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Formulation and Evaluation of Deodorant Powder

Payal Shelar[1*], Jayshri Dikkar[2]

[1,2]*Mangaldeep institute of pharmacy, Dr. Babasaheb Ambedkar Technological University*

[*]*Corresponding author, payalshelar1234@gmail.com*

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Abstract

Deodorant powders are widely used personal care products designed to prevent or reduce body odor, particularly in the axillary region, caused by the microbial decomposition of sweat produced by eccrine and apocrine glands (https://www.ncbi.nlm.nih.gov/books/NBK513244/). The unpleasant odor mainly arises due to the breakdown of sweat components into low molecular weight fatty acids, ammonia, and other volatile compounds (https://pmc.ncbi.nlm.nih.gov/articles/PMC10391722/). Conventional deodorant products often contain synthetic chemicals which may lead to skin irritation and other adverse effects upon prolonged use (https://www.mayoclinic.org/diseases-conditions/sweating-and-body-odor/symptoms-causes/syc-20353895). Hence, there is an increasing demand for safe, effective, and skin-friendly alternatives (https://my.clevelandclinic.org/health/symptoms/17865-body-odor/). In conclusion, the developed deodorant powder can serve as an effective, safe, and economical alternative to conventional deodorant formulations (https://pmc.ncbi.nlm.nih.gov/articles/PMC12609316/). This study supports the use of such formulations in personal care and highlights the scope for further development and large-scale production.

2. INTRODUCTION

2.1 Definition of Deodorant Powder

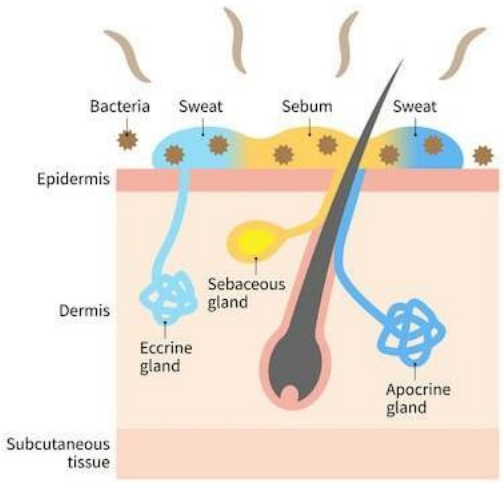


Figure: Structure of Skin and Sweat Glands

Deodorant powder is a topical cosmetic formulation designed to reduce or eliminate body odor by absorbing moisture, controlling microbial growth, and providing a pleasant fragrance. Unlike antiperspirants, which block sweat glands, deodorant powders primarily act by managing the conditions that lead to odor formation. These powders are applied externally on body areas such as the underarms, feet, and other regions prone to perspiration.

Body odor, scientifically referred to as bromhidrosis, occurs when sweat produced by eccrine and apocrine glands is metabolized by skin-resident bacteria. This microbial degradation leads to the formation of volatile compounds such as fatty acids and ammonia, which produce unpleasant smells. Deodorant powders interrupt this process either by absorbing sweat, inhibiting bacterial growth, or masking odor through fragrance.

The formulation typically consists of absorbent bases such as talc, kaolin, or starch, along with antimicrobial agents like triclosan or herbal extracts. Fragrance components are also added to enhance user acceptability. Some formulations may include cooling agents like menthol or skin-soothing agents such as zinc oxide.

Deodorant powders are widely preferred due to their dry feel, ease of application, and suitability for humid climates.

2.2 Historical Background of Deodorants



Figure: Historical Background of Deodorants

The concept of controlling body odor dates back to ancient civilizations. Early humans recognized the importance of personal hygiene and used natural substances to mask or reduce unpleasant smells. In ancient Egypt, people used aromatic oils, resins, and perfumes to maintain body freshness. Similarly, the Romans and Greeks practiced regular bathing and used scented powders and oils.

During the Middle Ages, hygiene practices declined in Europe, but the use of perfumes increased to mask body odor. The modern deodorant industry began in the late 19th century. The first commercial deodorant, known as “Mum,” was introduced in 1888 in the United States. It was a wax-based cream applied to the underarms.

Later developments led to the introduction of antiperspirants containing aluminum salts in the early 20th century. These products worked by blocking sweat glands, thus reducing moisture and odor. Powder-based deodorants also gained popularity due to their ability to absorb sweat effectively.

