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FORMULATION AND EVALUATION OF ANTIPERSPIRANT ROLL-ON USING MORINGA OLEIFERA

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ABSTRACT

Hyperhidrosis is a condition characterized by excessive sweating that affects human beings. Antiperspirants are the first-line treatments for hyperhidrosis. Antiperspirants help reduce excessive sweating. This study was conducted to to investigate home remedies to overcome body odor, and to develop and evaluate herbal antiperspirant. When an antiperspirant is applied to the skin surface, its Active ingredients i.e., aluminium chlorohydrate gets dissolved in the sweat or moisture present on the skin surface of armpit, the dissolved substance forms a gel creates a small temporary 'plug' near the top of the sweat gland, which considerably reduces the amount of sweat producing from the skin surface. In this study the formulated Antiperspirant roll-on of F1-F4 incorporates active ingredients, such as Aluminium chlorohydrate including chemical with Bees wax, Stearic acid, Liquid Paraffin, Span 20, Tween 80, Glycerol disodium EDTA, Sodium benzoate and orange oil utilized as the excipients. The formulated Antiperspirant roll-on was analysed for its various evaluation test. Among the overall formulation of F1-F4 prepared, F4 formulation was chosen as optimum formulation as it shows good antibacterial activity while performing antibacterial activity by agar well diffusion method using gram negative bacteria Escherichia coli on nutrient agar medium incubated for 24hrs against standard gentamycin. The result confirms that the Antiperspirant roll-on using Moringa oleifera possessed desirable antibacterial activity making it suitable for application.

KEYWORDS: Hyperhidrosis, Antiperspirant Roll-on, Moringa oleifera, Aluminium Chlorohydrate, Antibacterial Activity, Herbal Formulation.

INTRODUCTION

Antiperspirant is more than just a personal care product—it's a scientifically engineered solution to one of the body's most basic and challenging processes: perspiration. Unlike deodorants that simply mask odour, antiperspirants work at the source— temporarily blocking sweat glands using aluminium-based compounds to significantly reduce the amount of sweat released.

The use of Moringa oliefera in an antiperspirant roll-on formulation offers dual benefits: its antimicrobial action can help reduce odour-causing bacteria, while its antioxidant and soothing properties may improve skin health and reduce irritation commonly associated with sweating.

Aluminium Chlorohydrate (ACH) is a widely used aluminium-based compound primarily found in antiperspirants and deodorants. ACH is favoured in cosmetic formulations due to its excellent [1] Department of Pharmaceutics Karavali College of Pharmacy, Mangalore Chapter[1] Introduction solubility, chemical stability, and high efficacy in reducing perspiration. When applied to the skin, particularly in the underarm area, it forms a gel-like plug within the sweat ducts by reacting with moisture and electrolytes in the sweat. This plug temporarily blocks the release of sweat to the skin surface, effectively reducing wetness. When an antiperspirant is applied to the skin surface, its antiperspirant Active ingredients i.e., generally aluminium salts gets dissolved in the sweat or moisture present on the skin surface of armpit, the dissolved substance forms a gel creates a small temporary 'plug' near the top of the sweat gland, which considerably reduces the amount of sweat producing from the skin surface. Roll ons are the most versatile and the most popular form of antiperspirant. In the market, a wide variety of roll ons is available which differ in their formulation base. The most commonly used vehicles are water, alcohol, hydro alcoholic systems, esters and silicon. Roll on is a highly accepted form of

antiperspirant due to their long history of application, and high efficacy.

The aim of the study was to formulate and evaluate a cosmetic antiperspirant product by incorporating Moringa oleifera extract, a natural bioactive ingredient with antibacterial property, along with Aluminium Chlorohydrate, a well-established synthetic antiperspirant agent. The study focuses on developing a stable, effective, and cosmetically acceptable formulation that can provide sweat control, odour protection, and skin health benefits, suitable for regular topical application in the underarm region. This project aims to bridge the gap between herbal cosmetic science and pharmaceutical formulation by combining the natural healing benefits of Moringa with the clinically effective antiperspirant action of Aluminium Chlorohydrate. The final product is expected to provide a safer alternative to purely synthetic deodorants and antiperspirants, aligning with the growing demand for herbo-synthetic cosmeceuticals in the modern pharmaceutical and cosmetic industry.

