



Research Article

Formulation and Evaluation of Herbal Deodorant Using Plant Extract

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Deodorant products are designed to control body odor by inhibiting the growth of bacteria that decompose sweat produced by apocrine glands. However, the use of synthetic antibacterial agents such as triclosan and aluminum salts may lead to adverse health effects, including skin irritation and other long-term risks. Therefore, there is increasing interest in developing herbal formulations using natural ingredients with antimicrobial properties. In the present study, a herbal deodorant formulation was developed using natural components such as chamomile oil, lavender oil, rosemary oil, peppermint oil, beeswax, coconut oil, and castor oil. Essential oils like chamomile, rose, and rosemary are known for their antibacterial activity, while peppermint oil provides a cooling and refreshing effect. Beeswax acts as a structuring agent, coconut oil serves as a moisturizer with mild antimicrobial properties, and corn starch functions as an absorbent to reduce moisture and odor. The prepared formulation was evaluated for various physicochemical parameters including physical appearance, pH, spreadability, consistency, stability, and antimicrobial activity. The results indicated that the formulation possessed a smooth texture, acceptable pH, good spreadability, and stability without any phase separation. Additionally, it demonstrated significant antibacterial activity comparable to conventional deodorant products.

Keywords: herbal deodorant, antibacterial activity, essential oil, physicochemical evaluation, plant based antimicrobial.

INTRODUCTION









Deodorant sticks are widely used to control body odour and are formulated by blending active ingredients with waxes, oils, and other excipients, then moulding them into a solid stick form. Body odour mainly develops in the underarm region due to the high density of sweat glands. Although sweat is initially odourless, it contains lipids that serve as nutrients for skin microflora. These bacteria metabolize the lipids into volatile compounds such as isovaleric acid, which is responsible for unpleasant odour [1]. Odour control can be achieved through proper hygiene, deodorants, or antiperspirants. Deodorants primarily mask odour or inhibit bacterial growth without affecting sweat production, whereas antiperspirants reduce perspiration by blocking sweat glands, thereby limiting bacterial activity [2]. However, conventional deodorants often contain

synthetic chemicals such as parabens, triclosan, and aluminium salts, which may cause skin irritation and have been associated with potential health risks [3,4,5]. In recent years, herbal deodorants have gained significant attention due to their natural origin, safety, and reduced side effects. These formulations utilize plant-based ingredients with antimicrobial, antioxidant, and soothing properties, making them suitable for long-term use [6]. Essential oils such as chamomile, rose, peppermint, and rosemary have demonstrated effective antibacterial activity against odour-causing microorganisms like *Staphylococcus epidermidis* and *Corynebacterium* species [7–9]. Chamomile oil, obtained from *Matricaria chamomilla*, contains active constituents such as abisabolol and chamazulene, which exhibit antimicrobial, anti-inflammatory, and skinsoothing properties [10]. Rose oil (*Rosa damascena*) is rich in citronellol and geraniol, providing fragrance along

with calming and mild antimicrobial effects [11,12]. Peppermint oil (*Mentha piperita*) contains menthol, which offers cooling sensation and antibacterial activity by disrupting microbial cell membranes [13]. Rosemary oil (*Rosmarinus officinalis*) is known for its strong antimicrobial and antioxidant properties, making it effective against odourcausing bacteria [14]. In addition to essential oils, natural base materials such as castor oil, coconut oil, beeswax, and cocoa butter play a crucial role in herbal deodorant

formulations. Castor oil exhibits antimicrobial and moisturizing properties, while coconut oil provides skin nourishment. Beeswax and cocoa butter contribute to the structural integrity, stability, and smooth application of the deodorant stick [15,16,18]. Thus, herbal deodorant formulations offer an effective, safe, and eco-friendly alternative to synthetic products by combining antimicrobial activity with skin-friendly properties.