In recent decades, there has been a shift toward natural and herbal formulations due to concerns about synthetic chemicals like parabens and aluminum compounds. Today, deodorant powders are formulated using advanced techniques and ingredients that ensure safety, efficacy, and skin compatibility.

The evolution of deodorants reflects changing consumer preferences, technological advancements, and increased awareness of hygiene and personal care.

2.3 Physiology of Sweat and Body Odor

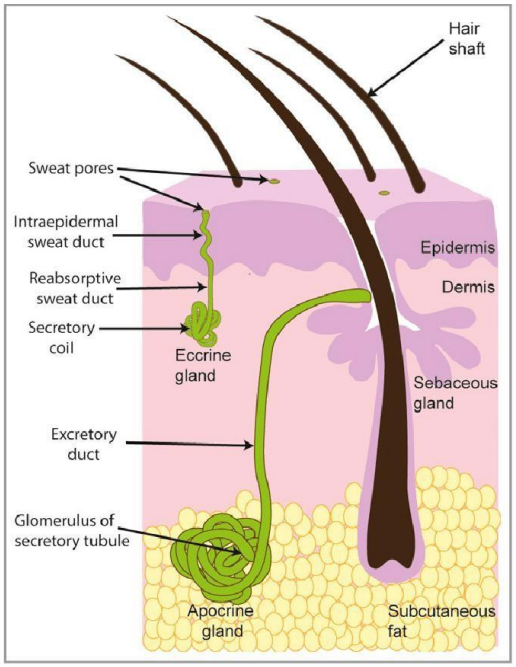


Figure: Eccrine and Apocrine Glands in Human Skin

The human body contains two main types of sweat glands: eccrine and apocrine glands. Eccrine glands are distributed throughout the body and primarily regulate temperature by secreting a watery fluid composed mainly of water and salts. This type of sweat is generally odorless.

Apocrine glands, on the other hand, are located in specific areas such as the underarms and groin. They produce a thicker secretion rich in proteins and lipids. When this secretion comes into contact with skin bacteria, it undergoes decomposition, leading to the formation of odor-causing compounds.

The microbiota present on the skin plays a crucial role in odor formation. Bacteria such as Corynebacterium and Staphylococcus species break down sweat components into volatile substances like short-chain fatty acids, sulfur compounds, and ammonia. These compounds are responsible for the characteristic unpleasant smell.

Factors influencing body odor include diet, hormonal changes, hygiene practices, environmental conditions, and genetic predisposition. For instance, spicy foods and certain medications can alter sweat composition and intensify odor.

2.4 Ideal Properties of Deodorant Powder

An ideal deodorant powder should possess several important characteristics to ensure effectiveness, safety, and user satisfaction. First, it should have excellent absorbent properties to remove excess moisture from the skin surface. This helps in preventing bacterial growth and maintaining dryness.

Secondly, the powder should exhibit antimicrobial activity to inhibit odor-causing microorganisms. This can be achieved using synthetic agents or natural extracts such as neem, tea tree oil, or clove oil.

The formulation should be non-toxic, non-irritating, and suitable for all skin types. It should not cause allergic reactions or skin sensitivity, especially in delicate areas like the underarms.

Another important property is good flowability and spreadability. The powder should be easy to apply and should distribute evenly over the skin. Particle size should be fine and uniform to avoid grittiness.

The deodorant powder should also have a pleasant and long-lasting fragrance to enhance user acceptability. Additionally, it should be stable under different environmental conditions, maintaining its effectiveness and quality over time.

Other desirable properties include non-staining nature, compatibility with other ingredients, and cost-effectiveness. These factors collectively determine the overall performance and market success of the product.

2.5 Advantages and Applications of Deodorant Powder

2.5.1 Advantages of Deodorant Powder

- Effective Moisture Absorption

  Deodorant powders contain absorbent materials such as talc and starch that effectively absorb sweat, keeping the skin dry.

- Control of Body Odor

  They help reduce body odor by limiting bacterial growth and masking unpleasant smells with fragrance.

- Non-Greasy and Dry Feel

  Unlike creams or roll-on formulations, powders provide a dry and smooth skin feel without leaving any sticky residue.

- Ease of Application

  Powders are easy to apply and spread uniformly over the skin surface.

- Cooling Effect

  Many formulations provide a soothing and cooling sensation, especially in hot climates.

