

Nature's secret weapon: Watermelon seed oil as petroleum jelly alternative for oily skin care moisturizer

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Abstract

Watermelon seed are known for their high-water content, typically around 90%, which makes them incredibly hydrating. Watermelon is also rich in vitamins A and C, potassium, magnesium, and dietary fibre. They are rich in nutrients such as protein, amino acids, minerals, healthy fats, antioxidants, and dietary fiber. They can be consumed raw or roasted/sprouted. Watermelon (*Citrullus lanatus*) is a fruit from the plant family of Cucurbitaceae. Watermelon is an edible fruit containing 92% water and 6% sugar. Watermelon seed oil is a versatile and effective skincare product suitable for all skin types, including oily, dry, and sensitive ones, thanks to its light, fast-absorbing properties. Petroleum jelly is an oil-based product that forms an oily film over the surface of the skin. Petroleum jelly's benefits come from its main ingredient petroleum, which helps seal your skin with a water-protective barrier. Watermelon seed oil is a good replacement for petroleum jelly. The prepared moisturizer having good effect on skin and fulfil all the parameters intended for moisturizing effect.

Keywords: Watermelon Seed Oil; Essential Fatty Acids; Linoleic Acid; Skin Care; Humectants; Solvent Extraction; Moisturizer

1. Introduction

1.1. Watermelon Fruit

Watermelons are large, round or oblong fruits with a thick green rind and a juicy, sweet interior flesh. They are known for their high-water content, typically around 90%, which makes them incredibly hydrating. Watermelon is a flowering plant that belongs to the Cucurbitaceae family. Watermelon is also rich in vitamins A and C, potassium, magnesium, and dietary fibre. It offers several health benefits, including weight management and promoting cardiovascular health. Watermelons can be used in various culinary applications, such as salads, smoothies, sorbets, and juices.

1.2. Watermelon Seed

Watermelon seeds are small edible seeds found inside watermelons. They are rich in nutrients such as protein, amino acids, minerals, healthy fats, antioxidants, and dietary fiber. They can be consumed raw or roasted/sprouted. Watermelon seeds have a hard outer shell and are typically black or dark brown in color. Watermelon seeds can be used in various ways, but those with allergies should consult a healthcare professional. Overall, they can be a nutritious addition to any diet.

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1.3. Watermelon Seed oil

Watermelon (*Citrullus lanatus*) is a fruit from the plant family of Cucurbitaceae. Watermelon is an edible fruit containing 92% water and 6% sugar. The fruits outer rind is usually green and interior part consists of red pink flesh with brown-black seeds embedded in it. It is grown in tropical and temperate regions worldwide and needs temperature more than 25° C to grow. In year 2017 world water melon production was 118 million tons and China been the highest watermelon producing country with 79.3 million tons. India is ranked 25th with Uttar Pradesh and Andhra Pradesh been the highest watermelon producing state. The watermelon seeds are rich in protein, vitamin B, mineral (Zinc, Magnesium, Sodium, Phosphorus, Potassium, Iron, Copper and Manganese) and fat content. These seeds are sometimes consumed as snacks by roasting in oven and sprinkling salt over them. Watermelon seeds are nowadays used for oil extraction. The seeds are dried and oil is extracted by pressing them. This practice is common in West Africa and the watermelon seed oil is popularly known as Ootanga oil or Kalahari oil. Oil is used as frying oil in various African nations.

1.4. Health Benefits of Watermelon Seed Oil

Detoxification and Acne-Fighting: Watermelon seed oil effectively cleanses skin by removing impurities, dirt, and dead skin, while linoleic acid-rich oils clarify pores, aid in oily skin and acne.

Anti-aging : Watermelon seed oil, rich in linoleic and oleic acids, is effective in combating wrinkles and premature aging, with Vitamin E and omega 6 essential fatty acids promoting collagen production.

Good for All Skin Types: Watermelon seed oil is a versatile and effective skincare product suitable for all skin types, including oily, dry, and sensitive ones, thanks to its light, fast-absorbing properties.

Fights uneven skin tone: Hyperpigmentation, a condition where certain areas of the skin have more melanin, can be reduced by using trace minerals and omega acids found in watermelon seed oil.

De-puffs and promotes blood circulation: Watermelon seed oil, rich in Vitamin E, combats free radical damage, promotes blood circulation, and reduces skin puffiness. It's beneficial for the entire body, including hair. Additional products are in development.



Figure 1 Watermelon Fruit

1.4.1. Petroleum jelly



Figure 2 Petroleum Jelly

Petroleum jelly is an oil-based product that forms an oily film over the surface of the skin. This oily film seals in moisture, helping keep skin hydrated and soft. Petrolatum, also known as petroleum jelly, is a widely used topical agent, with a variety of uses in dermatology. Additionally, data on its potential for flammability, allergenicity, and comedogenicity are

detailed, dispelling misconceptions about petrolatum use around oxygen and as a cause of acne. Petroleum jelly's benefits come from its main ingredient petroleum, which helps seal your skin with a water-protective barrier.

