Chemicals to Keep You Fresh and Pleasant All Day Long

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Many slogans and sayings make a very positive link between sweat, work, and achievement. However, human attitudes demand that body malodour generated from sweat on hard work is eliminated at the earliest. This attitude of cleanliness was largely responsible for use of various methods to control body malodour from time immemorial. The earliest form of controlling body odour is bathing, and till today has no substitute. Regular bathing not only eliminates sebaceous secretions and odorous end products of perspiration but also skin bacteria that are equally responsible for body malodour.

The urbanisation of the population, continuous media coverage, influence of advertising, rising education, standard of living and higher disposable income have all contributed in increasing the desire to smell fresh, pleasant and be accepted by the social circle. Freshly washed healthy body is not unpleasant. Similarly fresh perspiration is odourless. However, the bacterial activities in presence of body secretions, contribute to the intensity and quality of odour.

The concept of masking body malodour is very old, but the development of personal hygiene requirements, to the present degree, leading to the growth of specialised products is recent. This growth specially to fight malodour in the axillae region, has been remarkable for the last 100 odd years. In earlier days, masking unpleasant body odour with a pleasant smell was popular, but now-a-days, preventing the development of malodour in the first place and thereby eliminating body odour is necessary.

Antiperspirant and deodorants are two specific categories of products that are used for this purpose and marketed as aerosols, creams, roll-on's, lotions, liquids, sticks, etc. To understand the differences between deodorants and antiperspirants a brief understanding of our skin structure and the various glands responsible for sweat is essential.

HUMAN SKIN

The skin is no ordinary structure in the human body. This 1.7 m^2, protective cover separates the fragile interior of our body from potentially harmful and damaging stimuli present in the environment. The skin, thus regulating body temperature controls loss of water from the body tissues. Different sensory nerve endings that are present on our skin also protect the human body. Our skin cover prevents penetration of radiation. The skin, thus protecting the human body from any damage also resists mechanical jerks caused by external agencies.

Skin is composed of two main layers, the "Epidermis", and the "Dermis".

Epidermis

The Epidermis is the most superficial layer, composed of stratified squamous epithelium. From the outside inward, the stratified epithelium is divided into five layers as described below.

* "Stratum Corneum" is the most superficially placed cells without nuclei and that are keratinised, with indistinct cell outlines. This layer is thickest at the soles and the palms and very thin at the lips. Hairs, nails, etc., are outgrowths of this layer.

* "Stratum Lucidum" is a thin, slightly transparent layer 3 to 5 cells deep and placed below the "Stratum Corneum" very similar to it with indistinct cell outline without nuclei.

* "Stratum Granulosum" consisting of 3 to 5 layers of flattened polyhedral cells is followed by

* "Stratum Spinosum" that is also made up of polyhedral cells of variable thickness. The surface of these cells is covered with minute spines, that interdigitate with similar spines of adjacent cells. These cytoplasmic protrusions are also called as the "Prickle Cells". The branches of two cells do not have cytoplasmic continuity but are attached to by well-developed cytoplasmic nodes or desmosomes. These cells are basophilic supported by a network of cytoplasmic fibrils. Star shaped branched cells capable of DNA synthesis, also called as "cells of Langerhans" is scattered irregularly throughout this skin.

* "Stratum Germinativum" (Stratum Malpighii), composed of a single layer, of columnar epithelium, having transverse, thin, short, cytoplasmic process on its basal lamina. It anchors the epithelium to the lower dermis. These cells with oblong nuclei, with cuboidal to columnar cell's structure are placed perpendicular to the basement membrane, and produce newer cells to replace those above by the process of "mitosis." At the junction of the epidermis and dermis are present "melanocytes" or "melanin"

containing branched cells. “Malpighain cells” and the “melanin” present in the deeper cells of the “Stratum Germinativum” is produced by these melanocytes. Cytrocrine secretion converts the fully formed “melanin” granules from melanocytes to the malpighain cells. Melanin is a yellow to black pigment found in the Stratum Germinativum. It is formed on a specific cell particle, the melanosome within the melanocytes. Melanin contributes colour to the skin moreover protects one from the Ultra-violet rays of solar radiation.