II. MATERIALS AND PREPARATION METHODS

2.1. Materials

Aluminium chlorohydrate SRL chem Pvt. Ltd. Mumbai. Moringa oleifera Srinavya lab. Bees wax and stearic acid Molychem, mumba. Liquid paraffin and Orange oil Nice Pvt. Ltd. Ernakulam, Kerala. Span -20 Isochem, Tamil nadu. Tween -80 Medilise, Puzhathi, Kerala. Glycerol and Disodium EDTA Kanton lab. Puzhathi, Kerala. Sodium benzoate Medilise, Puzhathi, Kerala.

2.2. Preparation of Moringa extract

5g of moringa powder is taken in a 100ml beaker to which 50ml of methanol is added and stirred. The beaker was covered with filter paper and then it is kept for maceration for 24hrs. And then subjected for filteration process through filter paper, filterate is collected.

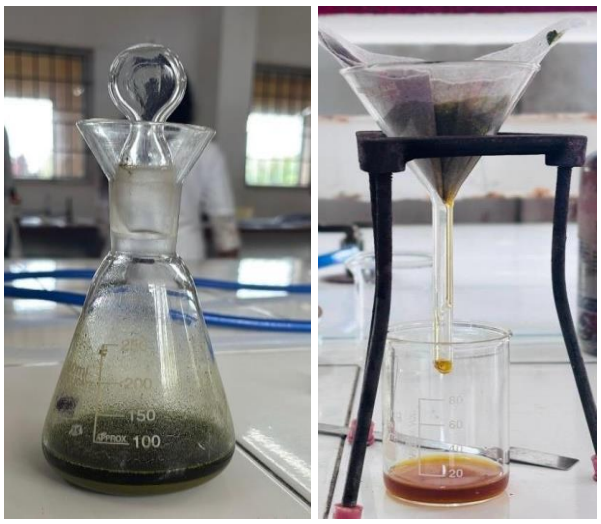

Fig. 1: Maceration and filteration of *moringa oleifera.*

2.3. Preparation of Antiperspirant roll-on formulation

Antiperspirant roll-on is o/w emulsion based preparation containing oil phase and aqueous phase.

2.4. Preparation of oil phase

The oil phase(Beeswax, stearic acid, liquid paraffin, tween80, span20) was mixed together by melting in a china dish on constant stirring upto 75^{o}C.

Fig. 2: Preparation of oil phase.

2.5. Preparation of aqueous phase

The aqueous phase(ACH, moringa extract, glycerol, disodium EDTA)were mixed together in a beaker and warmed to about same temperature(75^{0}C)as that of oil phase.

Fig. 3: Preparation of aqueous phase.

2.6. Development of Antiperspirant roll-on

Aqueous phase was added to oil phase drop by drop on constant stirring. Perfume (orange oil) was in corporate when the formulation begins to form desired consistency. The preservative sodium benzoate was added after cooling and stirred till the formulation acquires desired consistency.

Table 1: Composition of roll-on development.

INGREDIENTS	WORKINGFORMULA(W/F)			
	F1	F2	F3	F4
Aluminium chlorohydrate	1.25g	1.5g	1.75g	2g
Moringa extract	0.5ml	1ml	1.5ml	2ml
Beeswax	0.8g	0.8g	0.8g	0.8g
Stearic acid	0.6g	0.6g	0.6g	0.6g
Liquid paraffin	3ml	3ml	3ml	3ml
Span20	0.5ml	0.5ml	0.5ml	0.5ml
Tween 80	0.5ml	0.5ml	0.5ml	0.5ml
Glycerol	3ml	3ml	3ml	3ml
Disodium EDTA	0.05g	0.05g	0.05g	0.05g
Sodium benzoate	0.1g	0.1g	0.1g	0.1g
Orange oil	q.s	q.s	q.s	q.s

Fig. 3: Development of antiperspirant roll-on.

III. PHYTOCHEMICAL SCREENING

3.1. Test for Alkaloids: Hager's test: Few drops of hager's reagent is added to the 2ml of moringa extract. The formation of Bright yellow precipitate formation indicated the existence of alkaloids.

