Deodorants and Antiperspirants
• Anatomy and Physiology of Human Sweat Glands
  • Sweating is an important body temperature regulator, especially in warm and humid weather climates, stress situations, or during heavy exercise.
  • It also functions to remove waste and toxic by-products from the body.
  • Most people have several million sweat glands distributed over their bodies, providing plenty of opportunity for underarm odors to develop.
• Sweat glands found in human skin are classified into two different types: eccrine glands and apocrine glands

• Their secretory portion is found deep in the dermis, from which a duct leads directly onto the skin surface.

• They function continuously and are known as the “true” sweat glands since their main function is to control body temperature and electrolyte balance through the evaporation of water from sweat on the body surface.
• **Apocrine glands** are primarily **limited to certain body parts**, such as the axilla, anus, and breast.

• These are also found in the dermis; however, these are larger than eccrine glands and their ducts **open into the hair follicle duct**.

• Apocrine glands also **exist at birth**; however, they become **functional at puberty**

• They are usually **triggered by** emotions, such as excitement, anger, and fear.
Figure 3.31  Eccrine and apocrine sweat glands.
• **Sweat by itself is odorless.** A characteristic odor develops by the activity of bacterial flora on the skin surface.

• **Bacteria break down** various chemicals in sweat, resulting in volatile by-products, which have an unpleasant odor.

• The human scent is **genetically controlled and systemically influenced by** dietary and medicinal intake, as well as by the application of fragrance products.
Types and Definition of Products Reducing Body Odor

- **Deodorants** reduce or mask unpleasant body odors by reodorization and/or antibacterial action. However, they do not interfere with the delivery of sweat gland secretions.

- **Antiperspirants** reduce underarm wetness by inhibiting perspiration that is secreted by the eccrine glands.

- **Antiperspirants** usually contain aluminum-based or aluminum-zirconium-based compounds that can form a temporary plug within the sweat duct and stop the flow of sweat to the skin surface.
• It should be noted that a, “deodorant” is not an “antiperspirant” but an “antiperspirant” can be a “deodorant.”

• The reason for this is that aluminum salts have **bactericidal properties**, rapidly reducing the indigenous bacterial population when applied on a regular basis.
Hyperhidrosis

• There is a condition called hyperhidrosis or excessive sweating.

• The excessive sweat leads to unpleasant body odor that can adversely affect the person’s ability to attain a normal and healthy QoL.

• The treatment of hyperhidrosis usually starts with OTC antiperspirants. However, none of today’s OTC antiperspirants are specifically designed or claimed to have a beneficial effect on excessive sweating.
Hyperhidrosis

• **Additional treatment options** include prescription antiperspirants, oral medications, topical injections, and surgery.

• Prescription antiperspirants contain **higher doses of aluminum chloride**, which can cause irritation and damage clothing.

• FDA approved **Botox (botulinum toxin type A)**, to treat severe underarm sweating (not for other sites) that cannot be managed by topical agents.
• **Side effects**

• Minor negative effects may occur.

• **Skin irritation** and **allergies**. One of the major causes can be the use of products on **broken skin** (e.g., from shaving). This irritation can be avoided if the product is not used after such procedures. They are most commonly related to the **fragrances**.

• Antiperspirants can **stain** the clothes, which is a distinct negative effect from consumers’ perspective.
• Consumers have concerns that antiperspirants may interfere with the body’s natural cooling process, leading to **overheating**.
• Studies show that this is **not true** for several reasons:

1. The axillary region is **more involved with apocrine sweating**, which is triggered by emotional arousal, than eccrine sweating, which regulates the body temperature.

2. Even when eccrine sweating happens, the sweat **cannot efficiently evaporate and cool** the body due to the occluded nature of the underarm region.
• **Required Qualities and Characteristics and Consumer Needs**

From a consumer perspective:
• Neutral or pleasant odor
• Easy to spread
• Pleasant feeling during application
• Well-tolerated and non-allergenic
• Long-term deodorization
• Quick drying properties
• Non-staining properties
Required Qualities and Characteristics and Consumer Needs

The technical qualities:

• Fulfill long-term stability
• Appropriate texture
• Appropriate rheological properties
• No irritation potential
• Dermatological safety
Types of Ingredients

• **Odor masking** ingredients reduce the perception of odor through blending with underarm odor and masking it. **Examples** for such ingredients are fragrances.

