11

Liquid Hand Soap and Body Wash

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I. INTRODUCTION

Liquid soap was first developed in the 1940s and was primarily used in hospitals and institutions for washing hands. In the late 1970s with the launch of Softsoap brand liquid soap in the U.S. by Minnetonka, Inc., liquid soap has gained increasing popularity. Liquid soaps offer convenience and are considered to be more hygienic than bar soap especially in public places.

Body wash was first introduced in the U.S. in 1993 by Jergens followed by Dove (Unilever), Caress (Unilever), and Oil of Olay (Procter & Gamble) in 1994.

Sales of bar soaps in the U.S. and Europe have been declining while sales of liquid soap, shower gel, and liquid body wash have been increasing for the last few years [1].

In the last decade the functions of body washes have been extended from basic cleansing to include antibacterial action, skin moisturization, deodorant properties, exfoliation, aromatherapy, delivery of emollients to soften the skin, delivery of nourishing vitamins and other ingredients, and delivery of film-formers such as chitosan to create a protective barrier between the skin and the environment. There have even been attempts to make a body wash that provides UV protection.

Figure 11.1 and Figure 11.2 show some representative commercial liquid hand soap and liquid body wash/shower gel products from around the world.

This chapter attempts to give a thorough review of all aspects of liquid soaps and body washes, from typical composition and ingredients to the test methods and performance evaluations, formulation technology, and new products and future trends. The chapter that appeared in the first edition [2] has been rewritten, updated, and expanded to reflect the significant evolution and advances in these products.

FIG. 11.1 Commercial liquid hand soap products from around the world.

FIG. 11.2 Commercial shower gel/liquid body wash products from around the world.

II. TYPICAL COMPOSITION AND INGREDIENTS

A. Typical Composition

Liquid hand soap and body wash formulations are similar in composition. The essential ingredients are skin cleaning agents, skin conditioning agents, rheology modifiers, color, fragrance, preservatives, and other additives such as antibacterial agents, vitamins, and herbal extracts. A list of some of these ingredients and the suppliers can be found in the book by Flick [3]. The physicochemical properties, chemical structures, applications, and safety of these ingredients are well summarized by Hunting [4] and by Barel *et al*. [5]. A typical composition is shown in Table 11.1. Reever [2] provides a detailed review and summary of the compositions of some commercial liquid hand soaps.

B. Ingredients

1. Skin Cleaning Agents

Surfactants or mixtures of surfactants are the main ingredients for skin cleaning. There are two types of surfactants used for the formulation, soap-based surfactants and synthetic surfactants. The soap-based formulations provide voluminous,

TABLE 11.1 Typical Liquid Hand Soap and Body Wash Composition

Ingredient	Amount (wt%)	Purpose
Surfactants	10–40	Cleaning, foaming
Emollients	1–30	Moisturizing, skin conditioning
Rheology modifiers	1–5	Viscosity control
Preservatives	<1.0	Microbial stability
Fragrances	0.3–1.5	Aesthetics
Coloring agents	<0.1	Aesthetics
Other additives	0–3	Antibacterial, exfoliating, antiaging, whitening
Water	Balance	Solubilizer/carrier vehicle

creamy lather and a "squeaky clean" feel to the skin. However, they lead to drying and irritation of the skin in cold weather. Therefore, these surfactants are used mostly in products that are sold in tropical regions where the climate is hot and humid. The commonly used soap surfactants are based on potassium soaps of lauric, myristic, and palmitic acids. Generally, these surfactants are used in combination with each other to provide good lather and skin feel. Due to alkalinity of the soaps, the pH of these formulations is very high (9 to 10) and hence is not very mild to skin. Furthermore, this high pH limits the choice of skin care agents and fragrances that can be incorporated in these products due to hydrolytic instability.

Synthetic surfactants are used almost exclusively in the liquid products that are sold in Europe and North America. These surfactants are much milder to skin than the soap-based surfactants and can be formulated in products with skin neutral pH (5.5). Furthermore, the products formulated with these surfactants are much more compatible with a wide variety of skin care agents and fragrances.

Of the four types of synthetic surfactants, anionic, cationic, amphoteric, and nonionic, the anionic surfactants provide maximum lather and hence are used as major components in liquid products. The active ingredients used in the major brands of liquid soaps are described by Dyer and Hassapis [6].

A widely available anionic surfactant is sodium lauryl sulfate. This surfactant is fairly irritating to skin. Ethoxylation of this surfactant lowers its irritation potential but it also lowers its lather. The optimal mildness and lather is obtained with a degree of ethoxylation of 2 or 3. This surfactant is widely used with 2 moles of ethoxylation (laureth 2-sulfate) and is available as 28% active or 70% active. In some cases it is also used with 3 moles of ethoxylation (laureth 3-sulfate). The loss of lather due to ethoxylation is generally compensated for by using foam boosters such as lauramide diethanolamide, cocamide diethanolamide, and amine oxides. Alfa olefin sulfonate is another cost-effective surfactant emerging as a popular surfactant for liquid soap formulations [7].