- Reduced Risk of Skin Irritation

  Properly formulated powders are generally mild and suitable for sensitive skin.

- Cost-Effective

  Deodorant powders are economical compared to sprays and other advanced formulations.

- Environmentally Friendly

  They do not require aerosol propellants, making them safer for the environment.

2.5.2 Applications of Deodorant Powder

- Underarm Use

  Applied to reduce sweat and odor in the axillary (underarm) region.



Figure: Underarm Use

- Foot Care

  Widely used as foot powders to control sweating, odor, and fungal infections.



Figure: Foot Care

- Body Hygiene

  Used on different parts of the body to maintain dryness and freshness.



Figure: Body Hygiene

- Sports and Fitness Use

  Helps athletes and active individuals manage excessive sweating.



Figure: Sports and Fitness Use

- Medical and Clinical Use

  Sometimes used to maintain hygiene in patients prone to excessive sweating or skin infections.



Figure: Medical Applications

- Cosmetic Industry

  Incorporated into body powders and talcum products for fragrance and freshness.



Figure: Cosmetic Industry

3. *REVIEW OF LITERATURE*

1. **Sharma et al.** reported that deodorant powders possess odor-absorbing, antimicrobial, and moisture-controlling properties. The study explained that deodorant powders contain ingredients like talc, baking soda, essential oils, and zinc compounds which help in reducing sweat odor and maintaining skin freshness. Due to these beneficial effects, deodorant powders are widely used in personal hygiene and cosmetic applications.
2. **Patel et al.** studied the formulation and evaluation of herbal deodorant powders using natural ingredients. The authors concluded that herbal deodorant powders effectively absorb sweat,

reduce body odor, and provide long-lasting freshness with fewer side effects compared to synthetic deodorants.

3. **Kumar et al.** investigated the antimicrobial activity of various deodorant powder formulations and reported significant antibacterial effects against odor-causing microorganisms. The study suggested that deodorant powders can be effectively used for controlling body odor and maintaining personal hygiene.
4. **Singh et al.** evaluated cosmetic formulations containing natural deodorizing agents and observed effective moisture absorption and odor control. The study revealed that properly formulated deodorant powders improve skin dryness and provide comfort during prolonged use.
5. **Gupta et al.** reported that herbal cosmetic products are gaining popularity due to their natural origin, safety, and minimal adverse effects. The authors highlighted the increasing use of herbal ingredients such as neem, sandalwood, and essential oils in deodorant powder formulations.
6. **Verma et al.** explained the importance of evaluation parameters such as pH, particle size, flow properties, moisture content, and stability studies in deodorant powders. These parameters are essential for determining the quality, effectiveness, and safety of cosmetic powder formulations.
7. **Joshi et al.** described the pharmacological and cosmetic importance of natural ingredients used in deodorant powders. The authors emphasized the role of antimicrobial and fragrance agents in preventing body odor and improving skin condition.

4. AIM AND OBJECTIVES

Aim

To formulate and evaluate a deodorant powder containing suitable ingredients for effective odor control, moisture absorption, skin protection, and improving personal hygiene with minimal side effects.

Objectives

1. To prepare a deodorant powder using suitable natural and synthetic ingredients.
2. To study the physicochemical properties of the formulated powder such as particle size, pH, flow properties, color, odor, and moisture content.
3. To evaluate the odor-absorbing capacity and moisture control ability of the deodorant powder.
4. To assess the stability of the formulation under different storage conditions.
5. To determine the skin irritation potential and safety of the prepared formulation.
6. To evaluate the antimicrobial activity against odor-causing microorganisms.
7. To develop a deodorant powder formulation that is safe, effective, economical, and suitable for daily use.

5. MECHANISM AND ACTION OF DEODORANT POWDER

1. **Moisture absorption:** Deodorant powder contains absorbent materials such as talc, starch, kaolin and other fine particulate substances which help in absorbing excess sweat from the skin surface. These ingredients reduce wetness by trapping moisture and maintaining dryness in sweat-prone areas. The reduction in moisture content limits the conditions required for microbial growth and helps in preventing body odor formation. Continuous use of deodorant powder improves skin

comfort and prevents stickiness associated with sweating.

