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DEVELOPMENT AND EVALUATION OF HERBAL UNDER-EYE PATCH INCORPORATING *SYZYGIUM CUMINI*

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Abstract:

The present study aimed to develop and evaluate herbal under-eye patches incorporating Syzygium cumini seed powder, which is rich in antioxidant compounds such as phenolics, flavonoids and tannins. Three formulations (F_1, F_2 and F_3) were prepared by the solvent casting method using agar agar and gelatin. They were evaluated for organoleptic properties, homogeneity, pH, irritancy, folding endurance and stability. Among them, F_2 showed comparatively better properties, including good homogeneity, smooth and flexible texture, acceptable pH (5.79) and satisfactory stability. Hence, F_2 was selected for antioxidant evaluation. Antioxidant activity was assessed using the H_2O_2 scavenging assay, with ascorbic acid as the standard. The extract showed concentration-dependent activity, increasing from 20.96% to 60.98%, with an IC_{50} value of approximately 36 µg/ml, compared to 45.09 µg/ml for ascorbic acid. The study concludes that Syzygium cumini seed powder can be successfully incorporated into under-eye patches, and F_2 exhibited comparatively better formulation properties and promising in-vitro antioxidant activity.

Key words: *Syzygium cumini, Herbal cosmetics, Under-eye patch, Antioxidant activity, H_2O_2 scavenging assay, IC_{50}.*

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INTRODUCTION:

Cosmetics are articles intended to be rubbed, poured, sprinkled, sprayed on, introduced into, or otherwise applied to the human body or any part there of for cleansing, beautifying, promoting attractiveness, or altering the appearance, without affecting the structure or function of the body. In 1938, cosmetics were introduced into the Federal Food, Drug and Cosmetic Act (FD&C Act or "the Act"), and along with food and drugs were also now under the authority of the Food and Drug Administration (FDA).[1]

The term 'cosmetic' originates from the Greek word 'Kosm tikos', defined as 'capable of arrangement, skilled in decoration', giving 'kosmein' to decoration, and 'kosmos' to order, harmony. In general, cosmetics are used to directly treat the external surfaces of the human body to fulfill four functions: to maintain good condition; to modify appearance; to protect; and to correct body odour. A more appropriate classification is as follows:cosmetics for personal cleansing (shampoos, deodorants, soaps); cosmetics for skin and hair care (toothpaste, topical care products); cosmetics for embellishment (lip colours, perfumes); protective cosmetics (sunscreen and anti-wrinkle products); corrective cosmetics (hair dyes, face masks); maintenance cosmetics (moisturizers, shaving creams); and active cosmetics (antiseptics, fluoride toothpaste).[2]

Today, cosmetics are widely used by people of different ages and genders. The industry has expanded beyond traditional makeup to include skincare, haircare, fragrances, and personal-care products. The global beauty industry is also increasingly connected with wellness, technology, and personalized consumer experiences.[3]



Figure 1: Cosmetics

HERBAL COSMETICS



Figure 2: Herbal cosmetics

Generally herbal cosmetics are also referred to as natural cosmetics. Herbal cosmetics are formulated, using different cosmetic ingredients to form the base in which one or more herbal ingredients are used to cure various skin ailments. Herbal Cosmetics, referred as Products, are formulated, using various permissible cosmetic ingredients to form the base in which one or more herbal ingredients are used to provide defined cosmetic benefits only, shall be called as "Herbal Cosmetics".

Plants are highly used for development of new drug products for cosmaceuticals and pharmaceutical applications. Herbs do not produce instant cures. They offer a way to put the body in proper tune with nature. The demand of herbal medicines is increasing rapidly due to their skin friendliness and lack of side effects.

The best thing of the herbal cosmetics is that it is purely made by the herbs and shrubs and thus is side-effects free. The natural content in the herbs does not have any side effects on the human body; instead provide the body with nutrients and other useful minerals.

