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Formulation And Evaluation of Terminalia Chebula Anti-Aging Cold Cream

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ABSTRACT

The formulation of anti-aging cold cream was prepared by using Terminalia chebula (haritaki/kadukkai) extract as a primary active ingredient. Terminalia chebula is well known for its potent rejuvenating and antioxidant properties, making it an ideal natural component for delaying skin aging. The formulation was prepared using supplementary ingredients such as amla extract, aloevera gel, glycerine, cetostearyl alcohol, white soft paraffin, and beeswax to enhance its stability, moisturization and skin protective effects. This aims to combat winter-related skin dryness and visible signs of aging. Leveraging Terminalia chebula's antioxidant, anti-inflammatory, and rejuvenating properties thus provides skin hydration, elasticity, brightening, reducing fine lines and wrinkles to protect the skin. The physicochemical evaluation of the cream demonstrates the desirable characteristics including smooth texture, homogeneity, pleasant odour, easy washability, and a pH within the skin compatible range. The anti-aging and antioxidant activity was assessed using the DPPH-free radical scavenging assay at a wavelength of 519nm. The Terminalia chebula-based cold cream is a safe, stable and effective formulation with promising anti-aging and antioxidant properties.

KEY WORDS: Terminalia chebula, winter care, skin rejuvenation, herbal extract anti-wrinkle cream.

I. INTRODUCTION

According to Section 3 of the Drugs and Cosmetics Act (India), 1940 a cosmetic is any material that is meant to be rubbed, poured, sprinkled, sprayed, inserted into, or applied in any other way to the human body or any part of it in order to cleanse, beautify, promote attractiveness, or change appearance. Any item meant to be used as a component of a cosmetic is also included in this definition [1].Many medical systems, including Rig-Veda, Yajur Veda, Ayurveda, Unani, and homeopathy, have long recognized the idea of herbal cosmetics [2].

COSMETICS AND COSMACEUTICALS:

Dr. Albert Kligman is credited with coining the term after he identified a group of items that fell somewhere between pharmaceuticals and cosmetics. Although it may not always have a biological therapeutic effect, it is increasingly frequently used to denote a cosmetic product that has a medicinal therapeutic value[3].

CONCEPT OF COSMETICS IN AYURVEDA:

Ayurveda is one of the most renowned traditional medical systems that has survived and flourished over the centuries. Prakriti (body constitution), sara (structural predominance), sanhanan (compactness of the body), twak (skin condition), praman (measuring), and dirghayulakshyana (signs of long life) are some of the characteristics that Ayurveda considers while determining beauty. In addition to bringing happiness, beauty also promotes self-esteem and confidence. Using medicinal herbs and minerals, Ayurvedic cosmetology starts with activities from the womb, such as dinacharya (daily regimen), ratricharya (night regimen), and ritucharya (seasonal regimen).

CREAMS:

Creams are topical treatments that are administered to the skin. A cream is a fluid, homogenous, viscous, or semi-solid mixture that is applied externally to the skin or certain mucous membranes for medicinal, preventative, or protective purposes particularly when an occlusive effect is not required. A semisolid dosage form that contains one or more pharmacological ingredients dissolved or distributed in an appropriate base is called a cream. To make preparations that are practically miscible with skin secretions, they are made with hydrophilic or hydrophobic bases [4].People use creams based on their skin ailments and needs, and they might be herbal, ayurvedic, or allopathic [5].

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TYPES OF SKIN CREAMS

They are divided into two types:

1. **Oil-in-Water (O/W) Creams:**
   Tiny oil droplets dispersed across a continuous aqueous phase make up these creams. An emulsion in which the oil is distributed as droplets within the water phase is known as an oil-in-water (O/W) emulsion [6].
2. **Water-in-Oil (W/O) Creams:**
   Tiny water droplets dispersed over an oily phase make up these lotions. Water as the dispersed phase and oil as the dispersion medium define a water-in-oil (W/O) emulsion [7-8].

THE ANATOMY AND PHYSIOLOGY OF SKIN:

Skin and other auxiliary structures like hair, nails, glands, muscles, and blood arteries make up the integumentary system, which was named after the Latin word "integument," which translated to "body covering." The skin, which makes up 12-16% of an adult's body weight, is thought to be the greatest exterior component of the human body [9]. The study, diagnosis, and treatment of skin conditions are the focus of the medical specialty of dermatology[10]. Numerous biological components exist, including keratinocytes, red blood cells, and melanocytes[11]. The appearance of skin changes related to pigmentation, wrinkles, and sagging is improved with cosmetics[12].