2. **Effects on sweat and odor formation:** Sweat itself is odorless but when it comes in contact with skin bacteria, it leads to the formation of unpleasant odor. Deodorant powders act by minimizing sweat accumulation and reducing bacterial activity on the skin. The presence of absorbent and antibacterial agents helps in controlling the decomposition of sweat components, thereby preventing the production of malodorous compounds. This action plays a significant role in maintaining personal hygiene and freshness.
3. **Antimicrobial action:** Deodorant powders contain antimicrobial agents such as zinc oxide, boric acid or herbal extracts which inhibit the growth of odor-causing microorganisms. These agents interfere with bacterial metabolism and reduce the breakdown of sweat into foul-smelling substances. The antimicrobial activity ensures long-lasting odor control and protects the skin from infections caused by microbial proliferation.
4. **Effects on the skin surface:** The fine particles of deodorant powder form a protective layer over the skin which helps in reducing friction between skin surfaces. This protective action prevents irritation, rashes and discomfort, especially in areas prone to sweating such as underarms and feet. The smooth texture of the powder enhances skin feel and provides a soothing effect during application.
5. **Odor neutralization:** Certain components in deodorant powder chemically neutralize odor-causing compounds. These substances interact with volatile molecules responsible for bad smell and reduce their intensity. This mechanism works along with antimicrobial action to ensure effective and long-lasting odor control.
6. **Fragrance action:** Deodorant powders are formulated with perfumes or essential oils which provide a pleasant fragrance to the skin. These fragrance components mask any residual odor and give a refreshing sensation. The slow release of fragrance ensures prolonged freshness and enhances user acceptability of the product.
7. **Cooling and soothing effect:** Some deodorant powders provide a cooling sensation due to the presence of specific ingredients. This cooling effect helps in reducing discomfort caused by excessive sweating and provides relief in hot and humid conditions. Additionally, soothing agents help in calming the skin and preventing irritation.
8. **Antiseptic effect:** Deodorant powders may contain antiseptic agents which help in preventing the growth of bacteria, fungi and other microorganisms on the skin. These agents contribute to maintaining skin hygiene and preventing infections, especially in moist areas of the body. The combined antiseptic and antimicrobial properties enhance the overall effectiveness of the deodorant powder.

6. MATERIALS AND METHODS

6.1 METHOD OF PREPARATION

A. Collection

Talc powder, zinc oxide, starch, kaolin, baking soda, essential oils (such as lavender or peppermint oil), fragrance, and preservatives were procured from the local market. All the materials used in the formulation were of analytical grade and suitable for cosmetic use.

B. Preparation of Powder Base

The required quantities of talc, starch and kaolin were accurately weighed and mixed thoroughly using a

mortar and pestle to obtain a uniform powder base. The mixing process was carried out for a sufficient time to ensure homogeneity of all ingredients.

C. Sieving

The prepared powder mixture was passed through a suitable sieve (such as sieve no. 80) to obtain fine particles and to remove any lumps. This step ensures uniform particle size and improves the texture and application properties of the deodorant powder.

D. Development of Formulation

To the prepared powder base, zinc oxide and baking soda were added and mixed uniformly. A few drops of essential oil and fragrance were incorporated slowly with continuous mixing to ensure even distribution. Finally, the prepared deodorant powder was transferred into a suitable container, properly packed and labeled.

6.2 INGREDIENTS

1. Talc
2. Zinc oxide
3. Starch
4. Kaolin
5. Baking soda
6. Essential oil
7. Fragrance

6.3 INGREDIENT USED IN FORMULATION

A. Talc

1. **Scientific name:** Hydrated magnesium silicate
2. **Chemical formula:** $Mg_3Si_4O_{10}(OH)_2$
3. **Category:** Absorbent agent
4. **Function:** Used as a base material to absorb moisture and provide smooth texture
5. **Source:** Mineral origin
6. **Properties:** Fine, soft, white powder with excellent moisture absorbing capacity
7. **Uses:** Widely used in cosmetic powders for improving spreadability and dryness

B. Zinc Oxide

1. **Chemical formula:** ZnO
2. **Category:** Antimicrobial agent
3. **Function:** Helps in reducing bacterial growth and skin irritation
4. **Properties:** White powder with mild antiseptic properties
5. **Uses:** Used in cosmetic and pharmaceutical preparations

C. Starch

1. **Source:** Corn or rice
2. **Category:** Absorbent agent
3. **Function:** Helps in absorbing excess moisture from the skin
4. **Properties:** Fine powder with good water absorption capacity
5. **Uses:** Used in body powders and cosmetic formulations