1.4.2. What is petroleum jelly made of?

Petroleum jelly (also called petrolatum) is a mixture of mineral oils and waxes, which form a semisolid jellylike substance. This product hasn't changed much since Robert Augustus Chesebrough discovered it in 1859. Petrolatum is a by-product created from the processing of petroleum oil. Petroleum initially undergoes distillation through high temperatures to vaporize fuels such as gasoline or kerosene. The product then undergoes asphaltting, in which a solvent is used to extract heavier oils, followed by dewaxing, which further removes unwanted components. Historically, "bone-black," a porous bone charcoal was used as a filtering modality.

1.5. Benefits and uses for petroleum jelly

Heal minor skin scrapes and burns: A study shows Trusted Source that petroleum jelly is effective in keeping skin moist during post-surgery healing. This may be particularly good for regular, less dramatic skin injuries. Make sure that the surface you apply petroleum jelly on is properly cleaned and disinfected. Otherwise, bacteria and other pathogens can get trapped inside and delay the healing process.

Moisturize your face, hands, and more: Face and body lotion: Apply petroleum jelly after a shower. As an occlusive moisturizer, it prevents your skin from drying out. You can also use it for dry noses during cold or allergy season. **Cracked heels:** Soak your feet in warm water with some salt added to it. Towel-dry thoroughly and apply petroleum jelly and clean cotton socks. **Improve your gardening hands:** After washing and drying, use some petroleum jelly and a clean pair of gloves to help lock in moisture and accelerate healing.

1.5.1. Chapped lips: Apply to chapped lips as you would any Chap Stick

Prevent diaper rash: Petroleum jelly has been shown Trusted Source to reduce the incidence of diaper rash in babies. Clean and towel-dry your little one's skin properly before applying. Petroleum jelly will form a protective barrier that will help protect the skin from constant exposure to moisture. Make an appointment with the doctor if there is a persistent rash.

Remove eye makeup: Oil is an effective way to remove makeup, and petroleum jelly is safe to use in the eye area, according to a study on eye ultrasounds. Use a cotton pad or Q-tip (for hard-to-reach areas), and press gently without tugging too hard on your skin. Make sure to close your eyes as you wipe. Some people also swear by using it on crow's feet lines.

Save split ends: Sun and wind exposure as well as pool water can dry up your hair. Petroleum jelly can reduce the look of split ends and add shine to your hair. Rub a small amount of jelly between your palms and apply to hair ends

1.6. Disadvantages of petroleum jelly

While petroleum jelly has many benefits, it should be for external use only. Do not eat or insert petroleum jelly. Avoid using petroleum jelly for masturbation or as a vaginal lubricant. According to Reuters, a study of 141 women found that 17 percent used petroleum jelly internally and 40 percent of them tested positive for bacterial vaginosis.

Allergies: Some people are more sensitive and can develop allergies if they use petroleum-derived products. Always keep an eye out for irritations and adverse reactions when using a new product.

Infections: Not allowing the skin to dry or cleaning the skin properly before applying petroleum jelly can cause fungal or bacterial infections. A contaminated jar can also spread bacteria if you insert jelly vaginally.[15,19]

1.6.1. Compositions

Watermelon seed contains about 22-25 % of oil with high amount of unsaturated fatty acids (about 80%) predominantly linoleic acid or omega 6 fatty acid (about 45-73%). Oleic, palmitic and stearic acid are also present in small quantities.

Table 1 Fatty acid composition

Fatty Acid Name	Numbering	Percentage
Linoleic acid	18:2	45-65%
Oleic acid	18:1	10-20%
Palmitic acid	16:0	8-10%
Stearic acid	18:0	7-10%

Table 2 Physio-Chemical Characteristics of Watermelon Oil:

Characterization	Value Range
Refractive Index at 30°C	1.471- 1.474
Specific Gravity at 30°C	0.85
Saponification Value	183.1
Iodine Value	121.5
Acid Value	2.37
Smoke Point	150 °C
Fire Point	175°C

Table 3 Chemical Composition of Watermelon Seed Oil

Triacylglycerol	58.4%
Free Fatty Acids	1.5%
Diacylglycerol	0.7%
Monoacylglycerol	1%
Phosphatides	0.5%
Wax	2%

Table 4 Component of Watermelon Seed

Component	Percentage
Protein	27-35%
Oil	5-10%
Ash	2-3%
Carbohydrates Fiber	10-15%
Crude	0.5-2%
Total Dietary	7-8%

2. Extraction of watermelon seed oil

Watermelon seeds are used for oil extraction, known as Outang or Kalahari oil, in West Africa. Watermelon seed contains about 40% of oil with high amount of unsaturated fatty acids (about 80%) predominantly linoleic acid or omega 6 fatty acid (about 45-73%). Oleic, palmitic and stearic acid are also present in small quantities. The oil is light, moisturizing, and easily absorbed by the skin. It can be used in the cosmetic industry for skin care products and as an anti-inflammatory agent. Discarded seeds can be used for oil extraction, and a study was conducted to analyze the extracted oil and use it for skin care products.