TABLE 11.2 Surfactants Commonly Used in Liquid Hand Soap and Body Wash for Skin Cleansing and Foaming

Type	Surfactant
Anionic	Ammonium lauryl sulfate (ALS)
	Ammonium laureth sulfate
	Sodium lauryl sulfate (SLS)
	Sodium lauryl ether sulfate (SLES)
	Alpha olefin sulfonate (AOS)
	Sodium cocoyl isethionate
	Sodium isethionate
	Sodium alkylbenzene sulfonate
	Sodium lauryl sacorsinate
	Sodium lauryl lactate
	Sodium lauroamphoacetate
Nonionic	Alkylpolyglucoside
Amphoteric	Cocoamidopropyl betaine

Table 11.2 lists the surfactants commonly used in liquid hand soap and body wash.

A typical liquid soap and body wash product is generally comprised of a mixture of these different types of surfactants to achieve the desired cleaning and foaming performance.

2. Skin Conditioning Agents

Skin feel is an important attribute to the users of liquid hand soap and body wash products aside from cleaning. Generally, it is desirable to have a feeling of smoothness but not sticky or feeling of residual materials on the skin after washing and rinsing of hands and body. Many different ingredients have been used to impart a good skin feel and often with moisturizing benefits. These include humectants, such as glycerin and protein, and skin refatting agents, such as PEG-7 glyceryl cocoate. Another widely used class of material is water-soluble cationic polymers such Polyquarternium-7, Polyquarternium-10, and guar hydroxypropyltrimonium chloride. One key benefit of this class of material appears to be the high degree of skin feel provided at a very low formula concentration used [8].

Table 11.3 lists a number of skin conditioning agents used in some major brands of liquid hand soaps or shower gels.

3. Rheology Modifiers

Liquid hand soap and body wash products are typically formulated in a thick liquid or gel form. Consumers look for the convenience in dispensing these products but they should not be "runny" or slip through the fingers. The viscosity of liquid hand

TABLE 11.3 Examples of Skin Conditioning Agents Used in Major Brands of Shower Gel

Skin conditioning agent	Shower gel brand
Soybean oil	Olay
Sunflower seed oil	Dove, Sauve
Polyquaternium-7	Palmolive, Softsoap, Fa
Polyquaternium-10	Caress, Sauve, Dial, Olay
Glycerin	Dove, Caress, Sauve, Olay, Dial
Maleated soybean oil	Olay
Petrolatum	Dove, Olay
Hydrolyzed wheat protein	Caress
Seaweed extract, ceramides	Dove
Polyethylene (exfoliant)	Dove, Palmolive, Softsoap
Vitamin E acetate	Dove, Olay, Dial, Softsoap
PEG-6 caprylic/capric glycerides	Sauve, Olay
PEG-7 glyceryl cocoate	Dial, Softsoap, Nivea, Fa
Castor seed oil	Caress
Hydrogenated coco-glycerides	Dove
Retinyl palmitate	Olay
Niacinamide	Olay
PEG-200 hydrogenated glyceryl palmate	Nivea
Glyceryl oleate	Fa
Caffeine	Fa

soap products is generally in the range 3,000 to 5,000 cP while the viscosity of shower gel products is typically in the range 5,000 to 20,000 cP. To achieve good physical and flow properties, rheology modifiers are typically used. These can be simple salts such as sodium chloride, potassium chloride, and ammonium sulfate or water-soluble polymers (see Chapter 5).

4. Aesthetic Modifiers

The color and the overall appearance of the product are very important attributes in getting consumers interested in the product and also conveying the functionality of the product to some degree. For example, gold or amber color is associated with antibacterial benefit, a clear, colorless, or pearly product tends to signal mildness or ultra mildness, and a milky product signals moisturization. Therefore, the selection of product color will often depend on the positioning of the product and is typically based on consumer research.

The fragrance of a product is probably even more critical and often the deciding factor for consumers to purchase and use the product. How the product smells in the bottle, during use, and after use is very important. The fragrance should match the

product concept or positioning and appeal to users. Some fragrances are capable of counteracting kitchen malodors [9,10]. More recently, fragrances have been used in products to provide experiential benefits such as aromatherapy to consumers (see Section V).

5. Preservatives

Typical liquid hand soap and body wash products contain significant amounts of water (60 to 85%) and many ingredients are also sensitive to microbial attack. To ensure the integrity of the product against microbiological contamination during manufacture and extended usage time, it is necessary to add antimicrobial preservatives. The level of these preservatives that is generally required is at a fraction of a percent. These preservatives are generally miscible in the surfactants that are used in the formulations. Microbiological preservation testing is done by injecting the formulation with certain microorganism commonly known to cause contamination and incubating them to make sure that no organism survives in the presence of these preservatives [11]. Preservatives commonly used include DMDM hydantoin, tetrasodium EDTA (preservation efficacy booster), sodium benzoate, sodium salicylate, methylchloroisothiazolinone, methylisothiozolinone, benzyl salicylate, butylphenyl methylpropional, hydroxylsohexyl 3-cyclohexene carboxyaldehyde, methylparaben, and propylparaben.

