2.72       | 2.79                 | 2.71                 | 2.73                 |
| 63           | 2.86       | 2.84                 | 2.83                 | 2.83                 |
| 70           | 2.90       | 2.93                 | 2.94                 | 2.92                 |
| 77           | 3.11       | 3.10                 | 3.10                 | 3.10                 |
| 84           | 3.23       | 3.23                 | 3.26                 | 3.28                 |
| 90           | 3.38       | 3.27                 | 3.36                 | 3.38                 |

**Table 15: Stability testing by centrifugation**

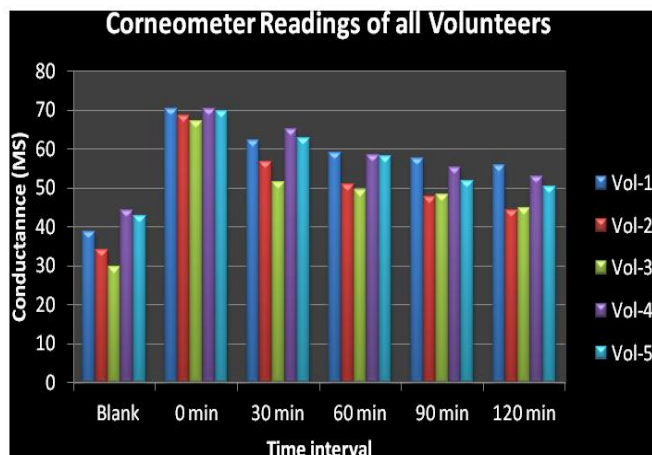
| Formulation | Speed in rpm | Centrifugation | Observation |
|-------------|--------------|----------------|-------------|
| Base        | 3000         | 1 hour         | NC          |
| 1%          | 3000         | 1 hour         | NC          |
| 2%          | 3000         | 1 hour         | NC          |
| 3%          | 3000         | 1 hour         | NC          |

NC- No Change

**Table 16: The values of Corneometer for interpretation**

| Skin Types               | Inner Forearm |
|--------------------------|---------------|
| Very dry                 | <30           |
| Dry                      | 30-45         |
| Sufficiently moisturized | <45           |

The Graphs are plotted by taking the time interval on x-axis and the digital reading of the Corneometer are plotted on the y-axis.



**Graph 1: Combine Graph Reading of all Volunteers**

Moisturizing products form a very wide range of products. In daily life, human skin is exposed to variety of factors that have detrimental effects on dermal integrity resulting in dry skin and wrinkles. The most common protective and preventive step taken against dry skin is the use of emollients and moisturizing creams and lotions. Hence the procured sample of the active was first evaluated for their quality by determining - color, odor, iodine value, saponification value, acid value and melting point. The values obtained were within the standard values and hence it can be concluded that the procured material was pure to be used for further experimentation. The proper

cream base was formulated by taking different trials. The final fixed cream base was decided for the incorporation of active material and assessment for their chemical and physical stability was carried out. The cream base showed the best results for stability with respect to pH, thermal stability, total fatty matter and specific gravity. The active material was then incorporated into the selected cream base in different concentration. Then it was allowed to assessment for their stability. The tested cream containing different concentration of active material showed the satisfactory results for the stability with respective color, odor, pH, viscosity, globule size and centrifugation. The cream containing 3% concentration of active material was selected for further subjective evaluation.

**Table 17: Relative Readings of the Corneometer Testing on volunteer**

| Name        | Product           | Blank | 0 min | 30 min | 60 min | 90 min | 120 min |
|-------------|-------------------|-------|-------|--------|--------|--------|---------|
| Volunteer 1 | Cream (3% active) | 38.8  | 70.3  | 62.3   | 59     | 57.6   | 55.8    |
| Volunteer 2 | Cream (3% active) | 34.1  | 68.6  | 56.7   | 50.9   | 47.7   | 44.3    |
| Volunteer 3 | Cream (3% active) | 29.7  | 67.1  | 51.6   | 49.3   | 48.3   | 44.8    |
| Volunteer 4 | Cream (3% active) | 40.2  | 70.3  | 65.1   | 58.3   | 55.2   | 53      |
| Volunteer 5 | Cream (3% active) | 43.2  | 69.8  | 62.7   | 58.2   | 51.8   | 50.4    |

The product was then subjected to subjective evaluation. The photographic evaluation of tested product was carried on volunteers of age 20 - 25 years. All the total volunteers had the dry skin. So the product was applied and their views were recorded. It was found that all the candidates experienced desired effect without any irritation. Moisturization capacity of the product was evaluated using Corneometer. Initially the readings of the blank sites on the arm were taken. Then after application of products the readings were taken at a time interval of 0 min, 30 min, 60 min, 90 min and 120 min. Readings in (Table 17) indicate that initially the skin of all the candidates was dry. Application of the product with 3% almond butter showed improvement in moisture content of the skin in all candidates. From the subjective evaluation (Table 17), it was concluded that the product was found to be excellent in terms of moisturization. From the result it was concluded that the cream containing 3% active material was excellent for moisturization. Hence it can be concluded that Almond Butter is having excellent moisturizing effect.

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