The skin comprises of three primary layers namely,

1. Epidermis
2. Dermis
3. Hypodermis.

1) Epidermis:

The epidermis, or outermost or superficial layer of skin, is made up of keratinized squamous epithelium. It is devoid of capillaries, veins, nerves, and blood vessels. Dendritic cells and keratinocytes are primarily found in the epidermal layer [13-14]. The five layers that make up the epidermis are as follows:

- **Stratum corneum:** The horny cell layer and it is the outermost sub layer. The stratum corneum's main function is to keep the skin from becoming too dry [15].
- **Stratum lucidum:** Skin cells that have been exfoliated make up this clear layer. Usually found on flat surfaces and in the palms of the hands. Reducing friction between the stratum corneum and stratum granulosum is its primary purpose.
- **Stratum granulosum:** The stratum lucidum and stratum spinosum are separated by the stratum granulosum. Granules have a lipid-rich secretion that acts as a water-proof barrier to stop fluid loss from the body [16].
- **Stratum spinosum:** Also known as a prickle cell layer, it lies between the granular and basal layers. It mostly consists of keratinocytes supported by desmosomes, which are proteins that contribute to the strength and suppleness of skin [17].
- **Stratum Basale:** It is also known as the basal cell layer and is the deepest layer of the epidermis. This layer contains keratinocytes that produce keratin. There are two primary uses for Stratum Basale. The term "germinative layer" refers to the layers composed of the basal layer and spiny layers [18].

2) Dermis:

The dermis is made up of connective tissue, which includes reticular, collagenous, and elastic fibers. Wrinkles develop as a result of the thinning of collagenous fibers, which give skin its rough texture. Thin reticular fibers serve as a supporting network. Fibroblasts, macrophages, and mast cells are found in the dermis. Macrophages aid in the digestion of nerve terminals, blood arteries, lymphatic vessels, and foreign objects. It is made up of layers that are not easily distinguished, including the reticular and papillary layers [19].

3) Hypodermis:

The loose fibrous connective tissue that makes up this layer is called the subcutaneous layer. It also has lymphatic and blood arteries as well as nerves. This layer's sebaceous glands produce fatty substances and sebum, which hydrates the skin and hair [20].

FUNCTIONS OF SKIN:

1. **Protection:** The skin serves as the body's main barrier to the outside world and protects it from bacteria, dehydration, UV rays, and mechanical harm.
2. **Sensation:** Both reflex and voluntary actions are triggered by the skin's free nerve endings' sensitivity to pain, temperature, touch, heat, and cold.
3. **Absorption:** It has the ability to absorb a variety of compounds, including chemicals, drugs, and nutrients, which, once in the

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bloodstream, can affect how the body works.

4. **Excretion:** By eliminating salts, toxins, trace amounts of urea, and metabolic waste products through sweat, the skin's excretory function plays a vital role in maintaining physical homeostasis, controlling body temperature, and promoting general health.
5. **Regulation of body temperature:** The body's homeostatic mechanism, thermoregulation, maintains a constant internal body temperature despite changes in the outside world. This is essential for the immune system and enzymes to work properly, which are best served by a temperature range of 36.5 to 37.5ºC.

COLD CREAM:

In the second century, the Greek physician Galen is credited with inventing cold cream. When cold cream comes into contact with the skin, it softens & effective for dry skin on the knees, feet, and elbows. It's also perfect for natural makeup removal techniques and preventing eczema on dry parts of the body [21]. Traditionally, cold creams were prepared as water-in-oil (W/O) emulsions. These are used to remove makeup and smooth the skin.

ANTI-AGING

AGING:

The decline of physiological processes required for survival and fertility throughout time is known as aging [23]. Skin aging is an inevitable biological phenomena of human life that can be caused by cumulative exposure to damaging external factors (extrinsic aging) or the age-dependent reduction of cell function (intrinsic aging).

CAUSES OF AGING:

1. **Intrinsic Aging (Chronological / Natural Aging):** Causes delayed metabolic changes, impaired cellular regeneration, decreased synthesis of collagen and elastin, loss of skin suppleness, and slower metabolism. Additionally includes cellular telomere shortening, DNA damage, and oxidative stress as well [24].
2. **Extrinsic Aging (Environmental / Photo aging):** Triggered by environmental elements such pollution, smoking, ultraviolet (UV) radiation, and inadequate diet.The main cause of wrinkles, pigmentation, and rough texture is UV radiation, which releases reactive oxygen species (ROS) that break down collagen and elastin. Additional extrinsic variables contribute to accelerated aging by speeding up inflammatory reactions and oxidative damage [25].

ANTI-AGING:

The term "anti-aging" describes the treatments, devices, or products used to retard, stop, or reverse the physiological and visual signs of aging in the body, especially in the skin. Reducing oxidative stress, encouraging cellular regeneration, increasing collagen formation, and shielding tissues from internal and external harm are the ways anti-aging treatments function [24].

TYPES OF ANTI-AGING:

1. Retinoid-based Anti-Aging: Retinoids are derivatives of vitamin A that are frequently used in dermatology to address uneven pigmentation, fine lines, and wrinkles. They promote the dermal production of collagen and elastin and quicken cell turnover. Frequent topical application reduces roughness and age spots while increasing skin suppleness and thickness [26].

Function/Mechanism:

- ✓ Encourage exfoliation and epidermal regeneration.
- ✓ Stop the collagen-degrading matrix metalloproteinases (MMPs).
- ✓ In order to restore the dermal matrix, increase fibroblast activity [26].