• **Odor neutralizing** ingredients chemically neutralize odorous compounds, yielding odorless components. **Examples include** sodium and potassium bicarbonate and zinc carbonate.
• Odor quenching ingredients bind to the odorous chemicals and form complexes with these materials. **Examples include** zinc ricinoleate, certain metal oxides such as zinc oxide, Hydroxyapatite.

• Odor absorbing/adsorbing ingredients physically neutralize odorous molecules formed in the axilla via absorption or adsorption. This results in the **immobilization** of those molecules, **decreasing their volatility** and thus decreasing the perceived odor. **Range of silicones and silicates** are claimed to offer odor absorption benefits.
• **Esterase inhibitors** act by directly inhibiting certain enzymes of the underarm bacteria, which results in odor reduction. **An example** is zinc glycinate. **Another option to inhibit enzymes is to shift the pH optimal** for the development of underarm odor (pH 6) to the acidic range. **Lipophilic derivatives of citric acid are examples for such ingredients.**
• **Antiperspirants** reversibly block sweat gland excretion by **forming a temporary, gelatinous plug** in the eccrine duct that reduces, but do not stop, the flow of axillary perspiration.

• These blockages **prevent sweat from reaching the skin surface** in the axilla.

• They can remain within the sweat duct for **7-14 days**, depending on the rate of skin desquamation, user’s hygiene regimen, activity type, and quality.
• **Antimicrobial** prevent underarm odor formation by inhibiting or deactivating the bacteria.

• **Examples include** ethanol; triclosan; quaternary ammonium salts; glyceryl fatty acid esters, and sucrose fatty acid esters.

• **Essential oils**, such as thyme and clove oil, can also have antimicrobial benefits, in addition to masking bad odor.

• Antiperspirant active ingredients also have antimicrobial properties
The active ingredients can be divided into two groups:

- **Aluminum-based** agents, such as aluminum chloride, aluminum chlorohydrate, aluminum sesquichlorohydrate, aluminum dichlorohydrate, and aluminum sulfate.

- **Aluminum-zirconium-based** agents, such as aluminum zirconium tri-, tetra-, penta-, and octachlorohydrate.
• **Most Common Dosage Forms for Deodorants and Antiperspirant:**

1. Roll-ons
2. Solid sticks
3. Extrudable clear gels
4. Extrudable soft solids
5. Aerosols.
• **Roll-Ons:**
  
  • Nonoily feel and good spreadability
  
  • There are **various types** of roll-ons differing in their vehicle:

  > **Water-based** roll-ons are usually **opaque O/W** emulsions.

  • The active ingredient is typically formulated into the **external phase** to provide **better efficacy**.

  • These systems are usually based on **nonionic surfactants**, as well as emollients, humectants, hydrophilic thickeners, antioxidants, chelating agents, texturizers (such as talc or corn starch for a soft skin feel), preservatives, and fragrances.
Hydroalcoholic roll-ons have a shorter drying time and offer a refreshing feeling upon application.

- Only alcohol-soluble actives can be used in this system.

- These products are usually thickened with a hydrophilic polymer, such as cellulose derivatives or carrageenan.

- Emollients and silicones can also be incorporated using proper emulsifiers.
Silicone-based roll-ons can be formulated as anhydrous products where the actives are suspended in volatile silicone oils, such as cyclomethicone.

- To prevent sedimentation of the powder as well as thicken the silicone-based formulation, usually non-surfactant suspending agents are used.

- The smaller the particle size, the slower the settling rate.

- Silicone-based roll-ons can also be formulated as W/Si emulsions, which are very popular due to the dry, non-tacky feel they provide.
• **Solid Sticks**

- Deodorant sticks are typically based on sodium stearate as the gelling agent.

- The deodorizing agents and fragrances are usually dissolved in the **hydrophilic vehicle**, which is primarily a mixture of water and propylene glycol and/or dipropylene glycol.

- Products with *alcohol* are also available; however, they are not as popular as glycol-based formulations.
• **Nonionic surfactants** can be employed to provide **transparency** to the formulations; examples include PPG-3 myristyl ether and isosteareth-20. **Sodium stearate** can also contribute to the **clarity** of the formulas.

• **Also contain** preservatives, antioxidants, and chelating agents

• **Neutralizing agents** may be needed to adjust the product’s pH

• **Colors** can also be added to these formulations.
- Antiperspirant sticks are usually anhydrous suspensions containing the suspended antiperspirant actives in a silicone-based vehicle.

- Examples for such silicones include cyclopentasiloxane and cyclomethicone, which provide quick drying without being tacky or oily.

- Sticks usually contain various waxy and liquid emollients for a soft skin feel and glideability.

