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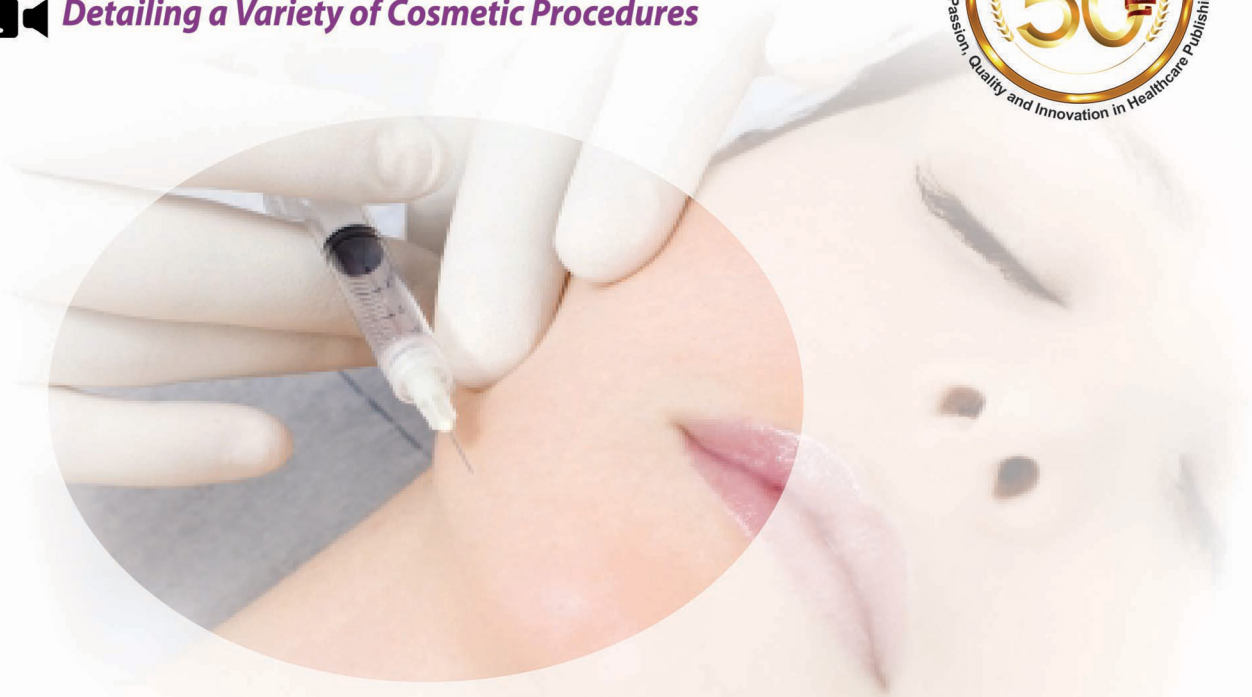

Aesthetic Dermatology

Current Perspectives

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JAYPEE

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1

SECTION

COSMECEUTICALS

JAYPEE BROTHERS

1

CHAPTER

Cleansers

Jaishree Sharad, Neha Sud

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INTRODUCTION

Cleansers can be defined as products used to clean a surface of dirt and grime. Our skin has a plethora of products that collect on the surface and need to be removed on a regular basis to maintain a basic standard of hygiene. The skin surface produces sebum which attracts and attaches dust to the skin surface as dirt. Cosmetics, creams and makeup can also increase this greasy feel and compound the above effect attracting dirt and clogging pores. Over this is added the external pollutants and bacteria. Bacterial action on the sweat with the excreted urea and different salts can produce repugnant body odor. In addition the stratum corneum also sheds or desquamates its cells. Cleansers help remove all the above to maintain personal hygiene and health.

HOW DO CLEANSERS WORK?[1,2]

Cleansers can employ a physical or chemical method to clean the skin. Physical cleansing is primarily by the use of friction, like wiping the skin with a cotton ball or tissue. The friction helps to dislodge the soils from the stratum corneum. Whereas for chemical cleansing, this act of loosening can be by emulsification or dissolving, depending on the composition of the cleanser, primarily its surfactant component and solution properties. Surfactants or "surface active agents" help to loosen the dirt from the sebum and grease and aid its removal by rinsing or wiping thereafter. It is their amphiphilic nature, i.e., surfactants have a polar and a nonpolar end, that aids in removing dirt by reducing the surface tension between the dirt and water. Surfactants position themselves at the oil-water interface. Here they emulsify dirt and grease by forming micelles or surfactant spheres holding the oil phase in the center. Their hydrophobic nonpolar ends point in and the hydrophilic polar ends point out in the water phase. For micelles to form, the concentration of the surfactant should be above a critical value, that is called the critical micellar concentration for that surfactant. There are multitude of surfactants, from those in soaps which are the most basic, sodium stearate or sodium tallowate and are anionic, to those in syndets which can be silicone containing[3] or depending on the surface charge can be (Table 1):

- Anionic
- Cationic
- Amphoteric, or
- Nonionic.