Material methodology: Watermelon seeds were dehulled, winnowed, screened, cleaned, grinded, and preheated before extraction. Crushing the seeds before solvent extraction increases surface area and makes solvent penetration easier. After pretreatment and heat treatment, solvent extraction assembly was set up using benzene, n-hexane, and mixed solvent systems. Miscella was allowed to cool, and distillation was performed to separate oil and solvent. The recovered solvent was used for the next batch.

2.1. Methods use for Oil Extraction from Seed:

2.1.1. Soxhlet Extraction

Organic solvent extraction is the most common method used for extracting oil. The use of conventional extraction for date seed oil with different solvents (petroleum ether, Acetone, hexane, chloroform, methanol etc.) using the maceration and Soxhlet methods. These solvents have characteristics such as easy removal by evaporation from the extracts, high solvent—solute ratio, oil viscosity, and polarity. The choice of the solvent type depends on its capacity to drive the extraction process and ensure maximum yield. In the organic solvent method, the date seed is cleaned, dried, and ground to rupture the oily cells, making the oil available to the solvent. The extraction yield is related to the degree of accessibility of the solvents to the oil-containing cells. Soxhlet extraction is the most common technique for oil seed extraction. During solvent extraction diffusion is the main mechanism. The seed and solvent come into contact with the solvent diffuses through the seed mass and extracts the available oil from broken oily cells. The oil is then separated from the solvents using a rotavapor.



Figure 3 Soxhlet Extraction

3. Literature survey

Bhushan Chaudhari, Hershel Patel, Pradnya Atpalkar and Prof. R. L. Nibe [2022] Watermelon seed oil, also known as Otenga or Kalahari oil, is effective for skin care due to its light, absorbable nature and humectant properties. It is suitable for cosmeceutical applications and requires acid pretreatment before transesterification. The oil contains 77.4% unsaturated fatty acid and 63.2% PUFA. The extraction time increases oil yield, with optimal extraction time being 4 hours. Crushed seeds provide a large surface area for solid-liquid contact, and boiling solvent temperatures are recommended for optimal extraction.

Sarfraz Athar, Abullais Ghazi, Osh Chourasiya³, Dr. Vijay Y. Karadbhajne [2020] Watermelon seed, often discarded, contains nutrients like protein, essential fatty acids, vitamins, and minerals. Its oil, with 35-40% unsaturated fatty acid content, is effective for skin care due to its light, absorbable, and humectant properties. This study explores solvent extraction of watermelon seed oil, its analysis, and application in skin care products.

Gabriel A. F., Igwemmar N. C., Sadam A. A., and Babalola S. A. Said that [2018] This research investigates the ethno-medicinal utilization of watermelon seed oil in Nigeria. The study reveals that the oil contains anti-nutritional components like saponins, alkaloids, phenols, flavonoids, and tannins. The oil also contains major elements like zinc,

calcium, and magnesium. The analysis also reveals the presence of crude protein, ash, crude fiber, crude lipid, moisture, and carbohydrates. Despite its toxicity, the seed's significant nutritional value can be beneficial for daily health. T

B. Komane a, I. Vermaak, G. Kamatou a, B. Summers c, A. Viljoen a, b Said that [2017] The study investigates the safety and efficacy of Kalahari melon seed oil in maintaining healthy skin. The oil contains fatty acids that can be beneficial when applied topically. The study used two-dimensional gas chromatography coupled to mass spectrometry to quantify the fatty acids. The results showed that the oil was non-irritant to the skin, reduced TEWL, and increased moisture retention. The non-irritant, hydrating, and moisturizing effects of the oil justify its incorporation into cosmetic products.

A.K. Yusuf said that [2017] Seed oils are being explored as biodegradable, renewable bioresources for replacing fossil fuels in the chemical industry. They can be harnessed as sustainable platform chemicals at both laboratory and industrial scales. This review compares traditional methods, conventional methods, and innovative methods of seed oil extraction, focusing on yield, recovery, purity, and quality. Pretreatment of oilseeds is crucial for achieving good yield and quality. The selection of suitable extraction methods depends on the intended scale.

Reetapa Biswas, Subarna Ghosal, Alok Chattopadhyay and Santa Datta said that [2017] This study explores the potential of watermelon seed oil, a valuable source of essential fatty acids, vitamin E, minerals, and antioxidant activity. It suggests that after thorough toxicological, animal, and nutritional studies, it's time to explore its commercial potential.

Dr. Vilas More, Proff.Dinkar Kambl, Dr. Rajabhau Khotpal And Dr. Anand Kulkarni Said That [2015] Pumpkin and watermelon seeded oil cake protein concentrates from Central India have been used to create environmentally friendly liquid and powder detergents, demonstrating superior cleaning properties and comparing well with commercial alternatives.

3.1. Experimental works

- Analysis of watermelon seed oil

Analysis of watermelon seed oil is followed under same process and same material. Detailed experimental process is as follows

- Chemical required

Stearic acid, Glycerol Monostearate, Iso-propyl alcohol, Watermelon seed oil, Polyethylene glycol, Carbomer, Glycerine, Tetra ethylene amine, TBH. Vitamin E, Twin-80, Distilled water.