Herbal cosmetics are the modern trend in the field of beauty and fashion. These agents are gaining popularity as nowadays most women prefer natural products over chemicals for their personal care to enhance their beauty as these products supply the body with nutrients and enhance health and provide satisfaction as these are free from synthetic chemicals and have relatively less side-effects compared to the synthetic cosmetics.

Instead of traditional synthetic products different plant parts and plant extracts are used in these products, e.g. aloe-vera gel and coconut oil. They also consist of natural nutrients like Vitamin E that keeps skin healthy, glowing and beautiful. For example, Aloevera is a herbal plant species belonging to Liliaceae family and is naturally and easily available.[4]

UNDER - EYE PATCH



Figure 3: Under eye patch

Under-eye patches are topical cosmetic preparations designed to be placed on the periocular skin beneath the eyes for a specified period. They are usually formulated as hydrogel, fabric, polymer, or other patch-like systems containing moisturizing, soothing, or other cosmetic ingredients.

The patch provides close contact between the formulation and the skin and can act as an occlusive or semi-occlusive delivery system, helping maintain moisture at the skin surface, antioxidant action, hydration and soothing action. Research has conducted under-eye patches containing ingredients such as hyaluronic acid, caffeine, peptides, and vitamins for improving the appearance and hydration of periorbital skin.[5]

Characteristics of Under-Eye Patches

Under-eye patches generally have the following characteristics:

- **Thin and flexible:** They are designed to fit the curved area beneath the eyes.
- **Close skin contact:** The material adheres closely to the periocular skin to maintain contact with the formulation.
- **Hydrogel or polymeric structure:** Many patches use water-rich hydrogel materials or polymer matrices.
- **Moisture-retaining:** Hydrogel systems can provide hydration and maintain a moist environment at the application site
- **Contain active cosmetic ingredients:** Formulations may contain hyaluronic acid, caffeine, peptides, vitamin derivatives, antioxidants, or botanical ingredients.
- **Cooling and soothing effect:** Water-rich patches can provide a temporary cooling sensation when applied to the skin.
- **Short application time:** They are generally designed for temporary application rather than continuous wear.
- **Convenient application:** They can be applied without requiring a separate cream or extensive procedure.
- **Designed for sensitive periocular skin:** The area around the eye is particularly delicate and susceptible to environmental damage, so formulations need appropriate tolerability.[6]

SYZYGIUM CUMINI



Figure 4: *Syzygium cumini*

Syzygium cumini (L.) Skeels, commonly known as Jamun, Jambul, Java plum or Indian blackberry, belongs to the family Myrtaceae. It is widely distributed in South Asia and has a long history of use in traditional medicine. Different parts of the plant, including fruits, seeds, leaves, stem bark, flowers and roots, are used for medicinal purposes. The plant contains a wide variety of bioactive phytoconstituents, including flavonoids, phenolic compounds, tannins, alkaloids, anthocyanins, terpenoids, fatty acids, vitamins and minerals. These compounds are associated with several biological activities, particularly antioxidant and antidiabetic activities, along with anti-inflammatory, antimicrobial, anticancer, radioprotective and other pharmacological effects.[7]

The seeds of *Syzygium cumini* contain several important phytoconstituents like alkaloids, jambosine and glycosides such as jambolin/antimellin. The seeds are also reported to be rich in flavonoids and phenolic compounds. Flavonoids are important because they possess free-radical-scavenging and antioxidant properties. The review also reports that seed extracts contain significant amounts of total phenolics and demonstrate antioxidant activity. Therefore, the presence of phenolic and flavonoid constituents provides a scientific basis for investigating *S. cumini* seed as a natural source of antioxidant compounds.[8]

Antioxidants help protect biological systems by scavenging free radicals and reducing oxidative damage. The antioxidant potential of *S. cumini* has been investigated using different in-vitro methods.[9]

Thus, the antioxidant property of *S. cumini* can be linked mainly to its phenolic compounds, flavonoids, tannins and other phytoconstituents. For a herbal cosmetic formulation, this antioxidant potential is particularly relevant because oxidative stress can contribute to cellular damage and visible signs associated with skin ageing.[10]

S. cumini, including antidiabetic, antioxidant, anti-inflammatory, anticancer, radioprotective, cardioprotective, gastroprotective, antidiarrheal and antimicrobial activities.[11]

AIM AND OBJECTIVES

AIM

To prepare herbal eye patch using *Syzygium cumini* seed powder and evaluate it.