2. Antioxidant-based Anti-Aging: One of the main causes of both intrinsic and extrinsic aging is oxidative stress brought on by free radicals, which antioxidants either prevent or reduce. Polyphenols, coenzyme Q10, vitamin C, and vitamin E are examples of common antioxidants. These substances guard against oxidative damage to proteins, DNA, and cell membranes [27].

Function / Mechanism:

- ✓ Reactive oxygen species (ROS), which are produced by pollution or UV light, are neutralized by this mechanism.
- ✓ Restore the equilibrium of antioxidant enzymes, such as superoxide dismutase and catalase.
- ✓ Keep the collagen structure healthy and postpone cellular senescence [27].

3. Peptide-based Anti-Aging: Short sequences of amino acids called peptides serve as the skin's signaling molecules. They direct the production of new collagen, elastin, and other extracellular matrix constituents by cells. Aged or photo damaged skin can be repaired and firmness increased with peptide creams [28].

Function/Mechanism:

- ✓ Induces fibroblasts to produce more collagen and elastin.
- ✓ Boost hydration and skin barrier

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restoration.
- ✓ Over time, increase suppleness and decrease the depth of wrinkles [28].

4. Herbal / Ayurvedic (Rasayana) Anti-Aging: In Ayurveda, rasayana therapy uses herbal compositions to promote longevity and renewal. Strong antioxidant, anti-inflammatory, and DNA-protective properties are demonstrated by herbs such as Terminalia chebula (Kadukkai), Emblica officinalis (Amla), and Withania somnifera (Ashwagandha) [29].

Function/Mechanism:
- ✓ Prevent lipid peroxidation and oxidative stress.
- ✓ Preserve DNA integrity and telomere length.
- ✓ Encourage the body's natural antioxidant enzymes [29].

5. Photo protective Anti-Aging: Long-term UV exposure destroys collagen and elastin and speeds up the creation of wrinkles, a condition known as photo aging. To stop UV-induced cellular and molecular damage, photo protective compounds are utilized, such as sunscreens with SPF, antioxidants, zinc oxide, and titanium dioxide [30].

Mechanism/Function:
- ✓ Absorb or block damaging UV rays.
- ✓ Stop the deterioration and discoloration of collagen.
- ✓ Cut down on UV-induced oxidative damage and inflammation [30].

6. Gene-modulating / Anti-senescence Anti-Aging: By altering genes linked to longevity, stress tolerance, and DNA repair (e.g., Klotho, FOXO, SIRT1), these medicines target aging at the cellular level. Senescence, the persistent cell cycle stop that contributes to tissue aging, is what they seek to prevent or postpone [28].

Function/Mechanism:
- ✓ Promote the expression of proteins and genes that prevent aging.
- ✓ Reduce telomere shortening and oxidative DNA damage.
- ✓ Decrease the number of senescent cells that accumulate [28].

7. Nutraceutical and Hormonal Anti-Aging: Nutraceuticals are bioactive substances produced from food that offer advantages for skin and health beyond simple nourishment. By enhancing cellular metabolism, lowering oxidative stress, and preserving hormonal balance, they help to fight aging. Hormonal anti-aging aims to improve vitality, skin elasticity, and metabolism by replacing or balancing hormones that naturally decrease with age, such as growth hormone, progesterone, testosterone, estrogen, and DHEA [25,31].

Function/Mechanism:
- ✓ Encourage energy synthesis and mitochondrial activity in aging cells.
- ✓ Lower the body's and skin's oxidative and inflammatory indicators.
- ✓ Avoid the onset of sagging, wrinkles, and dryness that are indicators of natural aging [25,31].

DIETARY SOURCES FOR ANTI-AGING:

1. Antioxidant-rich fruits include citrus fruits, pomegranates, and berries (strawberry, raspberry, and blueberry)[32].

2. Carotenoids and polyphenols are found in vegetables such as broccoli, tomatoes, spinach, kale, and carrots[33].

3. Nuts and Seeds: sunflower seeds, flaxseeds, walnuts, and almonds[34].

4. Marine sources and fatty fish include krill oil, sardines, mackerel, and salmon[35].

5. Whole Grains and Legumes: chickpeas, lentils, brown rice, and oats [36].

6. Herbal and Green Teas: Packed with polyphenols and catechins[37].

FUNCTIONS OF ANTI-AGING:

1. Maintains a youthful appearance, improves quality of life, and slows intrinsic and extrinsic ageing processes [24].
2. Enhances collagen and elastin synthesis to maintain skin firmness and elasticity, preventing wrinkles and fine lines [26].
3. Slows ageing at the cellular level by improving DNA repair and reducing telomere shortening[29].
4. Neutralizes free radicals through antioxidants, reducing cellular damage and premature ageing [32].
5. Moisturizes the skin and promotes a smooth, healthy appearance [38].
6. Hormonal anti-ageing therapies help maintain vitality, muscle tone, and skin elasticity [39].
7. Strengthens immunity, which naturally declines with age, through vitamins and nutraceuticals [40].