- Apparatus Required

Beakers, Conical Flask. Weighing Balance, Burette, Glass Rod, Condenser, Water Bath, Heating Mantle, Thermometer, Agitator.

3.1.1. Determination of Acid value of watermelon seed oil:

Chemicals:

0.1 N alcoholic KOH

Phenolphthalein indicator

Neutral alcohol

- Procedure

Take 1-2 gm of watermelon seed oil in conical flask and add 20ml of neutral alcohol to it. Shake it and heat it on hot water bath for 2 min. After that add 2-3 drops phenolphthalein indicator and titrate it against 0. 1N alcoholic KOH solution. Colour change is observed from pink to colorless.

- Calculations

$$\text{Acid value} = [N \times V]/W$$

Where, Normality of Alco. KOH i.e., 0.1N V=Volume of Alco. KOH required

W= Weight of watermelon seed oil taken

Acid value of watermelon seed oil is observed = 2.37

3.1.2. Determination of saponification value of watermelon seed oil:

0.5 N alcoholic KOH solution

0.5 N HCl solution

Phenolphthalein indicator

- Procedure

Take 1-2gm of Watermelon seed oil in round bottom flask and add 50ml of 0.5N alcoholic KOH solution. Shake it and heat it on water bath for 2-3 hours with reflux condenser attached to it. After heating add 2-3 drops of phenolphthalein indicator and titrate it against 0.5N HCl solution. Colour change is from pink to colorless. Repeat the same procedure for blank (without sample).

Calculations:

$$S.V. = (B-S)/W$$

Where, Normality of 0.5N HCl

V= volume of HCl required

W= Weight of oil taken

B= volume of 0.5N HCl required for blank

S= Volume of 0.5N HCl required for sample

Saponification value of watermelon seed oil is - 183.1

3.1.3. Determination of Density and Specific Gravity of watermelon seed oil Procedure:

Measure weight of empty density bottle. Take watermelon seed oil and pour it in density bottle until it comes from the hole of density bottle. Weight density bottle filled with watermelon seed oil. Repeat the same procedure for reference solvent i.e., water and calculate specific gravity

Observations:

Temperature = 40°

Weight of empty specific gravity bottle = 23.81gm

Weight of specific gravity bottle + water = 50.89 gm

Weight of specific gravity bottle + watermelon seed oil = 49.61 gm

Calculations

Mass of water = 50.89 – 23.81 = 27.08 gm

Mass of oil = 49.16 – 23.81 = 25.35 gm

Specific gravity of oil = Mass of oil / Mass of water

= 25.35

t27.08

t=0.93 g/ml

Specific gravity of oil = Density of oil / Density of water

Density of oil = Density of water × Specific gravity of oil

$$= 0.997 \times 0.93$$

$$= 0.927$$

4. Formulations

4.1. Preparation of Moisturizer Batch 1

The specific amount of stearic acid, GMS, propane-2-01, watermelon seed oil and PEG were melted together in a beaker and heat at 70 °C. The accurate amount of tri ethanol amine, distilled water, carbomer and glycerin were melted to from water phase these contents were heated, further all ingredients mixed completely to make water liking phase of moisturizer. All ingredients mixed completely to make aqueous phase of moisturizer. Oil phase phase transfer to water phase slowly with continuous stirring in such manner that homogeneous mixture is formed. After the complete addition, the mixture was cooled to about 50°C.

Other additives such as preserving agents and perfumes were added to this to yield the final product.

Table 5 Part A (Oil Phase):

Stearic acid	2.5gm
GMS (Glycerol Monostearate)	1gm
IPA (Isopropyl Alcohol)	1ml
Watermelon seed oil	5 ml
PEG (Polyethylene glycol)	0.25ml

Table 6 Part B (Water Phase)

Carbomer	7gm
Glycerin	5m
TEA (Tetra ethylene amine)	1ml
Preservative	1gm
Fragrance	1ml
Distilled water	80ml

4.2. Batch 2

The specific amount of stearic acid, GMS, isopropyl alcohol, watermelon seed oil and PEG were melted together in a beaker and heat at 70 °C. The accurate amount of tri ethanol amine, distilled water, carbomer and glycerin were melted to from water phase these contents were heated, further all ingredients mixed completely to make water liking phase of moisturizer. All ingredients mixed completely to make aqueous phase of moisturizer. Oil phase phase transfer to water phase slowly with continuous stirring in such manner that homogeneous mixture is formed. After the complete addition, the mixture was cooled to about 50°C. Other additives such as preserving agents and perfumes were added to this to yield the final product.[12]

Table 7A Part A (Oil Phase)

Stearic acid	2.5gm
GMS (Glycerol Monostearate)	1gm
IPA (Isopropyl Alcohol)	1ml
Watermelon seed oil	7ml
PEG (Polyethylene glycol)	0.25ml

Table 7B Part B (Water Phase)

Carbomer	1gm
Glycerine	5ml
TEA (Tetra ethylene amine)	1.5ml
Preservative	1gm
Fragrance	1ml
Distilled water	110ml