OBJECTIVES

- Collection of raw materials for the preparation of eye patch.
- Preparation of eye patch using *Syzygium cumini*.
- Evaluation of formulated eye patch.

MATERIALS REQUIRED

CHEMICALS REQUIRED

- *Syzygium cumini* seed powder
- Agar agar
- Gelatin
- Glycerin
- Aloe vera gel
- Methylparaben
- Rose water
- Distilled water

LABORATORY GLASSWARES REQUIRED

- Petridish
- Chinadish
- Glassrod
- Measuring cylinder
- Thermometer
- Beaker

Syzygium cumini seed powder

Syzygium cumini (jamun) is a medicinal plant rich in flavonoids, tannins, phenolic compounds, and antioxidants, is the main ingredient in this preparation. Its extract may help provide antioxidant and soothing effects when incorporated into an eye patch formulation. These properties may support protection against oxidative stress around the delicate eye area.



Figure 5: *Syzygium cumini* seed powder

Agar agar

- Agar is obtained from certain species of red algae (Rhodophyceae), mainly belonging to the genera *Gelidium* and *Gracilaria*.
- It acts as a natural gelling agent and provides structural strength to the hydrogel patches.

Gelatin

- Gelatin is obtained by partial hydrolysis of collagen derived from the skin, bones, and connective tissues of animals, mainly cattle and pigs.
- It improves the flexibility, elasticity, and film-forming properties of the hydrogel patches.

Glycerin

- Glycerin is mainly obtained as a byproduct of the saponification or hydrolysis of vegetable and animal fats and oils.
- Used as a humectant to retain moisture and prevent drying of the patches.

Aloe vera gel

- Aloe vera gel is obtained from the fresh leaves of *Aloe barbadensis* Mill.
- It is to provide soothing, moisturizing, and skin-healing properties.

Methylparaben

- Methylparaben is a synthetic preservative prepared by esterification of p-hydroxybenzoic acid (Para hydroxybenzoic acid) with methanol.
- It was incorporated as a preservative to prevent microbial contamination and enhance stability of the formulation.

Rose water

- Rose water is obtained by steam distillation of fresh petals of *Rosa damascena* Mill.
- It was added to provide a refreshing effect and pleasant fragrance.

METHOD OF PREPARATION

A. PREPARATION OF *syzygium cumini* SEED POWDER

Step 1: Collection

Collect fresh, mature *Syzygium cumini* (jamun) fruits and separate the seeds from the pulp.

Step 2: Washing

Wash the seeds thoroughly with clean water to remove adhering pulp and impurities.

Step 3: Drying

Spread the seeds in a clean tray and dry them in shade or in a hot-air oven at a controlled temperature until completely dry.

Step 4: Removal of outer covering

Remove the dried outer seed coat and retain the inner seed material.

Step 5: Grinding

Grind the dried seeds using a suitable grinder or pulveriser to obtain fine powder.

Step 6: Sieving

Pass the powder through sieve 100 to obtain a uniform particle size.

Step 7: Storage

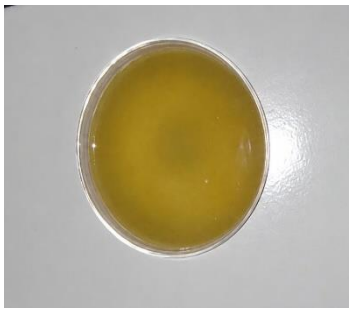
Store the prepared seed powder in a clean, dry, airtight container, protected from moisture and direct sunlight.