II. AIM AND OBJECTIVES

AIM: To formulate and evaluate a Terminalia chebula anti-aging cold cream and assess its physicochemical properties, antioxidant potential using DPPH assay and suitability for topical application.

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OBJECTIVES:

1. **Anti-aging efficacy:** Reduces fine lines, wrinkles, and signs of aging, promoting a smoother, more radiant complexion.
2. **Antioxidant protection:** Harness Terminalia chebula's antioxidant properties to neutralise free radicals and protect skin from oxidative stress.
3. **Rejuvenation and hydration:** Provide long-lasting hydration and promote skin rejuvenation, improving skin elasticity and firmness.
4. **Safety and natural origin:** Offer a safe, ayurvedic-inspired skincare solution, leveraging traditional wisdom and natural ingredients.
5. **Skin health and wellness:** Promote overall skin health and wellness, enhancing skin texture, tone, and appearance.

III. MATERIALS AND METHODS

COLLECTION OF MATERIALS:

The mature fruits of **Haritaki (Terminalia chebula Retz.)** are picked from trees between February and April, cleaned, boiled, or sun-dried, and then stored in an airtight container; the fruits of **Amla (Emblica officinalis Gaertn.)** are picked when they are fully ripe between November and February, cleaned, shade-dried, or sun-dried, and kept dry; the mature outer leaves of **Aloe vera (Aloe barbadensis Miller)** are cut during the dry season, the latex is drained, and the inner gel is separated for use or stabilization. Analytical grades of Borax, Bees wax, White soft paraffin, Sodium benzoate, and Glycerin were obtained for the formulation.

DRUG PROFILE:

1) Terminalia chebula (Haritaki):

Figure 1. Terminalia chebula

a. **Biological source:** It is the dried ripe fruit of Terminalia chebula Retz [41].
b. **Family:** Combretaceae [41].
c. **Synonyms / vernacular names:** Haritaki, Chebulic myrobalan, Kadukkai(tamil), Inknut [41].
d. **Plant description:** It is a medium–large deciduous tree with greyish brown bark, oblong or elliptical leaves, axillary spikes of small flowers and ovoid fruits (drupe) that are harvested when ripe and dried for medicinal use[41].
e. **Habitat / distribution:** Native to South and Southeast Asia; found in varied climates across India, Nepal, Sri Lanka, Myanmar and neighboring regions; grows in lowland to mid-elevation forests[41].
f. **Plant part used:** Dried ripe fruit (Chebulae Fructus)[41].
g. **Chemical constituents:** Tannins (chebulagic, chebulinic acids, gallic acid, ellagic acid), phenolic compounds (chebulin,punicalagin), flavonoids (quercetin, luteolin), lignans, triterpenes, and volatile oils[41].

2) Amla:

Figure 2.Phyllanthus emblica

a. **Biological source:** It is a fruit of Phyllanthus emblica L. (syn. Emblica officinalis)[42-43].
b. **Family:** Phyllanthaceae (Euphorbiaceae)[42-43].
c. **Synonyms / vernacular names:** Amla (Hindi/Sanskrit), Indian gooseberry, Amalaka (Sanskrit), Nelli (Tamil), Usirikaya (Telugu)[42-43].
d. **Plant description:** Small to medium deciduous tree with spreading crown; simple, light-green leaves in clusters; whitish-green flowers and nearly spherical, hard-fleshed, pale-green to yellowish fruits[42-43].
e. **Habitat / distribution:** Native to Indian subcontinent and Southeast Asia; cultivated widely in tropical and subtropical regions; tolerates dry to moderately humid climates[42-43].
f. **Plant part used:** Fruit (fresh or dried), also seeds and sometimes leaves in traditional formulations[42-43].
g. **Chemical constituents:** Rich source of vitamin C (ascorbic acid), tannins (emblicanin A & B), gallic acid and derivatives, flavonoids, phenolic

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compounds, alkaloids, and polysaccharides[42-43].

3) Aloe vera:

Figure 3. Aloe barbadensis

a. **Biological source:** Inner leaf gel (mucilaginous parenchyma) and latex (yellow bitter sap) from leaves of Aloe vera (**Aloe barbadensis** Miller) [44].
b. **Family:** Asphodelaceae (Liliaceae)[44].
c. **Synonyms / vernacular names:** Aloe barbadensis, Barbados aloe, Chinese aloe, Aloe vera, Indian aloe[44].
d. **Plant description:** Aloe vera is a succulent perennial with thick, fleshy, triangular serrated leaves forming rosettes; yellow tubular flowers on tall spikes; leaves contain three layers such as rind, latex (bitter), and inner clear gel[44].
e. **Habitat / distribution:** Originates from Arabian Peninsula; cultivated widely in subtropical and tropical regions worldwide; tolerates arid, xerophytic conditions[44].
f. **Plant part used:** Inner leaf gel (topical/cosmetic uses) and leaf latex (laxative uses) depending on preparation[44-45].
g. **Chemical constituents:** Polysaccharides (acemannan / glucomannans), anthraquinones (aloin, aloe-emodin), chromones (C-glucosyl chromone), lectins, sterols (lupeol, campesterol), vitamins, minerals, enzymes and amino acids - gel and latex have distinct profiles (gel rich in polysaccharides; latex rich in anthraquinones)[44,46,47].