Silicone surfactants (e.g., dimethicone) serve two purposes as they are able to penetrate into follicular orifices and surface grooves; they enhance removal of grime therein and also form an effective barrier for TEWL (trans epidermal water loss) as a result of the smooth surface film that they form on the skin. Hence, these surfactants are noncomedogenic and have a low irritation potential with hypoallergenicity.[7]

From these multitudes of surfactants primarily two are used in manufacturing bar cleansers—alkyl carboxylate (for soaps) and acyl isethionate (for syndets).

Liquid cleansers or personal care products use a combination of different surfactants for optimal and desired end results.

Cleansing by dissolving involves the basic principle of "like dissolves like", and this is in reference to the solvent phase of the cleanser. Surface dirt and body secretions, solids and other liquids get suspended in a homogeneous solution as a result of solvent use. Greasy residue or oil-based makeup would best be cleared by an oil-based nonpolar solvent and would work well in dry aged skin as

TABLE 1: Surfactants types based on surface charge with examples and salient properties[4-6]

Surfactant type	Example	Properties
Anionic (negatively charged)	• Sodium lauryl sulfate • Sodium laureth sulfate • Cocoylisethionate • Sodium stearate • Sodium tallowate	• Good detergents • Good lathering properties • Alkyl sulfates: Poor skin tolerance • Sodium cocoyl isethionate: Excellent skin compatibility
Cationic (positively charged)	• Sodium triethanolamine	• Poorly tolerated alone
Amphoteric (both positive and negative charge)	• Betaines, like cocamidopropylbetaine • Alkylamino acids	• Lather well • Well tolerated
Nonionic (uncharged)	• Polyglucosides • Polysorbates • Propylene glycol	• Lather poorly • Well tolerated

they have a tendency to leave an oil film. On the other hand polar cleansers, which are alcohol based, would work well in oily acne-prone young skin. They may simply be wiped by a cotton ball or swab and do not require water for the same.

Cleansers and Stratum Corneum Interaction

Product and stratum corneum interaction depends on chemical attributes of individual ingredients in a preparation and change in properties and behavior as a result of intraformulation interactions. The collective response determines if a cleanser or a moisturizer is a mild one or not.[8]
Ingredients of skin cleansers:[2]

- Water
- Surfactants
- Moisturizers
- Stabilizers
- Hardeners
- Foam enhancers
- Preservatives
- Fragrance
- Dyes and pigments.

Factors governing skin interaction and result with cleanser use:

- Surfactant: Type, chemical structure, and concentration
- Hydrophobically modified polymers
- Moisturizing agents
- pH of the cleansers
- Fragrances and preservatives
- Rinsabilty factor.

In the process of skin cleansing, some surfactants do bind to the skin lipids and get left over on the skin surface too after rinsing. This distorts and disrupts the intercellular lipid barrier. The surfactant may bind to the proteins and make them swell and become more permeable with the resultant loss of NMFs and TEWL, thus making the skin dry, dull, flaky, red, and itchy with an after wash tightness.

The ability of different surfactants for this skin irritation potential follows the following order:

Cationic = anionic > amphoteric > nonionic.[9,10]

Even though anionic and cationic surfactants lead the order for skin irritation, their lather forming properties and antimicrobial properties make them an important part of cleansers in general and antimicrobial washes, respectively.

To reduce their overall irritation potential incorporation in lower concentrations in combination with amphoteric and nonionic surfactants can help.[11-13]

Hydrophobically modified polymers reduce the surfactant skin interaction by forming surfactant polymer complexes, hence reducing skin irritation.