Dermis

“Dermis” or the “true skin ”consisting of connective tissue, lies below the epidermal layer which it supports and binds to the underlying tissues. Chiefly made up of collagen’s and elastic fibre, it provides tensile strength. Structurally the superficial part of the dermis is compact and forms the papillary layer resembling innumerable finger like projections into the prickle cell layer of the epidermis. The inner part of the dermis is made up of loose connective tissue containing fat. This layer constitutes the reticular layer of the dermis merging into the subcutaneous layer of fat.

Fibroblasts cells from which the fibrous tissue of the dermis develops is present in the dermis. Melanophores containing melanin pigments and cell belonging to the reticulo-endothetilal system protecting the body from invading bacteria is also present in the dermis.

Unlike epidermis, dermis has an well-organised lymphatic system and a luxuriant capillary blood vessel network supplying blood to the tip of the dermal papillae that play an important role in regulating temperature. Besides bundles of involuntary muscles and vasomotor nerves, dermis has sensory nerve endings of different types that keep an individual informed about the surroundings.

Pear shaped Sebaceous glands located in the dermis open into the root of the hair follicles and secretes an oily material called as sebum. In places that are independent of hairs, (sebaceous glands are not present at the palms and soles) the duct of the sebaceous glands opens directly to the surface of the skin.

The sebaceous glands are very active during adolescence and when the secretion is improper, the sebum lodges in the ducts as whitehead, the outerportion of which may get oxidise to blacken and form a blackhead. Sebum is rich in fatty acids, cholesterol, cholesterol esters, triglycerides, wax esters, and other aliphatic components. The cholesterol present in sebum can absorb about 100% water and keep the surface of the skin moist. Irradiation of sebum creates vitamin D. Sebum behaves as a lubricant to prevent damage to the epidermis during summer and conserves heat during winter.

Sweat glands are distributed throughout most of the skin. There are about 3 million active sweat glands in the body. The lower ends of the sweat glands reach deep part of the dermis and act as islands or regrowth of epidermis in cases of injury and burns. Modified smooth muscle cells, known as the myoepithelial cells present at the base of the sweat glands surround their ducts in a manner that their contraction help in elimination of sweat. Sweat glands are of two types, Eccrine, and Apocrine.

Eccrine glands are distributed throughout the surface of the body. They are present in large numbers on the palms and soles than on the head or the trunk. In humans, they may be present peaking at levels of 200 to 400 per square centimetres of skin surface. Their discharges are altered primarily due to changes in deep body temperature.

Glands present at the palms and soles respond and secrete at times of emotional stress. Eccrine sweat composition depends on the blood constituents and contains NaCl, urea, lactates, creatinine, uric acid, ammonia, amino acids, glucose, water soluble vitamins B and C.

Apocrine glands are larger sweat glands and derived from the hair follicles. The distribution of these glands in humans varies from individual to individual and race to race. Apocrine glands are found in special regions such as axillae, areola of the nipples, mons pubis, labia majora, etc., are said to be of sexual significance responding to the circulating adrenaline.

It is said that for every apocrine gland there is one Eccrine gland in the axillae region, whereas the ratio is one apocrine gland to ten eccrine gland in other areas. Thus, the main area where body malodour is produced is the axillae region. Apocrine sweat glands become active only after puberty in a normal healthy individual. Initially apocrine secretion is viscous, milky, and odourless but after puberty, their secretion varies in composition, possessing a characteristic odour. The odour is due to the presence of indoxyl, volatile fatty acids, hydroxy acids, ammonia, and other metabolic excretory products. Although fresh perspiration is odourless, the bacterial activity in presence of these secretions contributes to the intensity and quality of odour.

Sweating is very important physiologically as active secretion plays a vital role in keeping the body cool and regulating body temperature. When the ambient temperature is higher than body temperature, sweating is the only means of keeping the body temperature normal.