IV. EXTRACTION PROCEDURE

1. TERMINALIA CHEBULA:

The dried fruits of Terminalia chebula (Kadukkai / haritaki) are coarsely powdered and placed in a thimble fitted inside a Soxhlet extractor. Then ethanol is taken in the round bottom flask as the extraction solvent. The apparatus is assembled with a condenser and heated gently on a heating mantle. The solvent evaporates, condenses, and repeatedly siphons through the powdered material, extracting the active constituents. The process is continued for about 6–8 hours or until the siphon solvent becomes colorless (around 8–10 cycles). After completion, the extract is filtered and the solvent is evaporated using a water bath at 40–50 °C to obtain a concentrated extract, which is then stored in an airtight container for further use.

2. EMBLICA OFFICINALIS:

The dried and coarsely powdered fruits of Emblica officinalis (Amla) are accurately weighed and transferred into a clean conical flask. Then the distilled water is added as the solvent, and the mixture is tightly covered to prevent solvent evaporation and contamination. The flask is kept at room temperature for 3 to 7 days with occasional shaking or stirring to ensure complete extraction of the water-soluble constituents. After the maceration period, the mixture is filtered through muslin cloth or Whatman filter paper to separate the extract from the marc (residue). The filtrate is then concentrated by gentle evaporation on a water bath at 40–50 °C to obtain a thick aqueous extract, which is stored in an airtight container for further use.

V. FORMULATION OF COLD CREAM

S.NO	INGREDIENTS	QUANTITY
1.	Haritaki (kadukkai) extract	1.0 ml
2.	Amla extract	1.0 Ml
3.	Beeswax	1.0 gm
4.	White soft paraffin	2.0 gm
5.	Cetostearyl alcohol	0.5 gm
6.	Light liquid paraffin	1.0 ml
7.	Lavender oil	0.1 ml
8.	Borax	0.1 gm

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9.	Glycerine	0.5 ml
10.	Aloe vera	0.1 gm
11.	Sodium benzoate	0.05 gm
12.	Distilled water	q.s for 10gm

PROCEDURE FOR CREAM FORMULATION:

1. The W/O type cream was prepared using 2 phases.
2. All the active pharmaceutical ingredients and excipients were measured accurately.
3. The oil phase was prepared by melting white soft paraffin, beeswax, liquid paraffin, cetostearyl alcohol and lavender oil by maintaining at 70ºC temperature.
4. Similarly, aqueous phase was prepared by heating borax, aloevera gel, glycerine, sodium benzoate along with active drug haritaki extract and amla extract with sufficient water by maintaining at 70ºC temperature.
5. When the 2 phases attain 70ºC temperature, aqueous phase was gradually introduced into the oil phase with continuous stirring until the cream consistency is attained.
6. Lavender oil itself acts as a perfume for the formulation.
7. The cream was stirred well, packed and stored in a well closed container.

VI. PHYTOCHEMICAL TEST

TEST	PROCEDURE	OBSERVATION
1) TEST FOR TANNINS: LEAD ACETATE TEST:	Take 2ml of sample extract and add 1ml of 10%lead acetate solution to the test tube.	Formation of yellowish / white precipitate indicates the presence of tannins.
2) TEST FOR GLYCOSIDES: KELLER KILLANI TEST:	Add 2ml of extract to the test tube. Add 2ml of glacial acetic acid and 1 drop of 5% Ferric chloride solution. Then add 1ml of conc.H_2SO_4 at the sides of the test tube.	Formation of bluish-green interface indicates the presence of glycosides.
3) TEST FOR FLAVONOIDS: ALKALINE REAGENT TEST:	Add 2ml of extract to the test tube.To the sample add few drops of 2% NaOH solution.	Formation of intense yellow colour indicates the presence of flavonoids. The colour disappears when a few drops of dilute Hcl is added, thus confirming the result.
4) TEST FOR ALKALOIDS: MAYER'S TEST:	Take 2ml of sample extract in the test tube. Add few drops of mayer's reagent to the test tube.	Formation of cream/white precipitate indicates the presence of alkaloids.
5) TEST FOR TERPENOIDS: SALKOWSKI TEST:	Take 2ml of sample extract in the test tube & add 2ml of chloroform. Then add few drops of conc. H_2SO_4 along the sides of the test tube.	Formation of reddish-brown interface indicates the presence of terpenoids.

VII. EVALUATION PARAMETERS

1. ORGANOLEPTIC EVALUATION:
The physical appearance of the cream can be observed by its colour, odour, roughness, and texture.