B. METHOD OF PREPARATION OF EYEPATCH

- The herbal eye patches containing *Syzygium cumini* seed powder were prepared by the solvent casting method using Agar agar and Gelatin as natural gelling and film-forming agents.
- Initially, the required quantity of agar agar was accurately weighed and dispersed in a sufficient quantity of distilled water.
- The mixture was heated at 80–90°C with continuous stirring until a clear and homogeneous solution was obtained.
- Separately, gelatin was dissolved in warm distilled water maintained at 50–60°C.
- The solution was stirred continuously to obtain a smooth transparent solution.
- The gelatin solution was then added slowly into the agar agar solution with continuous stirring to prepare a uniform hydrogel base.
- After complete mixing, glycerin and aloe vera gel was incorporated into the formulation.
- The prepared mixture was allowed to cool below 40°C to prevent degradation of the active phytoconstituents.
- Subsequently, the previously prepared *Syzygium cumini* seed powder were added slowly with gentle stirring to ensure uniform distribution throughout the mixture.
- Rose water and methyl paraben added to the formulation.
- A total of three formulation (F_1, F_2, F_3) were prepared by varying the proportion of *Syzygium cumini* seed powder.
- The final homogeneous mixture was poured carefully into clean petri plates and spread uniformly to obtain patches of desired thickness.
- Then kept at room temperature and dried in a hot air oven at 40°C for approximately 2 hours until flexible hydrogel sheets were formed.
- After complete drying, the sheets were removed carefully and cut into crescent-shaped under eye patches using a template.
- The prepared patches were packed in airtight containers and stored in a cool and dry place for further evaluation studies.[12]







Mixture

Poured to Petriplate

Eye patch

Figure 6: Preparation of Eyepatch

ROLE OF INGREDIENTS

INGREDIENTS	ROLE
Syzygium cumini seed powder	Antioxidant effect
Agar agar	Natural gelling agent
Gelatin	Flexibility and elasticity
Glycerin	Humectant
Aloe vera gel	Moisturing and skin-healing properties
Methylparaben	Preservative
Rose water	Pleasant fragrance

Table 1: Role of Ingredients

FORMULATION

SL.NO:	INGREDIENTS	QUANTITY		
		F_1	**F_2**	**F_3**
1	*Syzygium cumini* seed powder	1g	2g	3g
2	Agar agar	0.75g	0.75g	0.75g
3	Gelatin	1.8g	1.8g	1.8g
4	Glycerin	1.2ml	1.2ml	1.2ml
5	Aloe vera gel	1.2g	1.2g	1.2g
6	Methylparaben	0.06g	0.06g	0.06g
7	Rose water	3ml	3ml	3ml
8	Distilled water	30ml	30ml	30ml