Many products have the ability to deposit moisturizing factors, emollients, occlusive or humectants, on the skin to counteract the dryness caused by the action of surfactants. However, due to the short skin-cleanser contact time, this ability for barrier restoration and skin hydration is guarded.[14]

Even though the skin has an inherent buffering capacity, another factor that on repeated exposure can alter moisture content, bacterial flora, and skin pH and result in skin irritation is the pH of the cleanser.[15] Cleansers with pH close to 5.5 are considered the most compatible with SC integrity causing minimal lipid alteration. Neutral and acidic cleansers are preferable over alkaline ones.[9]

Fragrances and preservatives are the other major irritants present in cleansers and surfactant effect on the skin can pave a pathway for deeper

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skin entry of these molecules also. Formaldehyde or formaldehyde releasers, like quaternium 15 or diazolidinyl urea or imidazolidinyl urea, followed by methylchloroisothiazolinone/methylisothiazolinone mixture with diazolidinyl urea have been implicated as the most common nonfragrance allergens in cosmetics and personal care products.[16,17] All these are commonly used as preservatives in cleansers.

The skin-cleanser contact time should be minimal to reduce the irritation potential of the cleanser. This property varies for different molecules and this rinsability factor is high for liquid lipid free cleansers.[18]

TYPES OF SKIN CLEANSERS

- Cleansing bars
  - Routine or basic bars
  - Moisturizing or beauty bars
    - Superfatted bars
    - Transparent bars
    - Syndet bars
  - Antibacterial or medicated or deodorant bars
- Liquid washes
  - Body washes
    - Regular body washes
    - Moisturizing body washes
    - Speciality body washes
  - Facial cleansers
    - Lathering cleansers
    - Nonlathering cleansers
      - Lipid-free cleansers
      - Cleansing creams
      - Cleansing milk/lotions
      - Astringents/toners
      - Waterless cleansers
      - Scrubs
  - Antibacterial washes—face/body
- Cleansing cloths
  - Dry
  - Wet.

Cleansing Bars[19]

The basic active ingredient in cleansing bars is the surfactant. Primarily two surfactants are used—alkyl carboxylate and acyl istheonate. Cleansing bars that use the former are called soaps and the ones using the latter are called synthetic detergent bars or syndets.

Basic Bars or Soaps

These are the simplest and most basic type of bars. Soaps are formed by a process called saponification wherein alkalis are made to react with fats and oils, hence making them simply sodium salts of fatty acids. The source of the fatty acids can be animal (e.g., tallow or lard)) or plant/vegetable (e.g., coconut oil, olive oil, palm oil). They can be used in different combinations, mostly animal to plant fatty acid ratio 4:1. Qualities of the final soap bar depend on the type of fatty acids used: longer carbon chain lengths, less soluble and remain solid whereas shorter lengths, lather easily. Basic soaps have a high pH and are irritating to the skin as a result of damaging effects of the surfactant on the skin barrier.

Moisturizing or Beauty Bars

These bars have skin moisturizing properties because of the presence of skin benefit agents and hence are less irritating to the skin.

Superfatted Soaps

In the process of soap making if excess fat/oil is left in the soap after saponification is complete, it results in superfatted soaps. The excess fats could be lanolin, paraffin, shea butter, cocoa butter, etc. and as a common effect reduce the drying effect of the soap on the skin.

Transparent Soaps

These are common bar soaps where glycerine (most commonly), a polyhydric alcohol, is added as a moisturizer, making it less irritating for the skin. Other polyhydric alcohols are polyethylene glycol and propylene glycol. Polyhydric alcohols are solvents that render the bar transparent.

Syndet Bars

Syndets are synthetic detergent-based cleansers. They have a pH, 5.5–7, close to the skin acid mantle with less than 10% soap content, hence less skin dryness and better skin compatibility.[9,20] The surfactant here is most commonly acyl isethionate which renders it less damaging to the stratum corneum lipids. They do not form a soap scum layer.

Medicated Bars

These have added antibacterial agents like triclosan, carbanilide and trichlocarbon. These antibacterial agents inhibit bacterial growth and indirectly help in reducing body odor too. Some antibacterial bars are also marketed as deodorant bars, which in addition have added fragrances to mask the body odor. Their primary beneficial effect would be to suppress the harmful bacteria but in the process they also disrupt or harm the natural skin flora and cause skin dryness and irritation. Antiacne bars

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TABLE 2: Highlighting differences in different types of cleansing bars[15,21]