2. HOMOGENEITY TEST:
To evaluate the cream for smooth and uniform texture by visual appearance and by touch to ensure the absence of lumps, grittiness and aggregation of globules.

3. WASHABILITY TEST:
The ease of removal of the cream can be evaluated by washing the slide with tap water.

4. AFTER FEEL TEST:
After the application of a specified quantity of the cream, the amount of residue, emollience and slipperiness are assessed.

5. pH MEASUREMENT:
pH is evaluated to assess the skin compatibility and product stability. A standard buffer solution is used to calibrate the ph meter. A digital ph meter is used to measure the ph of around 05gm of the cream that has been weighed and dissolved in 50ml of distilled water.

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6. DYE TEST:

The cream is combined with methylene blue (water-soluble dye).Under a microscope, a drop of the cream is placed on the microscopic slide, covered with a cover slip and examined. If the cream is of water-in-oil (w/o) type, the dispersed globules appear coloured. On the other hand, if the cream is of oil-in-water (o/w) type, the dispersed globules appear colourless.

7. SPREADABILITY TEST:

Adequate amount of cream is taken and placed between the two slides and a weight of 500gm was applied for 5mins, then the spread diameter was measured.

Spreadability can be expressed as;

$$\textbf{Spreadability (S)} = \frac{\mathbf{m \times L}}{\mathbf{t}}$$

Where;

m = weight applied to the upper slide.

L = length moved on the glass slide.

t = time taken.

8. IRRITATION TEST:

A small amount of cream is applied to the skin, spread it and observed for irritation, itching or redness on skin.

9. ACID VALUE TEST:

A 5gm of sample is weighed and taken in a conical flask. Add 50ml of neutralized ethanol or mixture of ethanol and ether as a solvent. Then phenolphthalein is added as an indicator and the solution was titrated against 0.1N KOH solution until the formation of pink colour which persists for 30seconds.

$$\textbf{Acid value (AV)} = \frac{\mathbf{V \times N \times 56.1}}{\mathbf{W}}$$

Where;

V = volume of KOH solution used (ml)

N = normality of KOH solution

W = weight of sample (gm)

56.1 = molecular weight of KOH

10. SAPONIFICATION VALUE:

Weigh about 1-2gm of the sample into a saponification flask. Add 25ml of 0.5N alcoholic KOH solution in ethanol. Reflux the mixture for about 1hr. Cool and add 1-2 drops of phenolphthalein as an indicator and titrate excess KOH with 0.5HCl. Record the volumes of HCl used for the sample (a) and blank (b).

$$\textbf{Saponification value} = \frac{\mathbf{(b - a) \times 28.05}}{\mathbf{w}}$$

Where;

w = weight of the substance (gm)

b = volume of HCl used for blank (mL)

a = volume of HCl used for sample (mL)

11. PEROXIDE VALUE:

Weigh about 5gm of sample into a clean conical flask. Add 30ml of acetic acid- chloroform mixture (3:2) as a solvent. Add 1ml of saturated potassium iodide solution. Keep in dark for 5mins. Then add 30ml of water and titrate with 0.1N sodium thiosulfate using starch as an indicator. The endpoint is the disappearance of blue colour due to starch-iodine complex.

$$\textbf{Peroxide value (Pv)} = \frac{\mathbf{(S - B) \times N \times 1000}}{\mathbf{W}}$$

Where;

S = volume of sodium thiosulfate used for sample.

B = volume of sodium thiosulfate used for blank.

N = normality of sodium thiosulfate.

W = weight of sample (gm).

12. ANTIOXIDANT PROPERTY:

The DDPH assay is carried out by using different concentrations of the test solution and HPLC-grade methanol are combined with 80µl of DPPH solution to create the final volume 0f 240µl. The test samples are tested in the concentrations ranging from 320 to 10µg/ml, whereas the reference standards are tested in the concentrations ranging from 30 to 1.25µg/ml. for 15mins, the reaction mixture is incubated at 25°C. A semi-automated analyzer is then used to measure absorbance at 519nm. The test sample is not used in a control reaction.

VIII. RESULTS AND DISCUSSION

1. ORGANOLEPTIC EVALUATION:

The table shows the morphological assessment of cream. The resulting mixture is suitable for cosmetic application as it possesses the pleasant and palatable flavor. The texture and smoothness were also suitable for cosmetic formulations.

FIGURE 4. PHYSICAL APPEARANCE OF CREAM

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Formulation	Colour	Odour	Texture	Appearance
F1	White	Pleasant	Smooth, Homogeneous	Glossy, Opaque
F2	White	Pleasant	Smooth, Homogeneous	Glossy, Opaque

2. **HOMOGENEITY TEST:**
The extracts were distributed uniformly in the cream by all formulations. This was assessed by both touch and visual appearance. The appearance and touch of the cream was good.

3. **WASHABILITY TEST:**
A small amount of cream was applied to the slide and then washed with tap water to conduct the washability test. The observations are as follows.

Formulations (F)	Washability
F1	Easily washable
F2	Easily washable

4. **AFTER FEEL TEST:**
The cream was applied to assess whether it is greasy or not.