4.3. Batch 3 (final preparation)

The specific amount of Palmitic acid, GMS, isopropyl alcohol, watermelon seed oil and PEG were melted together in a beaker and heat at 70 °C. The accurate amount of distilled water, carbomer and glycerin were melted to form water phase these contents were heated, further all ingredients mixed completely to make water liking phase of moisturizer. All ingredients mixed completely to make aqueous phase of moisturizer. Oil phase phase transfer to water phase slowly with continuous stirring in such manner that homogeneous mixture is formed. After the complete addition, the mixture was cooled to about 50 °C. Other additives such as preserving agents and perfumes were added to this to yield the final product.[12]

Table 8 Quantitative Composition of Oil and Water Phase in Final Moisturizer Batch

Chemical	Quantity
	Oil Phase
Steric Acid	2.5gm
GMS	1gm
Isopropyl alcohol	1ml
Watermelon seed oil	9 ml
PEG	0.25ml
	Water Phase
Carbomer	0.5gm
Glycerin	5ml
TEA	2ml
Preservative	1gm
Fragrance	1ml
Distilled water	120ml



Figure 4 Oil and Heating Mental



Figure 5 Moisturize

5. Evaluation and observation:

Analysis of Product pH: The pH of person skin is about 6-7. It is one of the important factors for checking the pH of cosmetic before applying on skin so that it does not cause any irritation to skin and the product should be accepted by skin.

Skin Irritation Test: It is carried out by applying product on the skin for 10 min. In between that if it does not cause any irritation or redness or itching to the skin then it is suitable for application.

Aging stability: The product is stored at 40° and periodical observation of oil, crystallization of wax on surface. Effect on skin and eyes: This can be measured by applying it on animals.

Moisture Content: This test is used to check the moisturizing effect of the product after applying it on the skin. After checking the moisture content for any particular product, we found that how moisturizing effect change for the skin and also this value differs from person to person and different for different skin type. So before doing this test we have to

check the original moisture content of skin without applying any moisturizer. In order to carry out this test we used digital moisture monitor for skin. This tester is also used to check its oil content.



Figure 6 Moisture Analyzer

5.1. Moisture and oil Content of Moisturizer Formulation For batch 1

5.1.1. Procedure

Table 9 Moisture and Oil Retention Analysis Post Moisturizer Application (Batch 1)

Time (Min)	Moisture content (%)	Oil content (%)
0	42.5	21.1
40	44.2	21.3
80	44.8	21.8
120	45.3	22.3
160	45.8	22.8
200	46.3	23.2
240	46.5	23.5

First, we have measured the original moisture content and oil content of skin with the help of analyzer and then we apply the moisturizer of batch 1 on skin. With the help of this analyzer, we take the reading at different time interval to check the change observe after applying the moisturizer. Similarly measure the oil content before applying the moisturizer and also check the oil content after applying different reading are being taken at different time interval which are given at below table.

Graph is plotted between moisture content verses change in time. As the time passes the moisturizing effect decreases and then increases. The result is shown below in the graph.

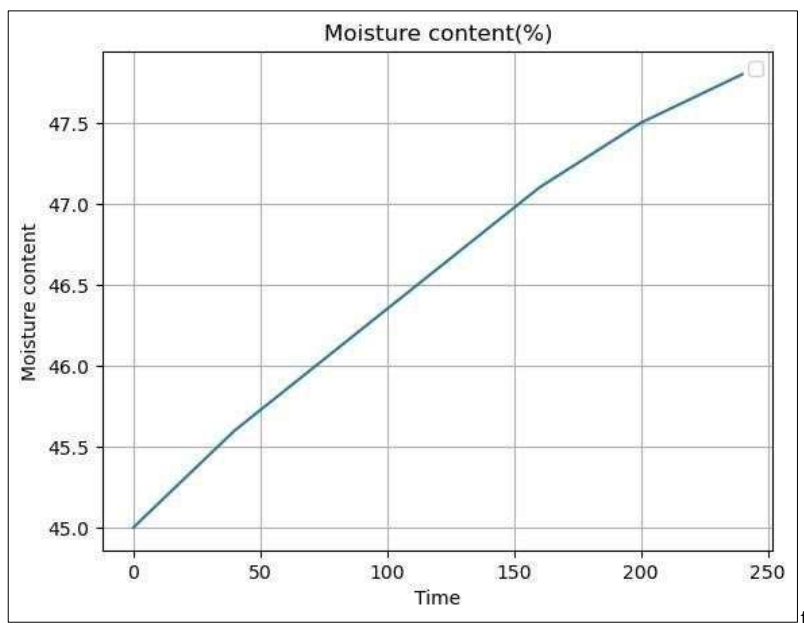


Figure7 Graph of Moisture Content vs. Time for Moisturizer Application for batch 1

The oil content of product change as the time passes. The change in oil content with respect to time is as shown in the graph by taking time on x-axis and oil content on y-axis.