Table 2: Formulation

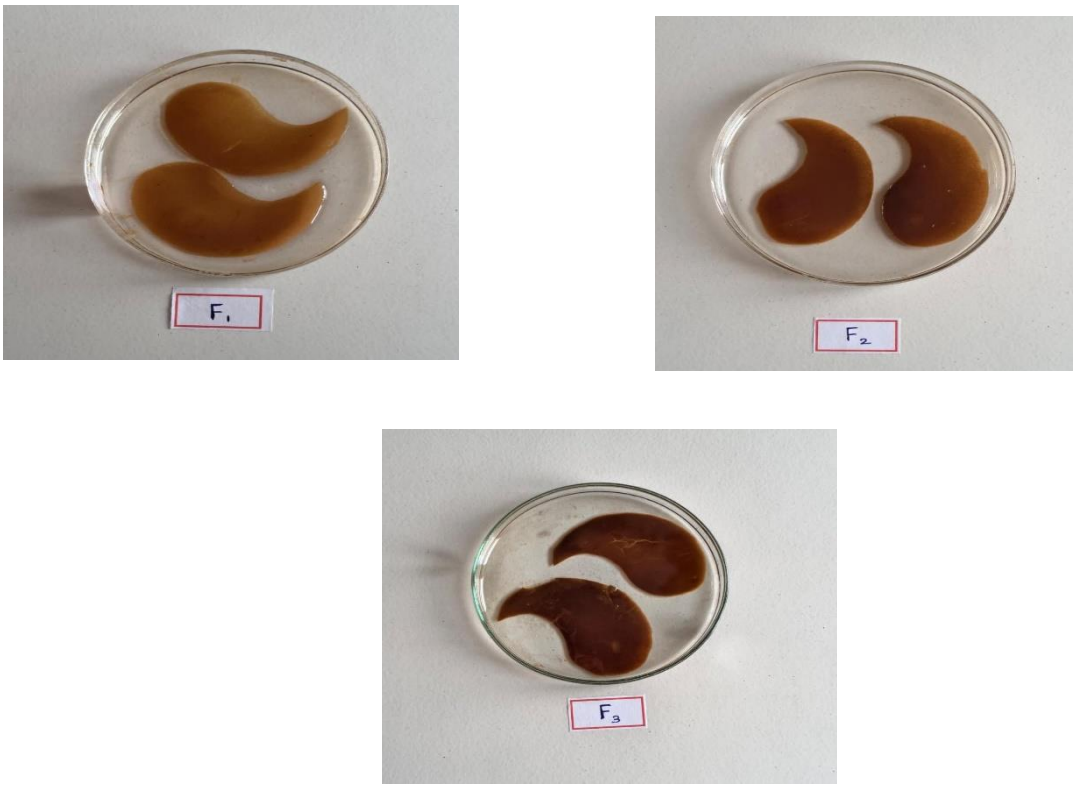


Figure 7: Three formulations of Eye patch

EVALUATION TEST FOR UNDER-EYE PATCH

The prepared *Syzygium cumini* eye patches were subjected to following evaluation methods:

1. **ORGANOLEPTIC PROPERTIES**

The organoleptic properties such as colour, odour and texture of the prepared eye patches were noticed by visual and sensory inspection.

2. HOMOGENEITY

The homogeneity test for an eye patch is to evaluate the homogeneity, samples are taken from different parts of the patch, such as the centre, edges, and examined for uniform colour and texture.[13]

3. pH OF THE EYE PATCH

1 g of the prepared eye patch was dispersed in 10 mL of distilled water and allowed to swell completely with continuous stirring to obtain a uniform dispersion. The pH of the formulation was measured using a calibrated digital pH meter at room temperature. The observed pH was found to be within the acceptable range (4.5-6.5) indicating good skin compatibility and suitability of the formulation for ophthalmic cosmetic use.

4. IRRITANCY TEST,

The prepared eye patch is placed on skin for 1 hour and observed for redness, swelling and itching. The formulation has no visible irritation on applied area, indicating the prepared formulation is suitable for topical application around the eyes.

5. FOLDING ENDURANCE

A prepared herbal hydrogel eye patch was repeatedly folded at the same position until it showed visible cracks or broke. The number of folds required to break the patch was recorded as the folding endurance value. The formulation exhibited good flexibility and elasticity without cracking, indicating suitable mechanical strength and durability of the eye patch formulation.[12]

6. STABILITY STUDY

The fine formulation was stored for one month at room temperature. Following this, the resulting product was examined visually for appearance and judged for both chemical (pH) and physical (colour, odour, and texture) stability.[14]

7. ANTIOXIDANT ACTIVITY - H_2O_2 Scavenging Assay

Antioxidant activity of extract was evaluated by using H_2O_2 method. 0.1ml of sample added with 3.4 ml of 0.1 M phosphate buffer and 0.6 ml of 40 mM H_2O_2. This mixture was incubated 10 minutes at room temperature. After incubation, absorbance was note down at λ_{max} 230 nm against blank solution. Ascorbic acid was used as standard.[15]