Formulations(F)	Results
F1	Non-greasy
F2	Greasy

5. **pH MEASUREMENT:**
The pH of the formulation was measured using digital pH meter. The cold cream formulation shows the pH range from 5.2-5.8.

Formulations (F)	pH			Average pH
	Trial 1	Trial 2	Trial 3	
F1	5.3	5.6	5.4	5.3
F2	5.3	5.5	5.6	5.5

6. **DYE TEST:**
This dye test verifies that every formulation was made as w/o type emulsion cream. When methylene blue, a water-soluble dye, was added to each of the formulations F1 and F2 separately and studied under a microscope. And it was discovered that all formulations displayed blue color in the dispersion phase, confirming the formulated cream is w/o type.

7. **SPREADABILITY TEST:**
The sample was placed between two glass slides, and after applying a weight of 50 grams to the slides for five minutes, the spreadability value for each formulation was determined using the formula. The formulation's spreadability values to be between 10-25 gm.cm/sec.

Formulation (F)	Spreadability (gm.cm/sec)			Average spreadability
	Trial 1	Trial 2	Trial 3	
F1	16.23	14.18	13.49	14.63
F2	15.77	16.89	14.61	15.75

8. **IRRITATION TEST:**
The cream was applied on the skin and observed for 24hours, as a result it shows no signs of irritation, redness, itching or swelling on the skin.

9. **ACID VALUE:**
The formulated cream's acid value was determined to be within the acceptable limits. The amount of milligrams of KOH needed to neutralize one gram of oil or fat is known as acid value. It shows how much free fatty acid is in the sample. If there are no fatty acids, the oil or fat is of high quantity; if there are no more fatty acids, the oil or fat has hydrolyzed and

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turned rancid. The table below shows the acid value results for every cream formulation. All cream shows the satisfactory values.

Formulation (F)	Acid Value(mg KOH/gm)
F1	1.23 mg KOH/ gm
F2	0.95 mg KOH/ gm

10. SAPONIFICATION VALUE:

The creams' saponification values were determined to be satisfactory. The amount of potassium hydroxide (KOH) or sodium hydroxide (NaOH) milligrams needed to saponify one gram of fat under the given circumstances is known as the saponification value. It is a measurement of the average molecular weight (or chain length) of all the triglycerides (fatty acids) in the sample. The mean molecular weight of triglycerides is lighter and the average length of fatty acids is shorter when the saponification value is higher and vice versa. The table below illustrates the saponification values for each cream formulation, all of which were satisfactory.

Formulation (F)	Saponification Value(KOH/gm)
F1	95.4 mg KOH/ gm
F2	98.2 mg KOH/ gm

11. PEROXIDE VALUE:

Peroxide value was determined to assess the extent of primary oxidation occurring in the oil phase of the formulation. A known quantity of the cream sample was accurately weighed and dissolved in a mixture of acetic acid and chloroform, which helps to completely release any oxidized components present in the sample. To this mixture, saturated potassium iodide solution was added, which reacts with the peroxides to liberate iodine. The flask was then kept in the dark for a few minutes to allow complete reaction. The liberated iodine was titrated with standard sodium thiosulphate solution using starch as an indicator, and the endpoint was observed when the blue colour disappeared. A blank determination was performed simultaneously under the same conditions. The peroxide value was calculated based on the difference between the sample and blank titration readings, and the results of the peroxide value for all formulations are presented in the table below.

Formulation (F)	Peroxide value (meq O_2 / kg)
F1	0.9 meq O_2 / kg
F2	1.4 meq O_2 / kg

12. DPPH RADICAL SCAVENGING ASSAY:

- Oxidative stress results from the production of reactive oxygen species (ROS) in excess of the biological system's antioxidant capability.
- Numerous human disorders, including atherosclerosis, diabetes mellitus, hypertension, inflammation, cancer and AIDS, have been associated to free radical oxidative stress.
- A class of compounds known as antioxidant considerably inhibits or delays oxidative processes when present in low quantities relative to oxidisable substrates, even though they are frequently oxidized themselves.
- Through several processes, such as electron donation (as reducing agents), metal ion chelation (thereby eliminating potential free radicals) and antioxidant sparing (co-antioxidants), antioxidants can impact biological systems.
- Antioxidants have the capacity to absorb free radicals, decrease them and stabilize them. They additionally reduce the impact of free radicals.
- The DPPH scavenging assay is a low-cost, uncomplicated chemical experiment that may be used for evaluating any compound's ability to neutralize free radicals.