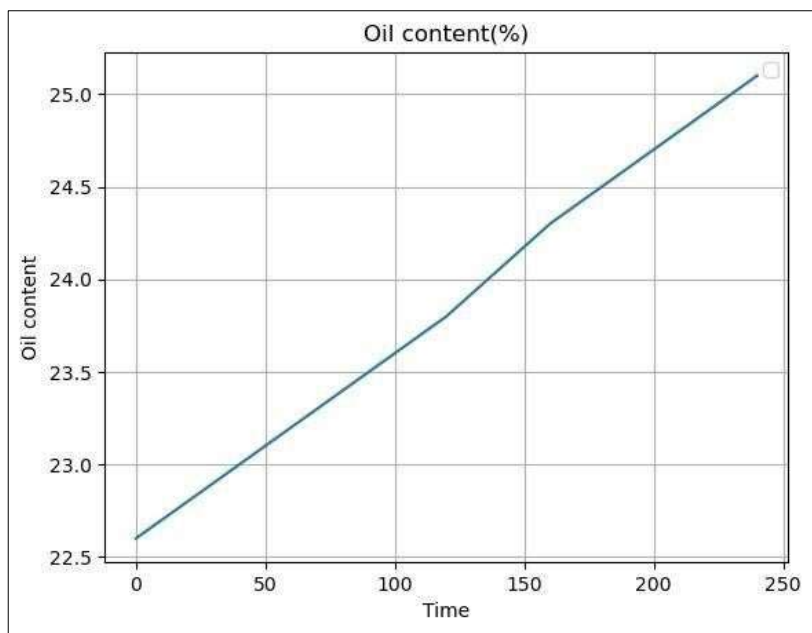


Figure 8 Graph of Moisture Oil content vs. Time for Moisturizer Application for batch 1

5.2. Moisture and oil Content of Moisturizer Formulation

5.2.1. For Batch 2

The specific amount of stearic acid, GMS, isopropyl alcohol, watermelon seed oil and PEG were melted together in a beaker and heat at 70°C. The accurate amount of tri ethanol amine, distilled water, carbomer and glycerin were melted to from water phase these contents were heated, further all ingredients mixed completely to make water liking phase of moisturizer. All ingredients mixed completely to make aqueous phase of moisturizer. Oil phase phase transfer to water phase slowly with continuous stirring in such manner that homogeneous mixture is formed. After the complete

addition, the mixture was cooled to about 50°C. Other additives such as preserving agents and perfumes were added to this to yield the final product.

Moisture content of bare skin = 31.2

Oil content of bare skin =44.4

Different reading is being taken at different time interval which are given at below table

Table 10 Moisture and Oil Retention Analysis Post Moisturizer Application (Batch 2)

Time (Min)	Moisture content (%)	Oil content (%)
0	44.2	22.6
40	44.6	23
80	45.2	23.3
120	45.8	23.7
160	46.6	24
200	47	23.9
240	47.2	23.5

Graph is plotted between change in time verses moisture content. As the time passes the moisturizing effect decreases and then increases. The result is shown below in the graph.

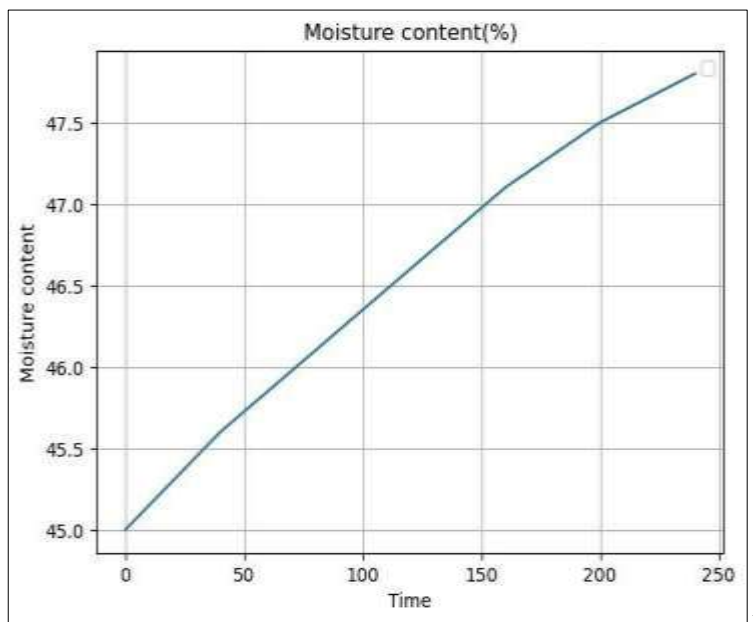


Figure 9 Graph of Moisture Content vs. Time for Moisturizer Application for batch 2

The oil content of product change as the time passes. The change in oil content with respect to time is as shown in the graph by taking time on x-axis and oil content on y-axis.