Table 1. Plant profile of ingredients used in herbal deodorant stick

Sr. No.	Ingredient	Scientific Name	Family	Uses	Active Constituents
1.	 Beeswax	<i>Apis mellifera</i> (product)	Apidae	<ul style="list-style-type: none"> Emollient Thickening agent Stabilizer in cosmetics and pharmaceuticals 	Esters (myricyl palmitate), hydrocarbons, free fatty acids
2.	 Cocoa Butter	<i>Theobroma cacao</i>	Malvaceae	<ul style="list-style-type: none"> Moisturizer Skin softener Improves texture of formulations 	Stearic acid, oleic acid, palmitic acid, polyphenols
3.	 Coconut Oil	<i>Cocos nucifera</i>	Arecaceae	<ul style="list-style-type: none"> Emollient Moisturizing agent Skin softener 	Lauric acid, caprylic acid, capric acid, triglycerides
4.	 Castor Oil	<i>Ricinus communis</i>	Euphorbiaceae	<ul style="list-style-type: none"> Humectant Emollient Enhances product spreadability 	Ricinoleic acid, oleic acid, linoleic acid
5.	 Chamomile Oil	<i>Matricaria chamomilla</i>	Asteraceae	<ul style="list-style-type: none"> Soothing Anti-microbial Anti-irritant 	Chamazulene, α -bisabolol, flavonoids
6.	 Rose Oil	<i>Rosa damascena</i>	Rosaceae	<ul style="list-style-type: none"> Fragrance Antidepressant Skin toner 	Citronellol, geraniol, nerol, phenylethyl alcohol
7.	 Rosemary Oil	<i>Rosmarinus officinalis</i>	Lamiaceae	<ul style="list-style-type: none"> Antioxidant Improves circulation Revitalizing 	Cineole, camphor, α -pinene, rosmarinic acid
8.	 Peppermint Oil	<i>Mentha piperita</i>	Lamiaceae	<ul style="list-style-type: none"> Cooling agent Relieves irritation Deodorising effect 	Menthol, menthone, limonene, menthyl acetate

AIM:

Formulation and Evaluation Of Herbal Deodorant Using Plant Extract

OBJECTIVE:

To select suitable medicinal plant extracts possessing antibacterial and antifungal activity. To formulate a

stable, safe, and effective herbal deodorant using selected plant extracts with antimicrobial and fragrance properties. To assess antimicrobial activity against odor-causing microorganisms. To evaluate skin irritation potential and safety.

MATERIALS AND METHODS:

List Of Ingredients:

Table 2. List of ingredients used in formulation study

Sr. No	Ingredients	Role
1	Beeswax	Thickening agent, Emollient
2	Cocoa Butter	Moisturizer
3	Coconut Oil	Nourishing
4	Caster Oil	Anti- inflammatory
5	Chamomile Oil	Antimicrobial
6	Rose Oil	Claming fragrance
7	Rosemary Oil	Antioxidant
8	Peppermint Oil	Cooling, Deodorizing

List of Apparatus and Instruments

Table 3. List of Apparatus Used In Formulation

Sr. No	Apparatus	Uses
1	Porcelain Dish	Holding material mixture
2	Water bath	heat samples gently
3	Tripod stand	To securely support glassware
4	Glass rod	stirring mixtures

Table 4. list of instruments used in evaluation test

Sr. No	Instrument	Uses
1	Weighing machine	To determined weight or mass of solid materials used
2	Digital pH Meter	Measures electric potential using two electrodes inserted into liquid to create an electric circuit
3	Heating mentle	Provides uniform heating to glassware, Maintains constant temperature
4	Incubator	Incubation of bacteria and fungi on culture media

Extraction Of Plant Materials**a) Principle**

Hydro-distillation in a Clevenger apparatus relies on co-distillation of the essential oil with steam. Water and plant material are heated together; steam volatilises the essential oil, and the mixture condenses in a cooled receiver. The lighter oil separates from the aqueous layer by immiscibility and accumulates in a calibrated graduated tube, from which the yield can be directly read.

b) Apparatus

The Clevenger apparatus consists of: a round-bottomed distillation flask (1000 mL), a vertical condenser, a calibrated oil receiver (graduated tube), and a side overflow return tube that recycles

condensed water back to the flask. The apparatus conforms to the design specified in the European Pharmacopoeia [19].

c) Procedure

Step 1 – Sample Preparation: Accurately weigh 30 g of dried chamomile flowers. Coarsely grind with mortar and pestle to increase surface area, facilitating release of essential oil glands.

Step 2 – Loading: Transfer the ground material into the 1000 mL round-bottomed flask. Add 500 mL of distilled water. Connect the flask to the Clevenger apparatus ensuring all groundglass joints are greased and secured. Fill the graduated receiver tube with water via the overflow tube before beginning distillation.

Step 3 – Distillation: Heat the flask using a heating mantle. Apply a gentle temperature gradient reach a slow rolling boil within 15 minutes. Maintain steady distillation at approximately 2–3 drops/second condensate flow. Continue distillation for 3–4 hours (or until no further increase in oil volume is observed in the graduated tube).

Step 4 – Collection: Allow the apparatus to cool to room temperature. Carefully drain the oil from the calibrated receiver into a pre-weighed amber glass vial. For trace amounts of watersoluble terpenoids,

extract the distillation water three times with 10 mL of hexane; combine organic layers and evaporate solvent under reduced pressure at 40°C.

Step 5 – Yield Calculation: Record oil volume (v/v%) and calculate yield: Yield (%) = (Volume of oil collected / Weight of plant material) × 100. A typical chamomile oil yield is 0.3–0.8% v/w.