The percentage scavenging of H_2O_2 was calculated using the equation. A_0

% Scavenging of $H_2O_2 = \frac{A_0 - A_1}{} \times 100$

RESULT AND DISCUSSION:

1. ORGANOLEPTIC EVALUATION

PARAMETER	F_1	F_2	F_3
Colour	Coffee Brown	Light Brown	Dark Brown
Odour	Pleasant	Pleasant	Pleasant
Texture	Gel like, smooth and sticky	Gel like, smooth and flexible	Gel like, smooth and brittle

Table 3: Organoleptic evaluation

2. HOMOGENEITY

PARAMETER	F_1	F_2	F_3
Homogeneity	Poor	Good	Moderate

Table 4: Homogeneity

3. pH OF THE EYE PATCH

PARAMETER	F_1	F_2	F_3
pH	5.74	5.79	5.86

Table 5: pH







F_1 F_2 F_3

Figure 8: pH

4. IRRITANCY TEST

PARAMETER	F_1	F_2	F_3
Irritancy	Nil	Nil	Nil

Table 6: Irritancy test

5. FOLDING ENDURANCE

PARAMETER	F_1	F_2	F_3
Folding endurance	No visible cracks	No visible cracks	Cracks are formed

Table 7: Folding endurance

6. STABILITY STUDY

The F_2 was selected for the stability study as it showed good homogeneity and organoleptic properties.

PARAMETER	F_2
Colour	No Change
Odour	No Change
Texture	No Change
pH	No Change

Table 8: Stability

7. ANTIOXIDANT TEST - H_2O_2 Scavenging Assay

F_2 was identified as the best formulation based on its comparatively better physicochemical properties, flexibility, homogeneity and stability. So, the antioxidant activity of the prepared extract of F_2 was evaluated by the hydrogen peroxide (H_2O_2) scavenging assay. The percentage of hydrogen peroxide scavenging activity was determined at different concentrations ranging from 10 to 50 µg/ml.

The results showed a concentration-dependent increase in antioxidant activity. The percentage scavenging activity increased from 20.96% at 10 µg/ml to 60.98% at 50 µg/ml. This indicates that the extract exhibited an increasing ability to scavenge hydrogen peroxide with increasing concentration.

The IC_{50} value of the extract was calculated from the linear regression equation and was found to be approximately 36µg/ml. The IC_{50} value represents the concentration required to scavenge 50% of hydrogen peroxide radicals under the experimental conditions.

The observed antioxidant activity may be attributed to the presence of phytochemical constituents such as phenolic compounds and flavonoids, which may contribute to the free radical scavenging potential of the extract.

Overall, the findings suggest that the extract possesses hydrogen peroxide scavenging activity and exhibits concentration-dependent antioxidant potential.

Ascorbic acid was used as a standard antioxidant to evaluate hydrogen peroxide scavenging activity. The IC_{50} value of ascorbic acid was found to be 45.09µg/ml.