	Basic bars	Superfatted bars	Transparent bars	Syndet bars	Antibacterial bars
Surfactant	Soap based*	Soap based*	Soap based*	Nonsoap based*	Soap based*
pH#	9–11	8–10	8–9	5.5–7	9–11
Added ingredients	None	Excess fatty acids	Glycerine or polyhydric alcohols	Creams	Triclosan, carbanilide, trichlocarbon
Drying effects on skin	+++	++	++/+	+/–	+++

Note: *Soap-based, having alkyl carboxylate as the surfactant, nonsoap based, having acyl isethionate as the surfactant.
#pH varies from bar to bar within the given categories also, this is a rough guide.[15]

too have some antibacterial agent, e.g., triclosan, azelaic acid, zinc oxide, benzoyl peroxide, tea tree oil, neem extract, clove oil, etc. to control the activity of *Propionibacterium acnes* or some active agents like α- or β-hydroxy acids like glycolic and salicylic acid, respectively. They help to reduce the sebaceous activity and help in exfoliation. Table 2 highlights the differences in different types of cleansing bars.

Liquid Cleansers[5,22]

Like bars liquid cleansers are also based on soap or nonsoap surfactants, albeit at a lower concentration, but with a higher water percentage than bars.

There can be a diverse combination of syndets which lather well with hard water but can irritate. To mitigate the irritation potential of surfactants, surfactants with different properties can be combined, e.g., alkyl sulphates (anionic surfactants) while having relatively poor skin compatibility, lather well. So combining an alkyl sulphate with an amphoteric surfactant such as cocamidopropyl betaine can improve both lather and skin compatibility. This lends an aesthetic appeal and better acceptability to liquid cleansers. Facial cleansers have a high percentage of amphoteric surfactants as they lather well and are tolerated well. They have a high rinsability factor too.

Liquid cleansers have a higher percentage of water that offers advantage of form and possibility to add a number of skin benefit agents but risk contamination, hence need preservatives, and increased molecular interactions challenging chemical stability. They contain antioxidants, chelating agents and are formulated around specific pH. Additives like shea butter, olive oil, glycerine, silicones, petrolatum, pulverized fruit seeds, and beads in liquid cleansers help to provide skin benefits ranging from moisturization to soft post rinse feel and exfoliation. Though due to a short contact time of cleansers on the skin, these changes may not be as evident. Dyes and fragrances in addition help to increase the consumer appeal of the product by stimulating visual and olfactory senses. Liquid cleansers can be categorized as those used primarily for the body, face, or hands. Division is guided by surfactant/solvent choices and combinations and delivery systems in addition to specific benefits designed for different body areas and needs.

Discussing a few nuances about the different liquid cleansers below.

Body Washes[1,22]

Regular Body Washes

They primarily serve the purpose of skin cleansing though added fragrances may help win over consumers' olfactory senses.

Moisturizing Body Washes

These body washes help deposit a skin benefit agent, moisturizing factors in this case, on use in addition to the primary action of skin cleansing and this ameliorates their inherent irritancy. Moisturizing ingredients are diverse: lanolin, olive oil, bees wax, paraffin, shea butter, cocoa butter, glycerine, urea, petrolatum, vegetable oils like sunflower and soybean oil, ceramides, cholesterol, etc. Coacervation of molecules like petrolatum in body washes can effectively help moisturize the skin along with cleansing.[1]

Speciality Body Washes[23]

These cleansing systems have ingredients apart from the above that benefit the skin.

As mentioned earlier they may have beads, e.g., polyethylene, aluminum oxide, sodium tetra borate decahydrate; or pulverized or ground fruit seeds, e.g., apricot seeds; or oatmeal that help in mechanical skin exfoliation and provide a dry skin benefit by removing dead skin cells in the scales. Of these,

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aluminum oxide and fruit pits have the most abrasive action because of their sharp edged surfaces and may lead to skin irritation in sensitive skins. Polyethylene microspheres on the other hand have a smooth surface and provide a gentle and effective exfoliation. They have been cited as an environmental hazard though, because of their nonbiodegradable nature after they were found as contaminants in the water in the Great lakes of North America.[24] There are others like sodium decahydrate granules that dissolve during use. Sugar granules mixed with detergents also melt away during use.

Menthol, another ingredient, in body washes helps provide a cooling and relaxing sensation on use.

Facial Cleansers[5,23,25]

Lathering Cleansers

Lathering cleansers produce a good amount of lather as a result of high concentration, above the critical micelle concentration, of mostly anionic or amphoteric surfactants. To minimize the lipid stripping effect on skin lipids, syndets are primarily incorporated in these systems along with the addition of skin-benefitting moisturizing agents.