- Nonionic surfactants, such as PPG-4 butylhexyl phosphate, can be used as dispersing agents for the antiperspirant actives.
• **Hardening agents** are generally **waxy solids**, such as stearyl alcohol, and hydrogenated castor oil, which **give structure** to the stick and act as lubricants.

• **Thickeners** commonly used which help keep the suspended particles in a suspended state and slow down settling.

• **Talc and silica** can also be used since they are effective suspending agents and can also provide lubricity for the formulation.

• **Additional ingredients** can include colorants, titanium dioxide (as an opacifying agent), fragrance, buffers, and antioxidants.
Extrudable Clear Gels

• Extrudable gel sticks are transparent formulations

• often associated by consumers with a lack of white residue on the skin. Therefore, they are also quite popular.

• These formulations are usually W/Si emulsions

• similar to silicone-based roll-ons with a higher viscosity.
Extrudable Clear Gels

- contain the antiperspirants actives dissolved in water in the internal phase.

- The internal phase may also contain alcohol and humectants, such as propylene glycol.

- Commonly used silicones include cyclopentasiloxane, dimethicone, cyclomethicone, and trisiloxane.

- They may also contain thickeners, electrolytes for stability, and fragrances.
Extrudable Soft Solids

- Extrudable soft solids are usually **white anhydrous silicone** suspension pastes.
- The powder active ingredient is suspended in the silicone and/or hydrocarbon vehicle.
- The paste is **thickened** to the desired viscosity with **waxes**
• **may also contain** preservatives, chelating agents, antioxidants, color additives, and fragrances.

• These products **rub in quickly**, are **non-tacky**, leave little or no visible residue on skin, and deliver high levels of antiperspirant protection.

• **the smaller the particle size**, the **slower the sedimentation** and the greater the stability of the system.
• **Aerosols**

• Aerosols are **popular** delivery systems for consumers who prefer a **hygienic** and **easy-to-use** product form.

➢ **Deodorant aerosols** typically contain a **solution of a deodorant** ingredient, which is blended with a **liquefied propellant**.

• **Propane, butane**, and **isobutane** are the most commonly used propellants.

• They condense to form a **clear, colorless, and odorless liquid**.
Antiperspirant aerosols are also anhydrous formulations, similar to deodorant aerosols.

- Difference between an antiperspirant aerosol and a deodorant aerosol: antiperspirant actives are suspended in the product concentrate and are not solubilized.

- The vehicle usually consists of volatile silicone oils, such as cyclomethicone, or a mixture of ester oils and silicones.

- Agglomeration of solid particles and settling of actives can be minimized by using suspending agents, such as clays (bentonite and hectorite).
• These systems generally contain the same propellants as deodorant aerosols.

• In addition, they can contain emollients; fragrances; and preservatives.

• Sedimentation is a potential concern for them, despite the application of thickeners.

• Therefore, most antiperspirant aerosol sprays have directions on shaking the can before use in order to homogenize the product.
• Ingredients Causing Safety Issues

➢ Aluminum

• breast cancer-antiperspirant concerns ("myths" as the FDA refers to them)

• The false information suggests that:

1. Antiperspirants can absorb through razor nicks from underarm shaving and deposit in the lymph nodes.

2. As antiperspirants prevent sweating, users cannot sweat out toxins, but they remain in the body, leading to cancer.
• Most studies performed showed no link between breast cancer and the aluminum content or antiperspirants.

• The actual amount of aluminum absorbed would be much less than what would be expected to be absorbed from the foods a person eats at the same time.

• Additionally, it seems that breast cancer tissue does not contain more aluminum than normal breast tissue.
• Now the FDA requires all antiperspirant products to have a warning statement that advises people with kidney disease to consult a physician before using the product.

• The kidneys play a large role in eliminating aluminum from the body, and therefore, patients with impaired kidney function may have a higher level of aluminum exposure.
• Additional health concern regarding the use of aluminum containing antiperspirants and Alzheimer’s disease.

• **studies have failed to replicate** the results of that particular study performed in the 1960s and confirm the role of aluminum in causing Alzheimer’s.

• There are **ongoing studies** investigating this topic.

• Currently, the research community is generally convinced that **aluminum is not a key risk factor** in developing Alzheimer’s disease.
Zirconium

• Zirconium is used as a complexing agent to form various complexes.

• Concerns arose regarding the carcinogenic potential of aerosolized zirconium complexes through inhalation.

• Today, no zirconium-containing active ingredients can be incorporated into aerosolized antiperspirant formulations.