CONSTITUENTS OF ECCRINE PERSPIRATION
(Values for 100 ml sweat)

Water	99.22 to 99.74 g
Solids	1.174 to 1.587 g
Ash	0.147 to 0.566 g
Creatinine	0.1 to 1.3 mg
Urea	12.0-57.0 mg
Lactic acid	285 to 336 mg
Carbolic acid	2.0 to 8.0 mg
Sugar as glucose	1.0-3.0 mg
Uric acid	0.07 to 0.25 mg
Dehydroascorbic acid	70.5 µg
Total nitrogen	33.2 mg
Non-protein nitrogen	27.0 to 64.0 mg
Amino acid	1.1 to 10.2 mg
Ammonia nitrogen	5.0 to 9.0 mg
Urea nitrogen	5.0 to 36 mg
Calcium	1.0 to 8.0 mg
Iodine	0.5 to 1.2 µg
Iron	0.022 to 0.045 mg
Chloride	36.0 to 468.0 mg
Sodium ions (Na+)	24.0 to 312.0 mg
Potassium ions (K+)	21.0 to 126 mg
Sulphur	0.7 to 7.4 mg
Copper	0.006 mg
Amino acids (Total)	43.62 mg

CONSTITUENTS OF APOCRINE PERSPIRATION

(Exact composition is not yet fully understood)

Indoxyl
Volatile fatty acids
Hydroxy acids
Ammonia
Carbohydrates
Steroids

CONSTITUENTS OF SEBUM
(Exact composition is not yet fully understood)

Fatty acids
Stored cholesterol
Cholesterol esters
Triglycerides
Wax esters
Other aliphatic components.

It may be noted that NaCl varies from 0.2 to 0.5%. Muscular exercise increases the concentration of salt in sweat. Sweat secreted by clothed skin has a higher salt concentration than that of naked skin.
Profuse sweating eliminates almost 0.5 to 1.0 g of non-protein nitrogen.

TYPES OF SWEATING IN HUMANS

* Insensible perspiration occurs, even in cold climate amounting to about 600 to 800 ml per day.
* Psychic sweating occurring chiefly in the palm, sole, axillae, head, and neck in extreme emotional conditions. Muscular exercises, eating spicy foods, sympathetic activity, nausea and vomiting, fainting, hypoglycaemia and asphyxia can induce sweating. Sweating is reduced by cold due to reduced cutaneous circulation. It is also reduced by dehydration either by reduced fluid intake or by excess sweating. Drinking a glass of cold water dilutes the blood and this can induce sweating profusely.
* Thermal sweating occurs in hot environmental temperature. As the environmental temperature increases, sweating rises and can under extreme conditions amount to 11 litres per day. Males start sweating excessively at temperatures above 28°C and females above 31°C. Apocrine glands activates at an earlier age in females than males. Women also have a larger number of apocrine glands, compared to men. Moreover the secretion granules of women are larger and so more the odours generated.

Although the axilla is more of apocrine organ, the profuse perspiration formed is due to the Eccrine glands that secrete large amounts of sweat in comparison to apocrine glands. Although eccrine perspiration is only a dilute solution of salts and less important in causing axiliary odour compared to apocrine secretion, it does indirectly contribute to overall promotion of malodour.

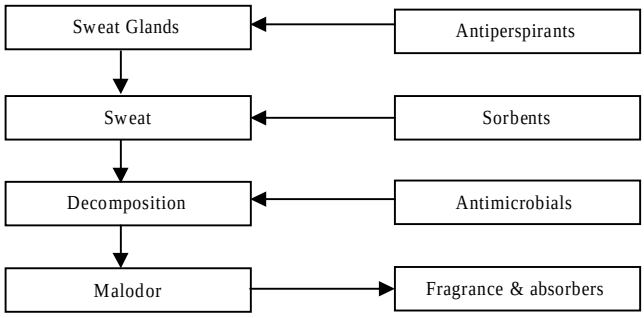
The smaller amounts of apocrine secretions that are sticky and oily in nature are dispersed over a wider area by moisture of the eccrine secretions. The Eccrine moisture generated by the eccrine secretions also provides an ideal environment to the rapid growth and proliferation of bacteria responsible for malodour. Hairs present on the axillae act as an ideal collecting site for the apocrine secretion and increase the surface area available for bacterial growth promoting body malodour.