Nonfoaming/low Foaming Cleansers[25]

This group is specially formulated for care of the facial skin. They comprise the cleansing creams, cleansing milks and lotions, lipid-free cleansers and waterless cleansers. These "gentle" cleansing systems have "gentler acting" surfactants like sarcosinates and betaines, e.g., cocamidopropyl betaine. Incorporation of humectants, like glycerine, butylene glycol or propylene glycol, in addition helps to attract water to the skin. Some skin care product ranges also introduce hyaluronic acid for its amazing water-retaining properties. Another way to make a product less irritating to the skin is to reduce the levels of irritants like fragrances and preservatives.

Lipid-free cleansers

They do not contain any naturally derived fats or lipids and are also called as "soap-free" cleansers. Fatty alcohols evaporate not leaving any film behind. So, these cleansers offer high rinsibility.[18] They work well as cleansers for dry to normal skin. They are rubbed to produce lather on dry skin and thereafter wiped away so do not need water for cleansing. Their main constituents are water, glycerine, cetyl alcohol and propylene glycol.

Cleansing creams

As the name defines they cleanse and moisturize, so are suited more for dry skin. They work on solvent action of the oil component; mineral oil or wax. Borax lends the detergent action. Heavy, longlasting oil-based makeup can be effectively removed with these cleansers.

Cleansing milk or lotions

They are water-based counterparts of cleansing creams. Their primary mode of action is through emulsification/dissolving in contrast as the external phase here is water. They can be effectively used to remove water-based makeup with a cotton ball or wipe or can be easily rinsed away with water, though generally water is not used.

Astringent or toners

Astringent/tonic/refresher—the nomenclature can vary depending on the concentration of the alcohol component, which imparts the toner with its solvency or dissolving properties. Toners are best suited for oily acne-prone skin or skin areas producing excess of sebum, the T zone especially the nose, and for removing makeup. They can be directly applied to a cotton ball or tissue wipe and used over the target area. This action in addition helps to dislodge the soil or dirt by physical means or friction. The alcohol as it evaporates in addition provides a cooling sensation as do added menthol and camphor in some.

Waterless cleansers

These cleansers are alcoholic preparations, mostly containing isopropyl alcohol, that dissolve oils and sebum. Surfactants if present are in minimal amounts.

Scrubs

Scrubs help to remove lodged dirt by a physical abrasive action imparted by particulate ingredients—natural or synthetic. Natural particles include seeds of fruits (e.g., peach, apricot, or apple), nut shells (e.g., walnut, almond), grains (oats, wheat), sandlewood or sugar. Synthetic particles include polyethylene or polypropylene beads or aluminum oxide or sodium tetraborate decahydrate granules. They help to exfoliate and control excess sebum production suiting oily flaky skin. Sensitive skin types may not be able to tolerate the abrasive action of the beads on the skin and may become red and inflamed. They are best used on intact skin.

Antibacterial Washes[26,27]

These can be called the liquid counterparts of medicated bar cleansers. Their primary indications are as cleansers for acne prone or seborrheic skin and as antiseptic hand cleansers. Antiacne cleansers with antibacterial agents, like benzoyl peroxide,

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sodium sulfacetamide, sulfur or natural extracts like neem extract or tea tree oil extract, quite similar to their bar counterparts, can be used as a part of a comprehensive treatment plan for acne. They have a bacteriostatic action on the *P. acnes* population and other skin pathogens too. But most of these ingredients irritate the skin. Added emollients can help to mitigate this dryness. Variation in mode of formulation delivery, like in foam form (property because of the added aerosols), can make it less messy and easy to use, especially for large areas, without residue and can enhance cosmetic acceptability and compliance. Salicylic acid, benzoyl peroxide and sodium sulphacetamide-sulfur combination are available as foam-based cleansers. The latter combination has been used for the treatment of rosacea and seborrheic dermatitis in addition to acne.[26]

Cleansing Cloths or Substrate Cleansers

These are the most recent addition to the armamentarium of skin cleansers. Here, the chemical ingredients are absorbed on a nonwoven cloth. They are a double-edged sword; having a dual, physical (imparted by the friction of the cloth with the skin), and a chemical action (role donned by the surfactants and solvents either by emulsifying or dissolving). The cloth can be a natural material, like cotton or synthetic, like rayon, polypropylene or a blend of the two. Because of parallel mechanisms acting at the same time the concentration and type of surfactants used can be skin friendly, i.e., milder surfactants at lower concentrations can be incorporated without worrying about the degree of skin cleansing. Surfactants with one-fourth the concentrations of that in regular liquid cleansers can suffice for substrate cleansers. With the benefit of better cleansing, they prevent overcleansing on part of the consumer as the dirt and soils removed are visible on the cloth as an evidence of effectiveness.