3.2. Test for Flavanoid: Alkaline reagent test: 2ml of NaOH is added to the moringa extract. The formation of intense yellow colour indicates the presence of flavonoids which turns to colourless after the addition of Dil. HCl.

3.3. Test for Phenol: FeCl3 test: A few drops of FeCl3 is added to the 2ml moringa extract. The formation of green colour indicates the presence of phenol.

3.4. Test for Saponin: Froth test: Adding a small amount of a moringa extract to water in a test tube and shaking it vigorously. The appearance of froth at the top indicates the presence of saponin.

3.5. Test for Tannin: Gelatin test: adding few ml of moringa extract to a 1% gelatin solution containing 10% sodium chloride. The formation of white precipitate indicates presence of gelatin.

3.6. Test for steroids: Salkwoski test: A few ml of chloroform extract of moringa and few ml of concentrated sulfuric acid is added along the sides of test tube. The formation of reddish brown at the junction of two layer.

Libermann-burchard test: A few drops of acetic anhydride and concentrated sulphuric acid to the chloroform extract of moringa extract. The formation of blue green indicates the presence of steroids.

3.7.Test for carbohydrates: Molisch's test: A few drops of Molisch reagent is added to moringa extract and then few ml of concentrated sulfuric acid added along the sides of the tube. The and then few ml of concentrated sulfuric acid added along the sides of the tube. Formation of violet ring at the junction of two layer indicates the presence of carbohydrate.

IV. EVALUATION PARAMETERS

4.1. Organoleptic Characteristics

Drug loaded formulations were tested for physical appearance, colour, odour, texture, consistency and homogeneity. These characteristics were evaluated by visual observations. Homogeneity and texture: It was tested by pressing a small quantity of the formulated Antiperspirant roll-on between the thumb and index finger. The consistency of the formulation and presence of coarse particles were used to evaluate the texture and homogeneity of the formulations. Immediate skin feels

(including stiffness, grittiness and greasiness) was also evaluated.[27]

4.2. pH

This is basically referring to acidity levels of substances. The normal value of pH (Antiperspirant roll-on) is pH 6-7.This test was measured using digital Ph meter.

Procedure for pH measurement

Calibration of pH meter was conducted by using buffer solution of pH 7.00, 4.00 and the performance of pH electrode was measured. Verify that the pH electrode was prepared correctly and connect the electrode to the meter. Pour pH buffer into100ml beakers and proceed with the calibration Immediately. Start the calibration on the meter. Rinse the electrode with de-ionized water and gently blot excess drops with a lint-free tissue. Place the electrode into the first buffer (pH 7.00), so the electrode tip and junction are fully immersed in the Buffer, and stir the buffer at a moderate, uniform rate. When the reading is stable, accept the buffer value using the meter's automatic buffer recognition Feature or manually enter the value of the pH buffer at its measured temperature. Again, Rinse the electrode with de-ionized water and gently blot excess drops with a lint-free tissue. Place the electrode into the second buffer (pH 4.00), so the electrode tip and junction are fully immersed in the buffer, and stir the buffer at a moderate, uniform rate.[31] About 1g of formulation was weighed and was dissolved in 100ml of distilled water and the solution was prepared The electrode was dipped in the solution (formulation). The pH mode key is pressed which is presenton the board. pH was displayed on the instrument. Reading was recorded. The electrode was again cleaned with distilled water wiped gently with tissue paper and at last reset the instrument.[21]

4.3. Washability Test

A portion of Antiperspirant roll-on was applied over the skin of hand and allowed to flow under the force of flowing tap water for 10 minutes. The time when the Antiperspirant roll-on was completely removed was noted.

4.4. Phase Separation

The prepared Antiperspirant roll-on was transferred in a suitable wide mouth container.

Set aside for storage, the oil phase and aqueous phase separation were visualizing after 24hrs.