D. Kaolin

1. **Chemical composition:** Hydrated aluminum silicate
2. **Category:** Absorbent and cleansing agent
3. **Function:** Removes impurities and absorbs oil from skin
4. **Properties:** Soft, white clay with good adsorption properties
5. **Uses:** Used in cosmetic powders and skin care products

E. Essential Oil

1. **Source:** Plant origin (lavender/peppermint)
2. **Category:** Fragrance agent
3. **Function:** Provides pleasant odor and refreshing effect
4. **Properties:** Volatile aromatic liquid
5. **Uses:** Used in perfumes and cosmetic products

F. Baking Soda

1. **Chemical name:** Sodium bicarbonate
2. **Formula:** $NaHCO_3$
3. **Category:** Deodorizing agent
4. **Function:** Neutralizes odor
5. **Properties:** White crystalline powder
6. **Uses:** Used in deodorant formulations

G. Fragrance

1. **Category:** Perfuming agent
2. **Function:** Provides pleasant smell
3. **Properties:** Aromatic compound
4. **Uses:** Used in cosmetic preparations

H. Preservative

1. **Category:** Stabilizing agent
2. **Function:** Prevents microbial contamination
3. **Uses:** Increases shelf life of formulation

6.4 Benefits of Deodorant Powder for Skin

Using deodorant powder on the skin has several benefits because:

- It helps in absorbing excess sweat and keeps the skin dry, preventing discomfort and stickiness.
- It reduces body odor by inhibiting the growth of odor-causing bacteria present on the skin surface.
- It provides a cooling and refreshing effect, especially in hot and humid conditions.
- It prevents skin irritation, rashes, and chafing by reducing friction between skin surfaces.
- It helps in maintaining personal hygiene and gives a long-lasting feeling of freshness.
- The powder should remain smooth and free-flowing without forming lumps after application.
- It should spread easily on the skin and provide uniform coverage.
- After application, a thin protective layer should remain on the skin surface.
- It improves skin comfort by keeping the body dry and odor-free throughout the day.
- It helps in soothing minor skin irritation and provides a soft and smooth feel.

6.5 Contents of Deodorant Powder

Deodorant powder contains various active and inactive ingredients such as absorbents, antimicrobial agents, fragrance substances, and stabilizers. These ingredients work together to control moisture, prevent odor formation, and improve skin feel.

A. Talc



Figure: Talc

Benefits of Talc for Skin

It absorbs moisture effectively and keeps the skin dry. It provides a smooth and soft texture to the powder.
It reduces friction and prevents skin irritation.

It improves spreadability and enhances the feel of the product.

B. Zinc Oxide



Figure: Zinc Oxide

Benefits of Zinc Oxide for Skin

It has antimicrobial properties that reduce bacterial growth. It helps in preventing skin irritation and rashes.
It provides mild antiseptic action.

It protects the skin from minor infections.

C. Starch



Figure: Starch powder

Benefits of Starch for Skin

It absorbs excess moisture from the skin. It provides a cooling and soothing effect. It improves the texture of the powder.
It helps in maintaining dryness for a longer time.

D. Essential Oil



Figure: Essential Oil

Benefits of Essential Oil for Skin It provides a pleasant fragrance.
It gives a refreshing and cooling sensation. It may have mild antimicrobial properties.
It enhances user acceptability of the product.

E. Baking Soda



Figure: Baking Soda

Benefits of Baking Soda for Skin

It neutralizes body odor effectively.

It helps in controlling sweat-related smell. It acts as a natural deodorizing agent.
It improves overall odor control performance.

F. Kaolin



Figure: Kaolin Powder

Benefits of Kaolin for Skin

It absorbs oil and impurities from the skin. It helps in cleansing the skin surface.
It provides smoothness and softness.

It enhances the overall quality of the powder.

6.6 Formulation of Deodorant Powder

Sr. No.	Ingredient	Quantity
1.	Talc	5 gm
2.	Zinc Oxide	1 gm
3.	Starch	2 gm
4.	Kaolin	1 gm
5.	Baking Soda	0.5 gm
6.	Essential Oil	2–3 drops
7.	Fragrance	q.s.
8.	Preservative	q.s.

7. *EVALUATION TESTS*

In Vitro Evaluation

1. Organoleptic Evaluation:

The prepared deodorant powder was evaluated for its physical characteristics such as color, odor, texture, smoothness and appearance. The formulation should be free from lumps and should possess a pleasant fragrance with good aesthetic appeal.