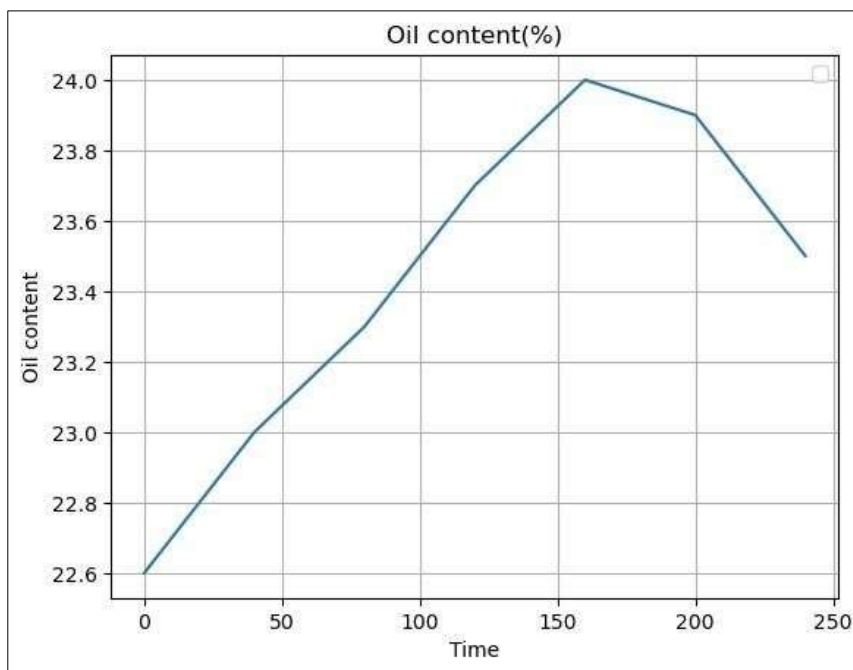


Figure 10 Graph of Oil content vs. Time for Moisturizer Application for batch 2

5.3. Moisture and oil Content of Moisturizer Formulation

5.3.1. For Batch 3 (Final Batch)

First, we have measured the original moisture content and oil content of skin with the help of analyzer and then we apply the moisturizer of batch 1 on skin. With the help of this analyzer, we take the reading at different time interval to check the change observe after applying the moisturizer. Similarly measure the oil content before applying the moisturizer and also check the oil content after applying different reading are being taken at different time interval which are given at below table.

- Moisture content of bare skin = 22%
- Oil content of bare skin = 36.7%

Different reading is being taken at different time interval which are given at below table Table: 3

Table 11 Time-Dependent Changes in Moisture and Oil Content in percent

Time (Min)	Moisture content (%)t	Oil content (%)
0	45	22.6
40	45.6	23
80	46.1	23.4
120	46.6	23.8
160	47.1	24.3
200	47.5	24.7
240	47.8	25.1

Graph is plotted between change in time verses moisture content. As the time passes the moisturizing effect increases. The result is shown below in the graph.

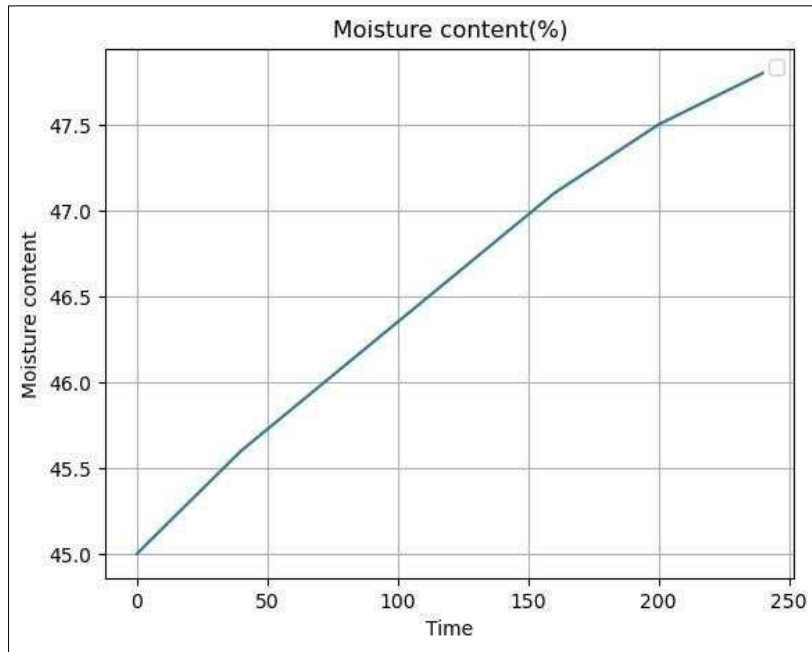


Figure 11 Graphical representation of moisture content with respect to time of final batch

The oil content of product change as the time passes. The change in oil content with respect to time is as shown in the graph by taking time on x-axis and oil content on y-axis.