The sebaceous secretions are decomposed by the skin bacteria-giving rise to numerous odorous substances, producing the natural odour of human skin. Although lower fatty acids, steroids, and lactones present in the sebaceous secretion have no inherent smell, they help in fixing the odour on to the skin. Body odour profiles being subject to the food habits, race of decent, physical and physiological condition is specific to every individual. Thus two persons will smell differently, depending on personal traits, environment, social and physiological reasons. The physiological state of the human body also determines the emanating odour profiles, containing pheromones, and sexually pleasing to attract the opposite sex.

From the physiology of sweating, it is easy to understand that in order to reduce or control axilliary odour one has to do the following:

* Absorb body odour.
* Arrange to remove the secretion or perspiration from the sweat gland at the earliest possible time and in the most practical way.
* Reduce or suppress apocrine sweating in the axillae.
* Prevent or inhibit growth and proliferation of bacterial flora.

Thus developing substances to fight offensive body odour, every step in the process should be checked for possible means of eliminating previously formed odour. Antiperspirants and deodorants were introduced in the early 1900's as a single product concept. During those times, perspiration and body odour were regarded as a singular body problem. Today body odour and perspiration are related entities but very distinct from each other. This has made available to the customers two distinct products namely antiperspirants and deodorants.



Antiperspirants are topical products specifically formulated to inhibit and reduce the production of perspiration either physically or by chemically affecting the physiology of skin structure and sweat glands. It is important to note that antiperspirants, mode of action alter a normal body function, viz., sweating. This qualifies antiperspirants as therapeutic products and so an active ingredient that behaves as one has to be considered as a drug.

Many chemical ingredients were used in marketed products to control perspiration in earlier times. With the passage of time and advances made in this field, nowadays the most common astringent salts used are metal salts of aluminium and zirconium. Aluminium salts and complexes are highly preferred as at low concentrations of (0.5 – 1.0 %) they also exhibit bacteristatic and bactericidal properties. This added advantage to its ability to reduce perspiration makes it a very popular ingredient in an antiperspirant product.

Antiperspirants mode of action on the axillae in preventing perspiration is still unclear. There are many theories suggested by various researchers.

* It is claimed that the formation of a blockage or plug in the sweat gland duct reduces the production of sweat at the glandular site. Aluminium and zinc salts ionise and complex with protein precipitating aluminium proteinate or the amphoteric hydrated aluminium oxide, forming a physical plug in the sweat gland, blocking the flow of perspiration to the surface of the skin.
* An alternate theory suggests that the permeability of the gland and duct walls be altered so that the moisture produced is reabsorbed back into the outer layer of the skin.
* A change in the electrophysical potential of the sweat gland, reduce the ability to transport sweat by forming a metal soap. The metal soap is formed by the reaction of

POPULAR ANTIPERSPIRANT CHEMICAL INGREDIENTS

Aluminium chlorohydrate	Permitted for use
Aluminium dichlorohydrate	25% maximum
Aluminium sesquichlorohydrate	(anhydrous)
Aluminium chlorohydrex propylene glycol complex	in all types of
Aluminium sesquichlorohydrex propylene glycol complex	products
Aluminium chlorohydrex poly propylene glycol complex	
Aluminium dichlorohydrex poly propylene glycol complex	
Aluminium sesquichlorohydrex poly propylene glycol complex	
Aluminium zirconium trichlorohydrate	Permitted for use
Aluminium zirconium tetrachlorohydrate	20% maximum
Aluminium zirconium pentachlorohydrate	(anhydrous)
Aluminium zirconium octachlorohydrate	in all types of
Aluminium zirconium trichlorohydrex glycine complex	products except
Aluminium zirconium tetrachlorohydrex glycine complex	aerosols
Aluminium zirconium pentachlorohydrex glycine complex	
Aluminium zirconium octachlorohydrex glycine complex	

the metal ions with the fatty acid present in sweat to plug the flow is another view.

* The degenerative Edema of the epidermis surrounding the sweat gland and duct restricting sweat flow is also put forward as a possible theory.

Although, use of antiperspirants reduces the flow of perspiration, it cannot be stopped completely. Moreover, there are large variations between individuals, in the degree of antiperspirant activity of metal salts. Some people perspire a lot. In such persons, the flow of sweat washes away the metal salts before the antiperspirants can exert any effect.

Sweating is an important physiological function for maintaining and controlling the body temperature. It is critically important to sweat for preserving the hydration and plastiazation of the skin surface. Many believe that using antiperspirants and limiting perspiration can be unhealthy.