4.4. Spreadability

The spreadability of the Antiperspirant roll-on was determined by measuring diameter. A precisely measured amount of cream is placed on a glass plate. A second, similar glass plate is placed on top of the cream, and a specific weight or load is applied for a set period (e.g., 150 grams for 1 minute). After the load is removed, the resulting diameter of the spread cream is measured.[24] The spread area(Si) was calculated using the formula: **$Si= \pi d^2/4$.**

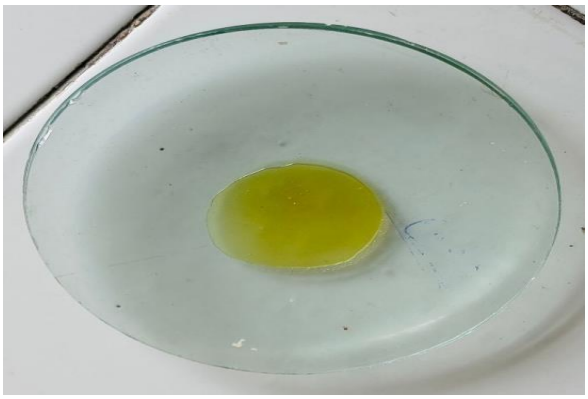

Fig. 4: Determination of spreadability.

4.5. Dye test: The amaranth dye is mixed with the emulsion. Place a drop of emulsion on a microscopic slide covers it with a cover slip, and examines it under a microscope. If the disperse globules appeared the ground colorless. The emulsion is o/w type. The reverse condition occurs in w/o type emulsion i.e. the disperse globules appear colourless in the red ground.[25]

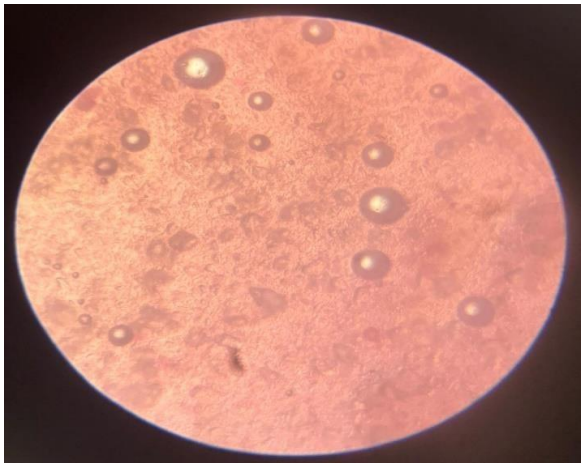

Fig. 5: Determination of dye test.

4.6. Grittiness

Using a light microscope, the formulation was examined microscopically to see if any noticeable particle matter was present. Therefore, it is evident that the antiperspirant roll-on preparation satisfies the necessary condition of being free of specific material and grittiness which is desirable for any topical preparation.[28]

4.7. Homogeneity

The homogeneity test for antiperspirant roll-on primarily involves visual inspection for the absence of coarse particles or aggregates by spreading a small quantity of the formulation on a glass slide or applying it to the skin of the hand.

Visual inspection on glass slide

Spread a small amount of the antiperspirant roll-on preparation on a clean glass slide or other transparent surface.

Visually inspect the preparation for any unevenness, large particles, or aggregates. A truly homogeneous antiperspirant roll-on will appear uniform in colour and texture.[29]

4.8. After Feel

Emoliency, slipperiness and amount of residue left after the application of the fixed amount of the formulation was found to be good.[30]

4.9. Antibacterial activity

The *in vitro* antibacterial activity of extract or the pure compound was evaluated by agar well diffusion method using agar media.[26]

Procedure for antibacterial assay

Antibacterial activity of optimized formulation was tested by using agar well diffusion method. Petri dishes were prepared by pouring the sterilized nutrient agar media under aseptic condition and allowed to solidify. After solidification of the media, the standardized test microbial inoculum of gram-negative bacteriathatis *Escherichiacoli*inagarplatesurfaceisinoculated by spreading uniformly a volume of entire agar surface by using glass spreader. Then a hole with a diameter of 8mm is punched aseptically with a sterile cork borer. A volume (100 micro liter) of the F4 formulation and antibiotic Gentamycin is served as standard for the assay and at desired concentration it is introduced into the well.[25] Then agar plates are incubated under suitable conditions (usually around 370C) depending upon the test microorganism. The Antimicrobial agent diffuses into the agar medium and inhibits the growth of test microorganism. Then the diameters of the inhibition zones produced around the well is measured in milli metre (mm) to assess the strength of Antibacterial activity after 24 hours. The results were compared to control samples and standard antimicrobial agents to determine the Antiperspirant roll-on relative efficacy.[31]

V. RESULTS

The present work was an attempt to formulate and evaluate oral antibacterial. Number of tests were conducted on prepared Antiperspirant roll-on such as organoleptic properties, pH, washability, spread-ability, consistency, irritancy, and antibacterial activity. The effect of formulation varies on different test conducted.