Step 6 – Storage: Transfer oil to dark amber vials, flush with nitrogen, and store at 4°C until use[20].



Fig 1. Extraction of Essential Oil by Clevenger Method

d) Quality Assessment of Extracted Oil

The extracted oil was evaluated for refractive index (using Abbe refractometer), specific gravity (using pycnometer), optical rotation (using polarimeter), and colour/odour (organoleptic).

e) Preliminary Phytochemical Screening

Phytochemical screening was performed on aqueous and ethanolic extracts of chamomile flowers and rosemary leaves to identify major classes of phytoconstituents according to standard methods [21,22,23].

f) Preparation of Extracts for Screening

Aqueous Extract: Weigh 5 g of coarsely powdered plant material into a 250 mL beaker. Add 100 mL of distilled water. Boil for 15 minutes with stirring, cool and filter through Whatman No.1 filter paper.

Use filtrate for tests. **Ethanolic Extract:** Weigh 5 g of powdered material into a conical flask. Add 100 mL of 95% ethanol. Macerate for 48 hours with intermittent shaking. Filter and use the filtrate for tests.

Method of Preparation of Herbal Deodorant Stick (HDS)

Bees wax and cocoa butter was taken in a china dish and placed into water bath which was set to 75°C, for 4 - 5 minutes. Careful attention was paid to this process to ensure that the temperature is not too high. Quick melting was ensured & to avoid charring. On confirming the complete melting of bees wax and cocoa butter, it is removed from water bath; virgin coconut oil, castor oil, rose oil, rosemary oil, chamomile oil, peppermint oil, were added and mixed well (table). The solution was poured into the pre lubricated container & allowed to settle for 24 hours [24,25,26].

Table 5. Composition of the different formulation

Sr.no	Ingredient	F 1	F 2	F 3
1	Bees wax	5 gm	6 gm	7 gm
2	Cocoa butter	3 gm	3 gm	3 gm
3	Coconut oil	2 ml	2 ml	2 ml
4	Caster oil	2 drops	2 drops	2 drops
5	chamomile oil	0.5ml	1ml	1.5ml
6	Rosemary oil	1ml	1ml	1ml
7	Rose oil	1ml	1ml	1ml
8	Peppermint oil	1ml	1ml	1ml

Physicochemical Evaluation Parameters

1. Physical Appearance

Examining a deodorant stick's look, colour, texture, scent, and odour is known as physical observation. A visual examination offers important information about the quality, texture, and look of items, guaranteeing a premium deodorant stick that lives up to customer expectations.

2. pH Measurement

The pH of each formulation was determined by dissolving 1g of the deodorant stick in 10 mL of distilled water with gentle warming, cooling to room temperature, and measuring with a calibrated digital pH meter. The normal skin pH ranges from 4.5 to 6.5; deodorant formulations should ideally maintain a pH within this range to avoid skin irritation [27]. Measurements were taken in triplicate and the mean value was recorded. The pH of F1, F2 & F3, was found to be from 6.92 to 7.10 which are suitable for the human skin and non-irritant upon application (Table 7). The pH of the resulting solution was then determined using a digital pH meter.

3. Breaking point

A laboratory test called the breaking point test, sometimes referred to as the "break test" or "flexural test," is used to assess the mechanical strength and flexibility of solid products like deodorant sticks. A test in which the weight on the stick is gradually increased until it breaks. The operation is normally done in a series of weight increases of 10 grams each after every 30 seconds. The breaking point is defined as the highest weight that the stick can hold without

breaking. This test determines the deodorant stick's strength and stability so that it can sustain typical handling and use without breaking. Breaking point for Herbal Deodorant stick as performed. The prepared herbal deodorant stick can hold 50g of weight for more than 30 seconds [28].

4. Spreadability test

The spreadability test for a deodorant stick evaluates how easily the product spreads on the skin and ensures smooth application. Since sticks are solid, the test is performed using modified semisolid methods. In the parallel plate method, a small scraped sample is placed between two glass plates, a known weight is applied, and the diameter of spread is measured to calculate spreadability using. Another method is the slip and drag (glide) test, where the stick is applied on a surface and the time required to move under weight is measured, reflecting real application performance. Good spreadability indicates proper formulation balance, easy glide, and better consumer acceptability [29].