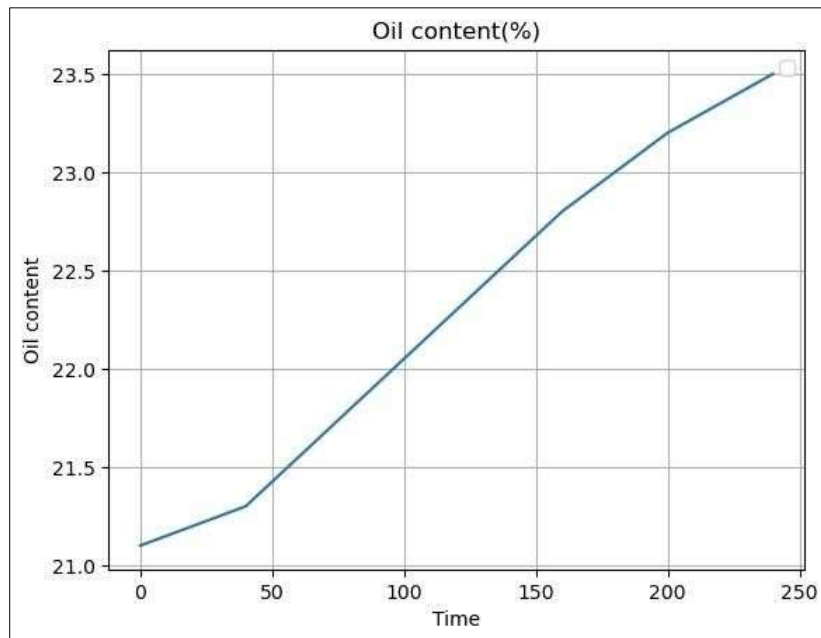


Figure 12 Graphical representation of oil content with respect to time of final batch

6. Results

Table 12 Evaluation Tests of Moisturizer Batches 1, 2, and 3 Compared with Standard Reference

Test	Batch 1	Batch 2	Batch 3	Std Reference
pH	Neutral	Neutral	Neutral	Closed to 7
Irritation Test	None	None	None	No Irritation
Appearance of Moisturizer	White	White	White	White
Spread ability	Well	Good	Good	Well
Consistency	Well	Good	Good	Excellent
Increase in Moisture content	35%	51.6%	115%	139.70%
Decrease Oil content	43%	47.5%	32%	49.50%

7. Discussion

- Moisturizer is of natural origin and it replaces petroleum origin.
- Moisturizer has good consistency and it is white in color.
- The pH of moisturizer is neutral and it does not harm to the skin.
- It shows good spread ability.
- So, we can commercialize it in place of petroleum origin product.
- The best result is obtained from batch 3, we can optimized commercially in industry. Moisturizer is costly due to seed availability.

8. Conclusions

The watermelon seed, despite its high nutritional content and medicinal value still remain unexplored and unutilized in India. Over the years, due to high rate of production and lack of awareness of benefits of its seeds, the seed is suffered negligence which results in wastage of seed oil.

The safety of water melon oil was confirmed as it was shown to be non-irritant to human skin. The efficiency was shown through reduction of skin dryness through moisture retention.

Watermelon seed oil is a superior alternative to petroleum jelly because it is natural, biodegradable, and rich in nutrients that nourish the skin.

It is non-comedogenic, meaning it won't clog pores, and it has a lightweight texture that absorbs easily without leaving a greasy residue and provides anti-inflammatory and anti-oxident benefits

In contrast, petroleum jelly is a non-renewable byproduct of the petroleum industry, lacks skin nutrients, and can clog pores. Thus, watermelon seed oil offers better skin health benefits and environmental sustainability.

Additionally, its high content of linoleic acid helps balance sebum production, making it ideal for managing oily skin. T

Future scope

The future scope of watermelon seed oil-based moisturizers appears promising, as they offer several potential benefits and align with current trends and consumer preferences. Here are some reasons why watermelon seed oil-based moisturizers may have a bright future:

Natural and Sustainable: Watermelon seed oil, a natural ingredient, is being used in moisturizers to meet the growing demand for eco-friendly, natural products.

Skin Hydration and Nourishment: Watermelon seed oil, rich in essential fatty acids like omega-6 and omega-9, provides moisturizing benefits for various skin types, ensuring skin barrier function and moisture retention.

Antioxidant and Anti-Aging Potential: Watermelon seed oil, rich in antioxidants like vitamin E and lycopene, protects skin from free radicals, potentially reducing fine lines and wrinkles in moisturizers.

Lightweight and Fast Absorption: Watermelon seed oil is a lightweight, easily absorbed moisturizer that caters to the demand for daily, non-greasy, and non-greasy products among consumers.

Potential for Product Innovation: Watermelon seed oil can be enhanced by incorporating other ingredients like hyaluronic acid, aloe vera, or plant extracts into moisturizers

for unique benefits like hydration, soothing, or brightening.

Market Demand: The global skincare market is expanding, with consumers seeking natural, plant-based alternatives. Watermelon seed oil-based moisturizers offer unique selling points and appeal for product differentiation.

Diverse Applications: Watermelon seed oil-based moisturizers offer targeted skincare solutions for various skin types, including sensitive, oily, and mature skin, addressing dryness, dullness, and irritation. While the future scope of watermelon seed oil-based moisturizers appears promising, it's important to consider ongoing research and developments in the skincare industry.

Compliance with ethical standards

Disclosure of conflict of interest

No conflict of interest to be disclosed.

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