2. Determination of pH:

The pH of the formulation was determined using a digital pH meter. About 1 gm of deodorant powder was dispersed in 100 ml of distilled water and kept for 2 hours. The pH was then measured. The measurement was carried out in triplicate and the instrument was calibrated using standard buffer solutions before use.

3. Particle Size Determination:

The particle size of the deodorant powder was determined by sieve analysis method. A known quantity of powder was passed through a standard sieve (sieve no. 80) and the retained and passed fractions were measured. Uniform particle size ensures better spreadability and smooth application.

4. Flow Properties:

The flow properties of the powder were evaluated by determining angle of repose. The powder was allowed to flow through a funnel to form a cone and the angle was calculated using the formula:

Angle of Repose (θ) = $\tan^{-1}$ (h/r)

Where,
h = height of the pile r =
radius of the base

Good flow property indicates ease of application and handling of the powder.

5. Bulk Density and Tapped Density:

A known quantity of powder was taken in a measuring cylinder and its bulk volume was noted. The cylinder was then tapped repeatedly until a constant volume was obtained. Bulk density and tapped density were calculated and used to determine compressibility index and Hausner ratio.

6. Washability:

The powder was applied on the skin and observed under running water. It should be easily removable without leaving excessive residue on the skin surface.

7. Odor Absorption Test:

The deodorant powder was evaluated for its ability to control and absorb body odor. The formulation was applied on skin and its effectiveness in reducing odor was observed over a period of time.

8. Stability Study:

The prepared deodorant powder was subjected to stability studies under different conditions of temperature and humidity. The formulation was observed for changes in color, odor, texture and

performance over a period of time to ensure product stability.

Observation Table

Sr. No.	Physical Parameters	Inference
1.	Color	White
2.	Odour	Pleasant
3.	Appearance	Fine powder
4.	Feel on Application	Smooth and soft
5.	pH	6.5 – 7

8. SKIN ANATOMY AND SWEAT GLANDS

8.1. A. Epidermis

1. The epidermis is the outermost layer of the skin and acts as the first protective barrier against environmental factors such as bacteria, dust, and chemicals. In deodorant application, this layer is the primary site of contact.
2. **Stratum Corneum:**
   This is the topmost layer consisting of dead cells. It protects underlying layers and absorbs deodorant powder, helping to reduce moisture and odor.
3. **Stratum Granulosum:**
   This layer produces lipids that make the skin water-resistant, which helps in controlling excessive sweating.
4. **Stratum Spinosum:**
   It provides strength and flexibility to the skin, ensuring resistance to mechanical stress during application of products.
5. **Stratum Basale:**
   This deepest layer continuously produces new skin cells, maintaining skin renewal even after regular product application.

B. Dermis

1. The dermis lies below the epidermis and plays a vital role in deodorant function. It contains connective tissues like collagen and elastin that maintain skin strength and elasticity.
2. This layer contains **sweat glands**, which produce sweat. Deodorant powders mainly act by absorbing this sweat and reducing moisture.
3. Blood vessels present in this layer supply nutrients and help regulate body temperature.
4. The dermis also contains **sebaceous glands** that produce oil (sebum). Excess oil and sweat can contribute to body odor, which deodorants help to control.
5. Hair follicles located in this layer are common sites for bacterial growth, leading to odor formation.

C. Subcutaneous Layer

1. The subcutaneous layer is the deepest layer composed mainly of fat and connective tissue. It connects the skin to muscles and bones.
2. This layer acts as an insulator, helping to regulate body temperature.
3. It also serves as an energy reserve and provides cushioning to internal structures.
4. Deodorant powders do not penetrate this layer; their action is limited to the upper skin layers.