There is an equal number who refute that the underarm areas only represent about 1% of the total body surface and that reduction of sweating by antiperspirants does not adversely affect the body's ability to control body temperature. In a topical country like India, how far an antiperspirant is to be used, is still a matter of conjecture.

Deodorants on the other hand, do not interfere with any naturally induced body function and are considered as cosmetics. Deodorants are designed to suppress the body odour, by physically masking the malodour, and covering it with a pleasant smell of fragrances or by preventing the formation of odiferous products caused due to the bacterial flora. Deodorants reduce the amount of skin bacteria that are directly responsible for body malodour through bacterial decomposition of perspiration and sebaceous residues.

Apocrine and Eccrine secretions are sterile and have little or no odour. However, a variety of micro-organisms has been reported to thrive in the axillae region. Although the microbial flora can be removed by normal washing procedure, the reduction in the total number of micro-organisms is only temporary.

The microbial flora soon returns to the normal level that is specific to an individual's normal count. Bacteria's are more evident at the openings of the hair follicles, than on the surrounding skin. An antiseptic to be topically effective, it must enter the follicular openings where the majority of the bacteria's are present.

Gram-positive microbes of the axillae act on the apocrine sweat forming malodorous acids, namely butyric, formic, acetic, propionic and valeric acids that are responsible for the typical odour of decomposed apocrine sweat. When skin is occluded, a very sharp increase in the bacteria and yeast cells take place in the upper most portion of the follicle orifice population, in relation to a non-occluded incubated skin surface. Almost all investigations have concluded that the auxiliary areas normally support growth of gram-positive microbes with some gram-negative ones.

It is possible to suppress the gram-positive, with or without the subsequent over growth of gram negatives. Gram-positives are mainly responsible for the typical odour of the decomposed apocrine. Bacterial resistance, super infection or fungal over growth does not occur inspite of any alteration of bacterial population.

Consistent use of deodorant products permits the accumulation of a small amount of the active ingredient, present, resulting in the reduction of the bacterial count. Typical application of deodorants cause very little ecological impact expect for a slight local increase in gram-negative population.

We do not like a hot wet climate, but the bacteria's love it, especially in the axillae region, where it is moist and comfortable at 37 ^{o} centigrade. A variety of gram-positive diphtheroids and coagulase positive and negative Staphylococci have been identified in adults as the main types of bacterial organism responsible for development of body malodour from perspiration.

Organisms escherichia coli proteus, pseudomonas, mima polymorpha and gram-negative staphylococci, herellea vaginicolla, and C'albicans, occasionally found in the axillae region are transients, and come and go sporadically depending on the circumstances.

Numerous chemical agents have been investigated and the practicality of inhibiting the development of auxilliary odour demonstrated. The use of anti-microbial agents to inhibit body malodour provides a sound rational for deodorants in many scientific studies. A wide selection of external anti-microbial agents has been popular and widely used in deodorants.

PCMX (Para dichlorometaxylenol) and DCMX (dichlorometaxylenol) are effective agents in reducing the bacterial flora. However, the objectionable phenolic odour of these chemicals, the purple to purple-red colour they impart to the formulations in presence of even small amounts of solubilised iron present in the product makes them unpopular.

Metallic salts of aluminium, zinc and zirconium salts have also been effective anti-microbial agents. The most commonly used salts include the following:

Aluminium chloride	Zinc oxide	Zirconium oxide
Aluminium potassium sulphate	Zinc phenol sulphate	Zirconium hydroxide
Aluminium phenol sulphate		Sodium zirconium lactate
Aluminium sulphate		
Aluminium chlorohydrate		

Deodorant formulation having a high degree percentage of alcohol / propylene glycol as base also possess very good bacteriostatic activity. Earlier anti-microbial such as neomycin, hexachlorophene and quaternary ammonium compounds are no longer used in deodorant products. Due to reported cases of photoallergic dermatitis, salicylic acid, and its brominated derivatives used earlier is not used now. Neomycin binds fatty acids resulting in an enhanced growth of neomycin resistant staphylococci. Hexachlorophene is banned due to infant deaths in 1969. Bacteria are released from negatively charged surfaces, and get attracted to positively charged surface. Quaternary ammonium compounds hold bacteria to the skin surface by altering the "Keratic charge" from its normal negative charge to positive.