Dry Cleansing Cloths

Here, the cleansing chemicals are directly applied to a cleansing cloth. The cloth needs to be wet before use and needs to be rubbed to produce lather. Petrolatum as an additive hydrates the skin and serves as a barrier to TEWL.[5]

Wet Cleansing Cloths

They are another product range that works well in people with dry skin as they leave a film of humectants and lipids on the skin after use. They are packaged in the wet state, much like baby wipes for the diaper area, and are use and throw products alike.

The most recent are the cleansing brushes. Companies with patent technologies, like the Clarisonic, have innovated cleansing heads with circumferential rows of grouped bristles oscillating at sonic frequencies (300 movements per second), which they claim works with the skin elasticity resulting in flexion action that loosens deeply impregnated impurities from skin pores too (claims of up to six times better cleansing action than the hands used alone). Heads of this handy equipment can be replaced depending on the body area and skin type to be treated.

CLEANSERS IN USE

Expectations from a good cleanser:

- Lather easily and in good amount
- Good smell or fragrance
- Remove all dirt and makeup
- Good post rinse feel to skin
- Does not excessively dry the skin
- Remove body odor
- Does not become mushy in humid surroundings and keeps its shape (for bars)
- Does not dry up and break in between use (for bars).

Primary goals of good cleansing:

- To remove soils (dirt, grease, makeup) from the skin surface effectively
- To remove skin contaminant bacteria effectively
- To exfoliate or remove the dead skin cells
- To cause minimal harm to the skin lipid barrier.

Adverse effects of cleansers: [9]

- After wash tightness is due to enhanced rate of water loss from the skin surface and is the sensation perceived after washing with a soap
- Skin dryness, scaling and roughness can be due to alcohol-based solvents, surfactants, over usage, vigorous cleansing which is further aggravated in dry and cold weather
- Skin irritation, erythema, and itching as a result of damage to the skin barrier
- Allergic contact dermatitis; sensitivity to preservatives, fragrances, and dyes.

HOW TO CHOOSE A CLEANSER

One can choose a cleanser depending on answers to the following questions:

- What is the skin type?

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- What is the cleanser form preference—soap/liquid/substrate?
- Any associated problem skin/diseased skin states?

The following table outlines properties of facial and skin cleansers suited in special case scenarios (Table 3).

TABLE 3: Selection based on accompanying skin condition or specific needs[28-35]

Skin condition	Type of cleanser
Newborn skin	• Bars or liquid cleansers with neutral pH (5.5–7.0) • Mild surfactants • Emollients • Preservative-free • Fragrance-free • Nonirritating to the eyes
Oily skin	• Lathering cleansers • Substrate-based cleansers • Toners • Scrubs
Acne-prone skin	• Nonionic bar or liquid cleanser • Antibacterial cleansers/bars • Good rinsability • Fragrance-free
Dry xerotic skin	• Cleansers containing humectants, emollients or ceramides • Coacervated petroleum body washes
Atopic skin	• Liquid cleansers or syndets with pH 5.5–6 • Hypoallergenic • Fragrance-free • Preservative-free
Rosacea skin	• Syndet cleansers and lipid-free cleansers • Neutral to slightly acidic pH • With emollients and humectants • Without irritants and allergens • Avoid alcohol-based cleansers
Photoaged skin	• Lipid-free cleansing agents • Containing humectants and emollients
Makeup-loaded skin	• Heavy oil-based makeup • Substrate, lathering cleansers or toners or cream-based cleansers • Light water-based makeup—cleansing lotions work well

CONCLUSION

There has been a gradual evolution from the traditional soap bars to synthetic detergents to speciality skin cleansers with a major boom at the turn of the century. Consumer demands, habits, and acceptability have been a major catalyst or driving force for technological progress in making more satisfactory cleansers, which respect the skin barrier function at the root level. From merely cleansing, cleansers have come a long way in providing moisturizing benefits too to the skin but cannot surpass the effects of a moisturizer per se on the skin.

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