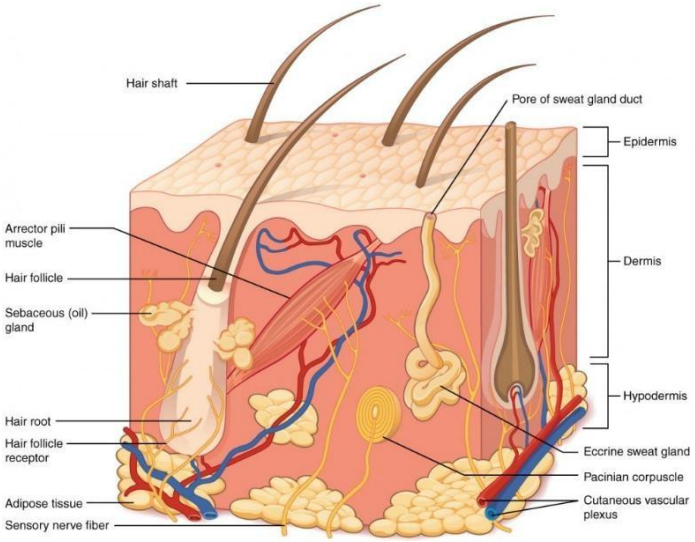


Figure: Anatomy of Skin and Sweat Glands

8.2 Introduction To Skin (Deodorant Powder)

The skin is the largest organ of the human body, covering approximately 1.5–2 square meters in adults. It forms the outer protective covering of the body and acts as the first line of defense against environmental hazards such as microorganisms, chemicals, dust, and physical injury.

In the context of deodorant powder, the skin plays a vital role as it is the primary site where sweat is produced and body odor develops. Deodorant powders are applied topically on the skin to absorb moisture, reduce microbial growth, and control odor formation.

Skin performs several important physiological and protective functions such as:

- Protection from microorganisms and harmful chemicals
- Prevention of excessive water loss
- Regulation of body temperature through sweat production
- Sensation of touch, pressure, pain, and temperature
- Synthesis of Vitamin D under sunlight
- Storage of fat and water
- Excretion of sweat and metabolic wastes

The skin is composed of three major layers:

1. Epidermis
2. Dermis
3. Hypodermis (Subcutaneous tissue)

1. Epidermis

The epidermis is the outermost layer of the skin. It is composed of stratified squamous keratinized epithelium and does not contain blood vessels. Nutrients are supplied to this layer by diffusion from the underlying dermis.

In deodorant application, this layer is the first point of contact and plays a major role in absorption and protection.

The epidermis mainly contains:

- Keratinocytes
- Melanocytes
- Langerhans cells
- Merkel cells

Functions of Epidermis

- Provides mechanical protection against external damage
- Prevents microbial invasion
- Reduces water loss from the body
- Produces keratin, which strengthens the skin
- Produces melanin pigment for UV protection
- Acts as an immune barrier

The epidermis consists of five layers arranged from deep to superficial:

1. Stratum Basale (Basal Layer)

This is the deepest layer of the epidermis.

Characteristics

- Composed of a single layer of cuboidal or columnar cells
- Contains actively dividing stem cells
- Contains melanocytes

Functions

- Continuous production of new skin cells by mitosis
- Production of melanin pigment
- Repair and regeneration of the epidermis

Melanin protects the skin from harmful ultraviolet (UV) radiation.

2. Stratum Spinosum

This layer lies above the basal layer.

Characteristics

- Made of polygonal keratinocytes
- Cells are connected by desmosomes giving a spiny appearance

Functions

- Provides strength and flexibility to the skin
- Initiates keratin production
- Participates in immune response through Langerhans cells

3. Stratum Granulosum

This layer contains flattened cells with keratohyalin granules.

Functions

- Keratin formation
- Formation of water barrier
- Beginning of programmed cell death

Lipids released from these cells make the skin waterproof, which is important in controlling sweat loss.

4. Stratum Lucidum

This layer is present only in thick skin such as palms and soles.

Characteristics

- Thin, transparent layer
- Consists of dead keratinocytes

Functions

- Provides additional protection
- Reduces friction and mechanical stress

5. Stratum Corneum

This is the outermost layer of the epidermis.

Characteristics

- Composed of dead, flattened keratinized cells
- Cells are continuously shed and replaced

Functions

- Acts as the primary protective barrier
- Prevents dehydration
- Protects against microbes and chemicals

The stratum corneum plays a major role in cosmetic and pharmaceutical applications because deodorant powders interact mainly with this layer by absorbing sweat and reducing moisture.

2. Dermis

The dermis lies beneath the epidermis and is composed mainly of connective tissue. It provides strength, elasticity, and nourishment to the skin.