The most commonly used anti-microbial used in deodorant products are chlorhexidine gluconate, triclosan, farnesol alone and in combination with glycerine laurate plus phenoxyethanol. Triethyl citrate and BHT in combination is also used in deodorants in comparatively limited scale. Of these chemicals triclosan is the more popular one followed by other actives that are used in lesser extent

Chlorhexidine an effective chemical antimicrobial agent is available commercially as the gluconate salt. Chemically it is 1,1'- hexamethylene bis (5-(p- chlorophenyl)) biguanide. It is cationic in nature and has a broad antimicrobial activity, effective against both gram positive and gram negative bacteria, yeast, dermatophytes, etc. It is not effective against spores and viruses. Its activity is not seriously effected by the presence of organic matter. Chlorhexidine shows different effects at different concentrations. At low concentration levels, the agent is bacteriostatic, whereas at higher levels it is bactericidal. The actual level at which it manifests as bacteriostatic or bactericidal depends on the bacterial species present. Unfortunately, Chlorhexidine reacts with anionic surfactant species, reducing the activity of the agent that becomes a major factor that cannot be overlooked when used in formulating a deodorant product.

Triclosan is a synthetic chemical that is now extensively used in deodorants. Chemically it is 2,4,4' trichloro-2 hydroxy diphenyl ether, an odourless or very faintly aromatic, off-white powder, with a melting point of 57° ± 1°C. It is stable in normal storage conditions, easy to incorporate in a formulation. Triclosan is relatively stable up to 150°. It is practically insoluble in water, moderately soluble in alkaline solutions, and readily soluble in most non-polar organic solvents. Triclosan is lipid soluble. It is incorporated at a level of 0.1 to 0.3 % (w/w) of the formulation, dissolved in suitable solvents and added to deodorants, to inhibit halitosis. Triclosan containing products show an antibacterial effect against pathogenic gram-positive and gram-negative strains that are mainly responsible for unpleasant body odour and has been determined by well-designed sniff test studies.

Triclosan is a broad-spectrum antimicrobial agent whose activity is dependent on the concentration and formulation of the product. Different experiments and extensive studies carried out to find the mode of action of triclosan concluded that the primary action of triclosan is directed against RNA, and protein synthesis in bacteria. It is considered that the uptake of nutrient molecules by the bacterial cell wall as well as whole bacterial cells by diffusion might be inhabited by triclosan with the cytoplasmic membrane being the target. When exposed to low concentrations of triclosan, the bacterial cells do not die, but their growth and multiplication are inhibited although the degree may not be the same for all nutrient molecules. Experimental findings support the hypothesis that bactericidal concentrations of triclosan induce a release of cytoplasmic material from the bacterial cells, inducing a decrease in the optical density of the suspension and eventual death. Thus there is a difference between the bacteriostatic effect of triclosan that results due to the prevention of the uptake of nutrients be the cell membrane and the bactericidal effect that is caused due to the irreversible disruption and rupture of the cell membrane.

Acute toxicity studies reveal that Triclosan is not a toxicant and have no potential for tetratologic effect. Studies conducted by the pathology-working group showed no evidence of carcinogenic potential at any level. The mutagenicity tests show negative results. In a two-generation reproduction study, there were no adverse effects on the reproduction performance at any dose tested. It is not skin sensitising and does not have photosensitising effect. Blood chemistry and haematological measurements conducted during these studies showed no difference between control subjects and one is using triclosan. Human safety studies show no adverse effects.

Triclosan for use in personal hygiene products should not only be analysed for its quantitative purity but also for the presence of impurities. This is especially important for polychlorinated dioxins and furans such as the 2,3,7,8, isomers commonly known as saveso-dioxins, which are unwanted by-products during triclosan manufacture. Dioxins

are highly toxic, persistent substances, with a wide range of adverse effects producing a plethora of responses in animals and presumably in humans, which can lead to chloracne, carcinogenecity, reproductive and developmental effects, immunotoxicity, effects on circulating reproductive harmones, increased risk of diabetes, endometriosis and enzyme inductions. It is very important that only approved quality triclosan is used in personal hygiene products.