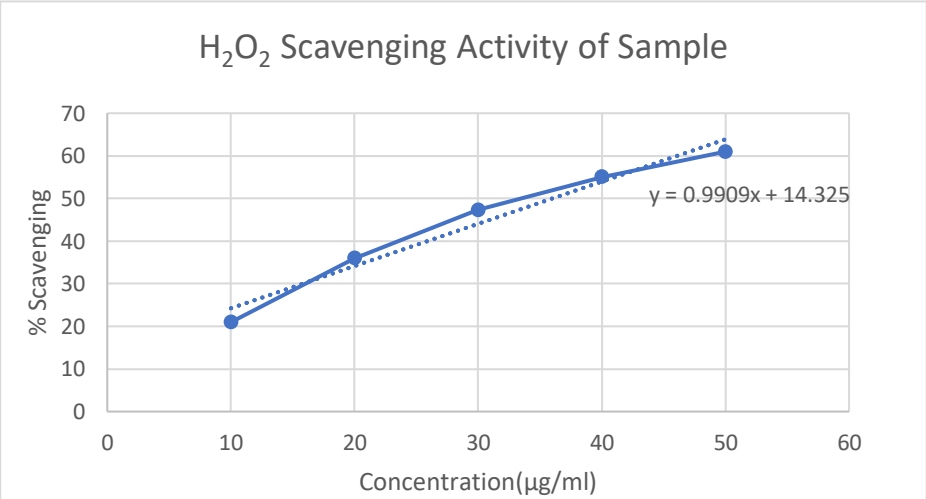


Figure 9: H_2O_2 Scavenging Activity of Sample

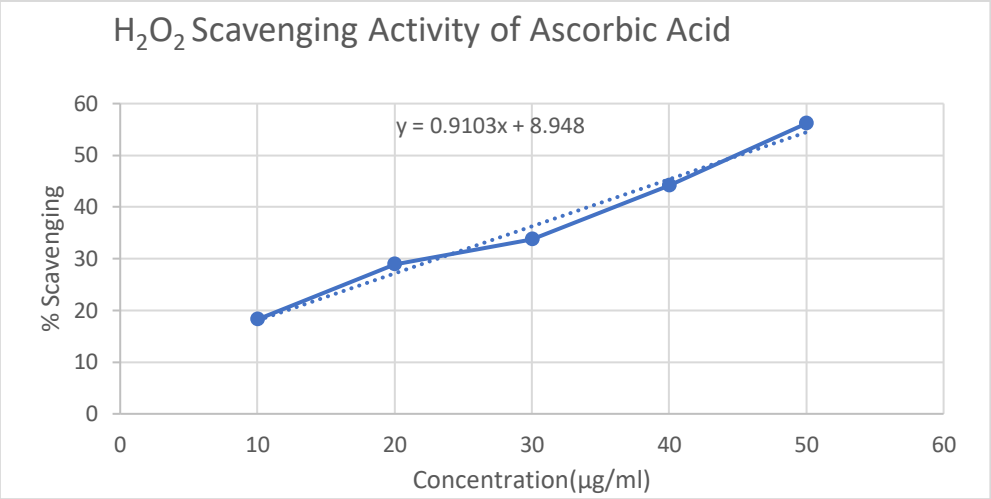


Figure 10: H_2O_2 Scavenging Activity of Ascorbic Acid as Standard

CONCLUSION:

The present study successfully developed and evaluated herbal under-eye patches incorporating *Syzygium cumini* seed powder using the solvent casting method. Three different formulations (F_1, F_2 and F_3) were prepared and subjected to various evaluation tests.

Based on the evaluation results, F_1 showed poor homogeneity, a smooth and sticky texture, and a pH of 5.74. In comparison, F_2 exhibited good homogeneity, a smooth and flexible texture, and a pH of 5.79. Both formulations showed no visible irritation and no cracks during the folding endurance test, whereas F_3 exhibited brittleness, cracking and breakage during evaluation. F_2 was identified as the comparatively best formulation due to its better physicochemical properties and was selected for further antioxidant activity evaluation.

The antioxidant activity was assessed using the hydrogen peroxide (H_2O_2) scavenging assay. The results showed a concentration-dependent increase in percentage scavenging activity, reaching 60.98% at 50 µg/ml. The IC_{50} value of the extract was found to be approximately 36 µg/ml, indicating its hydrogen peroxide scavenging potential.

Overall, the study suggests that *Syzygium cumini* seed powder is a promising herbal ingredient for the development of antioxidant under-eye patches. The selected F_2 formulation demonstrated comparatively better formulation characteristics along with promising in-vitro antioxidant activity.

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