It contains:

- Blood vessels
- Nerves
- Hair follicles
- Sweat glands
- Sebaceous glands
- Collagen fibers
- Elastin fibers

The dermis is divided into two layers:

A. Papillary Dermis

Characteristics

- Thin upper layer
- Contains loose connective tissue
- Rich in capillaries and sensory receptors

Functions

- Nourishes the epidermis
- Supports immune defense
- Provides sensation

B. Reticular Dermis

Characteristics

- Thick deeper layer
- Contains dense connective tissue

Functions

- Provides strength and elasticity
- Maintains structural integrity
- Houses skin appendages

Skin Appendages Present in Dermis

1. Hair Follicles

Structures responsible for hair growth.

Functions

- Protection
- Sensory function

- Regulation of body temperature

Hair follicles are important as they provide a site for bacterial growth leading to body odor.

2. Sebaceous Glands

These glands secrete sebum (oil).

Functions of Sebum

- Lubricates skin and hair
- Prevents dryness
- Provides antimicrobial protection

Excess sebum can contribute to odor and skin problems.

3. Sweat Glands

There are two types:

1. Eccrine glands
2. Apocrine glands

Functions

- Production of sweat
- Regulation of body temperature
- Removal of waste substances

Sweat glands play a crucial role in deodorant action because body odor is mainly caused by bacterial decomposition of sweat.

3. Hypodermis (Subcutaneous Tissue)

The hypodermis is the deepest layer located below the dermis.

Composition

- Adipose (fat) tissue
- Loose connective tissue

Functions

- Storage of fat (energy reserve)
- Shock absorption

- Thermal insulation
- Attachment of skin to underlying muscles

Deodorant powders do not penetrate this layer; their action is limited to the upper layers of the skin.

Physiology of Skin Barrier

The skin barrier mainly depends on the stratum corneum. It is often described as a:

"Brick and Mortar Model"

- **Bricks** represent dead keratinized cells
- **Mortar** represents lipid layers

This structure helps prevent water loss and protects the body from harmful substances and microbial invasion.

9. OBSERVATION AND RESULT

1. To formulate a deodorant powder using suitable ingredients as the main active components.
2. To prepare a safe, effective, and skin-friendly deodorant formulation using appropriate ingredients.
3. To evaluate the physical properties of the prepared deodorant powder such as:
   Color
   Odor
   Appearance
   Texture
   pH Spreadability
   Absorbability
4. To study the deodorizing action and skin compatibility of the deodorant powder.
5. To evaluate the stability of the formulation under different storage conditions.
6. To determine the irritation potential of the prepared deodorant powder on skin.
7. To develop a deodorant powder formulation that helps in absorbing sweat, reducing odor, and providing a refreshing effect to the skin.

The deodorant powder was successfully formulated using suitable ingredients. The prepared formulation showed good appearance, pleasant odor, smooth texture, and satisfactory deodorizing action. The pH of the formulation was found to be compatible with skin, indicating that it is safe for topical application.

The formulation provided a cooling and refreshing effect on the skin. The formulation also demonstrated satisfactory stability during storage studies without significant changes in color, odor, or texture.

Overall, the formulated deodorant powder was found to be effective, stable, and suitable for maintaining freshness and hygiene of the skin.

10. DISCUSSION

The present study was carried out to formulate and evaluate a deodorant powder using suitable ingredients as the main active components. The prepared formulation showed good appearance, uniformity, and acceptable texture. The pH of the formulation was found to be near the normal skin pH, indicating that the preparation is suitable for topical application without causing irritation to the skin.

The formulated deodorant powder exhibited satisfactory spreadability and absorbability, which are important characteristics for effective sweat absorption and odor control. The formulation was easy to apply and provided a refreshing effect on the skin after application. The ingredients present in the formulation contributed to moisture absorption and reduction of body odor.

The stability study indicated that the formulation remained stable under normal storage conditions without significant changes in color, odor, pH, or texture. The skin irritation test showed that the formulation was safe and did not produce redness or irritation on the skin surface.

The study confirms that suitable ingredients can be effectively incorporated into cosmetic powder formulations for personal care applications. Compared to conventional products, the prepared deodorant powder provides good skin compatibility, effective odor control, and minimal risk of irritation.

11. CONCLUSION

From the present study, it can be concluded that the formulated deodorant powder was successfully prepared and evaluated using suitable parameters. The formulation showed good odor control, satisfactory absorbability, proper pH, good spreadability, and stability. The prepared deodorant powder provided a refreshing effect, effective moisture absorption, and skin-friendly performance.

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