In antiperspirants, deodorants, and deo-antiperspirants *(exhibiting both antiperspirants and deodorant effects)* the formulation consists of the following main ingredients. The active ingredient, solvent/carrier, thickening agents *(to control the flow properties)*, an emollient *(to enhance the spreadablilty of the product and to give the skin a soft pleasant after feel)*, a lubricating agent *(to prevent seizure during application) and a fragrance.*

Formulation of antiperspirants and deodorants does look relatively simple. Nevertheless, it depends on the product form, requiring basic knowledge about the functions of various ingredients to be used to give good performance. The raw materials used in the formulation should be safe in applications, compatible with one another and cosmetically acceptable. The formulation should provide both aesthetic quality and product efficacy. Antiperspirants and deodorants are marketed in different product forms namely aerosols and pump sprays, sticks, roll-ons, creams, etc. The preferred form by consumers varies widely depending on the country and region it is marketed. Moreover, each form has its own advantages.

Aerosols/pump sprays

Aerosols are usually hydrocarbon based. Undoubtedly aerosol sprays with a hydrocarbon propellant have been the most popular forms of antiperspirant and deodorant for many years. However, there has been a slow market fall due to legislative and regulatory problems associated with clean air issues competition from other product types. The greatest consumer benefit is that one pack is usually sufficient for use, very conveniently by the entire family.

Creams

It was popular once but lately its popularity is waning. Not many creams are available in the market.

Roll-ons

They are easy to formulate at a low cost. It can be marketed in form of lotions, clear hydroalcoholic, or dry without any use of alcohol. A roll-on, traditionally is oil in water emulsion, but variants using silicone fluids are also available.

Sticks

It is a very popular form, now becoming increasingly popular day by day. Solid stick deodorants are based on stearate soap in an alcoholic medium along with other ingredients, like emollients, actives, solvent, etc.

In formulations where alcohol acts as a solvent, it also helps in accelerating the drying of the product when applied on skin. Propylene glycol is included in the formulation to reduce cost and alcohol usage. It also acts as a solubiliser for fragrances. Volatile silicones are used to manufacture alcohol free products. Antiperspirant actives and Anti-microbial compounds are often used in combination with a deo-active perfume, sometimes also with an odour absorber. Perfumes used should be sufficiently powerful to cover the base odour without interfering with the actives that may be used. Perfumes must be pleasant and long lasting. Sustained release encapsulated fragrances to improve perfume performance all daylong is used in premium products. Fragrance selection must be done carefully especially in case of antiperspirants, as some times fragrance stability can be an issue in the final formulation.

Organic or inorganic pigments are preferred as colorants in deodorant products. Oil soluble and water-soluble colours are avoided because of possible bleeding due to dissolution of the colorants, by perspiration and lipid secretions. However it should be emphasised that only non-toxic ingredients giving no indications of adverse effects like irritation, skin sensitisation or subacute toxicity, allergy, carcinogenic, mutagenic or tetratogenic effects and that is environmentally acceptable and complying with the relevant specifications laid down by regulatory bodies be used.

Ingredients used in the manufacture should not contain toxic metal impurities of arsenic, heavy metals, cobalt, chromium, nickel in substantial proportion as they could cause responses in humans in form of allergic contact dermatitis. This condition of allergic dermatitis is chronic in nature and its symptoms remain even after the obvious source of contamination is removed. Good manufacturing practice is to be followed with utmost importance during manufacture to limit these impurities within acceptable limits and reduce hazard to the user.

A variety of technologies and raw materials are available to enhance an antiperspirants and deodorants. To win the favour of customers, new products that offer real improvements in residue reduction on application without compromising in the performance, efficacy, and safety of the product is the need today. The growing awareness, improvements in the living standard and sophistication of society, has completely changed the set standards of personal hygiene. Like clean hair, white shining teeth, soft and clear complexion, smelling good is now a necessary personal requirement. Today's social circle accepts people who smell excitingly fresh, without unpleasant body odour. Judging market trends formulators will have to continue working for improved stable products to keep consumers, clean, fresh, and pleasant.