PRINCIPLE:

- ✓ DPPH or 1,1-diphenyl-2-picryl hydrazyl is a purple, stable free radical. DPPH is reduced by antioxidants to 1,1-diphenyl-2-picryl hydrazine a colourless molecule with an absorbance of 517 nm.
- ✓ 1, 1 diphenyl-2-picryl hydrazyl 1,1-diphenyl-2-picryl hydrazine is a colorless substance with an absorbance of 517 nm

REAGENTS:

- ✓ DPPH (EEC No.217-591-8, Sigma, USA) should be kept below freezing.
- ✓ Ranbaxy Chemical's HPLC-grade methanol.
- ✓ Ascorbic acid is the inhibitor (reference standard).
- ✓ Developing practical solutions:
- ✓ 32 mg/ml stock DPPH: 1 milligram diluted in 6 ml 0f methanol suitable for HPLC.

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PROCEDURE:

- The DPPH assay is performed using the following procedure.
- To summarize it briefly, 80 milliliters of DPPH solution, a range of test solution concentrations, and enough HPLC –grade methanol to fill 240 milliliters.
- 30-1.25 µg/ml are the various concentrations tested for the reference standard.320-10 µg/ml is the range of values evaluated for test samples.
- After mixing the reaction mixture, it is incubated for 15 minutes at 25°C.
- A semi-auto analyzer is used to detect the absorbance at 517nm. The test sample is not used in a control reaction.

CALCULATIONS:

Calculating percentage growth inhibition:

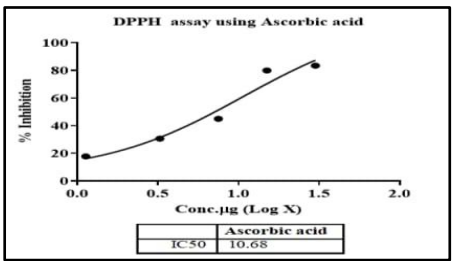
$$\%\ \boldsymbol{Inhibition} = \frac{(\boldsymbol{OD\ of\ control} - \boldsymbol{OD\ of\ sample}) \times \mathbf{100}}{\boldsymbol{OD\ of\ control}}$$

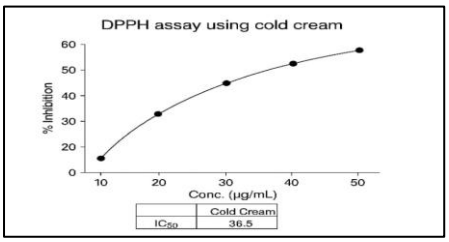
IX. RESULT:

Comparison b/w ascorbic acid and cold cream

Sample	Conc Mm	OD@517nm	% Inhibition	IC_{50}
Ascorbic acid	Control	0.827	0.00	**10.68**
	1.125	0.680	17.78	
	3.25	0.574	30.59	
	7.5	0.455	44.98	
	15	0.166	79.93	
	30	0.137	83.43	

Sample	Conc (µg/ml)	0D@519nm	% Inhibition	IC_{50}
Cold cream	Control	0.980	0.00	**36.5**
	10	0.842	14.08	
	20	0.732	25.30	
	30	0.598	38.98	
	40	0.512	47.75	
	50	0.458	53.26	





chebula exhibits a good antioxidant potential using the DPPH assay. The percentage inhibition increased steadily with increasing concentration which indicates that a dose-dependent free radical scavenging activity. The formulation showed an IC_{50} value of 36.5µgm/mL, confirming its effective antioxidant capacity. This antioxidant activity supports the cream's role in protecting the skin from oxidative stress, thereby contributing to its anti-aging potential. Since free radicals accelerate skin aging, the observed antioxidant activity suggests that the formulation may help reduce cellular damage, protect collagen, and delay signs of ageing such as wrinkles, fine lines and dullness. Overall the cream exhibits promising anti-aging properties suitable for regular skin care to protect the skin from oxidative and environmental damage.

Conclusion for Anti-aging activity:

The cold cream formulated with Terminalia

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X. CONCLUSION

In this research, the formulation and evaluation of Terminalia chebula anti-aging cold cream was carried out successfully. The study emphasized the significance of incorporating Terminalia chebula (kadukkai/haritaki) extract, a natural ingredient well-known for its rich antioxidant content, anti-inflammatory properties, and traditional skin-rejuvenating benefits. Through systematic evaluation, including pH determination, spreadability, stability testing, acid value, peroxide value, and antioxidant assessment (DPPH method), the formulated cold cream demonstrated describe results suitable for topical application.

The incorporation of Terminalia extract, highly regarded for its potent free-radical scavenging properties, contributed significantly to the anti-ageing potential of the cream. The antioxidant activity of the extract, supported by a low IC_{50} value, indicates strong efficacy in reducing oxidative stress- one of the major causes of skin aging. The prepared cold cream exhibited essential characteristics such as smooth texture, good homogeneity, adequate spreadability, suitable pH, and acceptable physiochemical stability, making it appropriate for various types.

This investigation highlights the potential of Terminalia chebula as a natural, safe, and effective ingredient in cosmetic formulations aimed at reducing signs of aging. The results support the growing preference for herbal cosmetics and demonstrate how traditional botanical knowledge can be harmoniously combined with modern formulation science. Overall, the development of this Terminalia chebula anti-aging cold cream represents a promising step toward creating affordable, natural skincare products with scientifically supported benefits.

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