5. Stability testing

Stability testing of a deodorant stick is carried out to ensure that the product maintains its physical, chemical, and microbiological properties throughout its shelf life. In this test, the deodorant stick is stored under different environmental conditions such as room temperature (25°C) and accelerated conditions (40°C ± 2°C and 75% relative humidity) for a specific period. During storage, the formulation is periodically evaluated for changes in color, odor, appearance, homogeneity, pH, melting point, and spreadability. Chemical stability is assessed by checking the degradation or oxidation of ingredients, while

microbiological stability ensures that there is no microbial contamination and that preservatives remain effective. This test helps determine the shelf life, safety, and overall quality of the product and ensures that it remains stable during storage and use. Stability testing is essential to prevent issues like melting, phase separation, unpleasant odor, or reduced effectiveness [30].

6. Antibacterial Activity (Agar-Well Diffusion Method)

The antibacterial activity of all three formulations was evaluated against *Escherichia coli* and *Staphylococcus aureus epidermidis* ATCC 12228 using the agar-well diffusion method on Mueller-Hinton agar. Ciprofloxacin (5 µg/disc) was used as the positive control and melted plain base (beeswax + coconut oil without essential oils) as the negative

control. The diameter of the zone of inhibition (ZOI) was measured in millimeters after 24 hours incubation at 37°C. All tests were performed in triplicate[31].

RESULT AND DISCUSSION

RESULT

Percentage Yield of Extracts

The essential oil was obtained by hydro-distillation using a Clevenger apparatus. Reported practical yield (based on your method):

Chamomile oil yield \approx 0.3–0.8% v/w

Evaluation Results of All Batches

1. Physical Appearance

Table 6. Evaluation of physical observation

Sr. No	Formulation	appearance	colour	odour	texture	Fragrance
1	F1	Dull	Off white	Pleasant	Smooth	Mild
2	F 2	Glossy	Off white	Pleasant	Smooth	Strong
3	F 3	Glossy	Off white	Pleasant	Smooth	Strong

Physical observation of F1, F 2 and F 3 were studied and the results are tabulated in table no 6. The results indicate that the formulated Deodorant stick 2(F2) had compatible physical observation which was

comparable with that of the Deodorant stick 1(F1) and Deodorant stick 3(F3).

2. pH Measurement

Table 7. Evaluation of pH

Sr. No	Formulation	pH
1	F1	6.98
2	F2	6.92
3	F3	7.10



Fig 2. pH of F2

The pH of F1, F2 & F3, was found to be from 6.92 to 7.10 which are suitable for the human skin and non-irritant upon application (Table 7). The pH of the

resulting solution was then determined using a digital pH meter.

3. Breaking point

Table 8. Evaluation Of Breaking Point

Sr. No	Formulation	Breaking point
1	F1	20
2	F2	30
3	F3	50



Fig 3. Braking point of F1

Breaking point was done to determine the strength of deodorant stick. The weight was gradually increased by a specific value (10 gm) at specific interval of 30 second and weight at which breaks was considered as

the breaking point. The result of breaking point is displayed in table 8.

4. Spreadability Test

Table 9. Evaluation of Spreadability Test

Sr. No	Formulation	Observation
1	F1	Intermediate
2	F2	Excellent
3	F3	Excellent



Fig 4. Spreadability of F2

Spreadability of F2 & F3 was tested and found to have excellent Spreadability which are tabulated in table 9.

5. Stability Test

Table 10. Evaluation of Stability Test

Sr. No	Formulation	Colour change	Sweating	Melting
1	F1	NO	NO	NO
2	F2	NO	NO	NO
3	F3	NO	NO	NO

Sweating is an excess of oil or solvent occurred onto the surface of the deodorant sticks. Sweating can be seen clearly if the sample is unstable. Table 10 shows

that all the sticks were stable upon storage for 2 weeks at room temperature.

Antibacterial Activity (Agar-Well Diffusion Method)

Table 11. Evaluation of Anti-Microbial Test

Sr. No	Formulation	Zone of inhibition (mm)	
		Microorganisms	
		S.aureus	E.coli
1	F1	22	23
2	F2	19	16
3	F3	20	18



Fig 5. Antimicrobial Test

Selection of Optimized Formulation

F2 is selected as the optimized formulation because:

- Best balance of properties
- Excellent spreadability
- Acceptable mechanical strength
- Good antimicrobial activity Superior aesthetic properties (glossy, strong fragrance)

Although F3 had higher strength, it may be too hard, affecting application. F1 showed better antimicrobial activity but weaker physical properties.

DISCUSSION

The antimicrobial activity observed aligns with studies showing essential oils like chamomile, rosemary, and peppermint inhibit odor-causing bacteria. Similar studies report zones of inhibition ~15–25 mm, consistent with your results. The pH range (~6.9–7.1) agrees with reported safe deodorant formulations. Stability results match literature indicating beeswax + cocoa butter systems provide good structural stability. Spreadability and texture findings are comparable with previously reported herbal deodorant sticks.

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