5.1 ORGANOLEPTICEVALUATION

Table 2: Organoleptic charecteristic.

PARAMETERS	F1	F2	F3	F4
COLOUR	Pale yellow	Pale Yellow	Pale Yellow	Pale Yellow
ODOUR	Pleasant	Pleasant	Pleasant	Pleasant
TEXTURE	Smooth	Smooth	Smooth	Smooth
STATE	Semisolid	Semisolid	Semisolid	Semisolid

5.2. PHYTO CHEMICAL EVALUATION

Table 3: Phytochemical evaluation.

TEST	OBSERVATION	INFERENCE
Alkaloids test: Hager's test:	Yellow precipitate	Alkaloids are present
Flavanoidtest: Alkaline reagent test:	Deep Yellow colour which disappears after addition of dil. HCl	Flavanoid is present
Phenoltest: FeCl3test:	Green colour	Phenol is present
Saponins test: Frothtest	Froth appears on top	Saponin is present
Tannins test: Gelatin test**:**	White precipitate on adding gelatin solution	Gelatin is present
Steroids test: Salkowskitest: Liebermann- burchardtest:	Reddish brown ring at junction Blue-greencolour	Steroid is present Steroid is present
Carbohydrate test: Molisch'stest:	Violet ring at the junction of two layer	Carbohydrate present

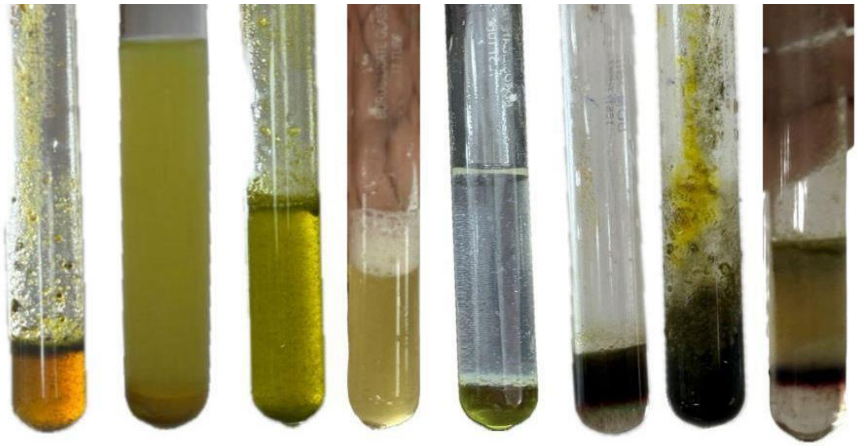

Fig. 6: Results of phyto chemical evaluation.

5.3. PHYSICAL CHARACTERISTIC

Table 4: Physical charecteristic.

PARAMETER	F1	F2	F3	F4
pH	6.6	6.5	6.7	6.8
Spreadability	Easily spreadable	Easily spreadable	Easily spreadable	Easily spreadable
Washability	Easily washable	Easily washable	Easily washable	Easily washable
Consistency	Smooth	Smooth	Smooth	Smooth
Phase separation	No	No	No	No
Afterfeel	Emollient	Emollient	Emollient	Emollient
Homogeneity	Homogenous	Homogenous	Homogenous	Homogenous
Grittiness	Non-Grittiness	Non-Grittiness	Non-Grittiness	Non-Grittiness

5.4. *IN-VITRO* ANTIBACTERIAL ACTIVITY

Table 5: *In-vitro* antibacterial activity.

Compound	Standard	F4 formulation
Method	Agar well-diffusion	Agar well-diffusion
Microorganism	Bacteria(*E. coli*)	Bacteria(*E. coli*)
Growth Medium	Nutrient agar medium	Nutrient agar medium
Final inoculums size (Diameter)	40mm	35mm
Incubation temperature	37^0C	37^0C
Incubation time	24hrs	24hrs

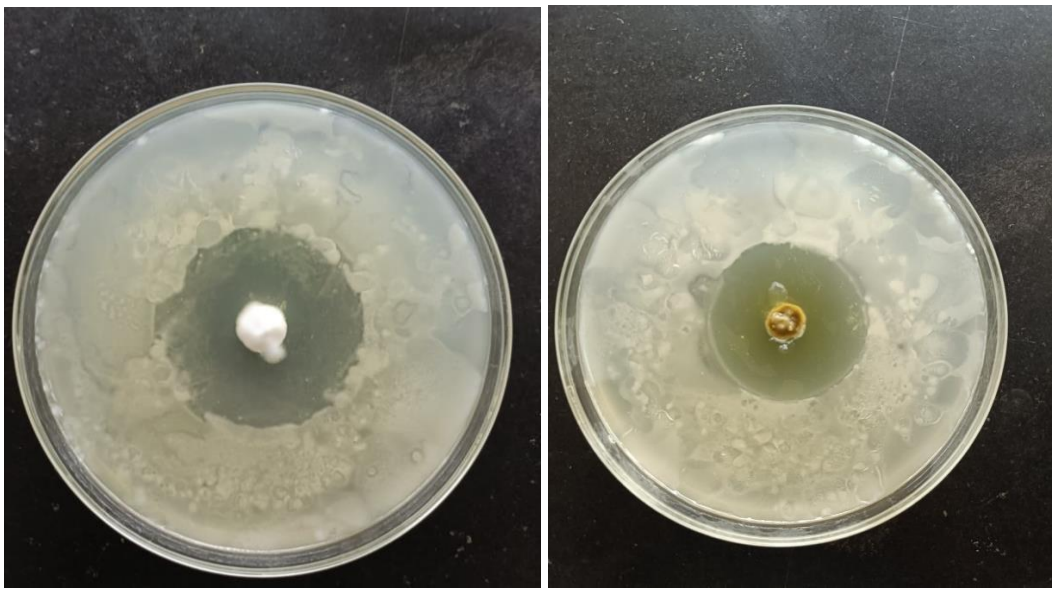

Fig. 7: Results of *in-vitro* antibacterial activity.

VI. DISCUSSION

The present work was undertaken with the aim of formulating an innovative antiperspirant roll-on using the herbal extract of Moringa oleifera, known for its strong antibacterial activity, in combination with aluminium chlorohydrate, a proven antiperspirant agent. The formulation was successfully developed by blending the natural properties of *Moringa oleifera* with the sweat-reducing effect of aluminium chlorohydrate to achieve both odor control and perspiration management.

This project highlights the potential of combining herbal bioactives with conventional antiperspirant agents in a well-designed dosage form to create safer, more effective, and aesthetically pleasing personal-care products. The success of this formulation demonstrates that the roll-on delivery system can maximize the dual benefits of antibacterial protection and sweat control, offering a promising advancement in the development of modern antiperspirant solutions.

VII. CONCLUSION

The present study successfully formulated an antiperspirant roll-on incorporating Moringa oleifera extract and aluminium chlorohydrate. The inclusion of Moringa oleifera, a plant renowned for its broad-spectrum antibacterial activity, enhances the product's ability to inhibit the growth of odor-causing skin bacteria, there by improving overall hygiene and freshness. The formulation was found to be non-greasy and safe for the skin, indicating good dermatological compatibility. Among the four formulations prepared, F4 exhibited superior consistency, spreadability, homogeneity and good antibacterial activity compared to the other formulation, making it the most effective and user-friendly option.

Overall, the project highlights the potential of integrating plant-derived bioactive ingredients with conventional antiperspirant agents to develop innovative, effective, and consumer-friendly personal-care products. This formulation demonstrates a promising approach toward enhanced antiperspirant efficacy with added antibacterial protection, making it a valuable contribution to the field of cosmeceutical product development.

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