6. Other Additives

In addition to the basic ingredients for cleaning and skin conditioning, many other additives are added to impart other benefits such as antibacterial, exfoliating, anti-aging, and whitening (Section V). Examples of these additives are triclosan, sugar, salts, hydrated silica, nut shells, dried fruit particles, herbal extracts, vitamins, etc.

III. TEST METHODS AND PERFORMANCE EVALUATION

There are a number of laboratory tests used by formulators to evaluate the various aspects of liquid hand soap or shower gel products. These include the evaluation of physical properties and various performance attributes. To validate the design of the product, consumer tests are usually necessary. Barel *et al.* [5] present an extensive and detailed discussion of various test methods and performance evaluations for cosmetic products. Most of these test methods also apply to liquid hand soap and shower gel.

The following provides a brief summary of some of the major test methods.

A. Physical Properties

The key physical properties for liquid hand soap and shower gel products that need to be defined and characterized are rheology, lather, pH, and color.

1. Rheology

Liquid hand soaps and shower gels are formulated so that they are thick in the bottle, become thinner during dispensing (for ease of dispensing), thicken back after dispensing (so that they are not runny during use), and can be spread easily during application. The rheological term for this property is "thixotropy" (see Chapter 4), i.e., a decrease of viscosity under shear stresses or shear rate, followed by gradual recovery when the shear stress or shear rate is removed. These properties are imparted to the formulations by components such as surfactants and rheology additives (see Chapter 5). The clear and opaque gels discussed in the preceding section fall under this category.

The viscosity is typically measured by a viscometer. The SI unit of viscosity is the pascal second (Pa s). However, the widely used unit is poise (P) or centipoise (cP) (1 cP = 1 mPa s). The routine laboratory testing of viscosity is typically done using Brookfield viscometers and reported in cP. For non-Newtonian fluids such as those discussed above, the viscosity is dependent on the spindle size and type (number) and speed of rotation (rotation per minute or r/min) of the viscometer.

Structured gel and emulsion formulations, designed to suspend particles or oils, are generally viscoelastic. They have both viscous and elastic properties. Such formulations are characterized by their elastic modulus (G') and loss modulus (G''). The elastic modulus (elastic component) is a measure of energy storage and the loss modulus (viscous component) is a measure of energy dissipation. For viscoelastic fluids $G' > G''$ and for viscous fluids $G' < G''$. For a suspension or emulsion to be stable G' should be greater than G'' over the range of temperature required for stability.

The viscoelastic parameters are generally measured by dynamic oscillatory measurements. Apparatus of three different configurations can be used: cone and plate, parallel plates, or concentric cylinders. In the case of cone and plate geometry, the test material is contained between a cone and a plate with the angle between cone and plate being small ($<4°$). The bottom member undergoes forced harmonic oscillations about its axis and this motion is transmitted through the test material to the top member, the motion of which is constrained by a torsion bar. The relevant measurements are the amplitude ratio of the motions of the two members and the associated phase lag. From this information it is relatively simple to determine G' and G''.

There are a number of other rheological methods used for characterizing viscoelastic fluids. A detailed discussion can be found in Chapter 4 or a rheology text such as Barnes *et al*. [12].

2. Lather

One of the most important attributes of shower gel formulations is lather. Shower gels are applied to the body either by hand or by body sponge (pouf) or wash cloth. In all cases the lather should be able to generate quickly and in sufficient amount,

be creamy and dense so as to provide sensorial feel during rubbing, and be stable until it is rinsed off. Generally, a shower gel that provides creamy and voluminous lather is perceived to be efficacious by consumers. In the case of liquid hand soap, more easily rinsable lather is desirable.

In the laboratory, lather properties of liquid hand soap and shower gel are measured as flash foam (speed of foam generation), maximum foam (quantity and stability), and foam creaminess (drainage time).

The standard (ASTM) methods for measuring foams fall under two categories: static (pouring, shaking, beating, and stirring) and dynamic (air injection). These methods are described by Tomura and Masuda [13]. However, due to the complexity of foams, new methods are being developed to provide evaluation of foam characteristics that is more representative of foams generated during consumer usage.

A commonly used method for evaluation of foam in shower gels and liquid hand soap is a static method, "cylinder shake." In this method a certain amount of water with predetermined levels of water hardness, sebum content, and temperature is placed in a graduated cylinder. An appropriate amount of product is then added to this water so that the foam generated during the shaking will be contained in the cylinder. Generally the amount of water is between 100 and 200 ml and the amount of product is 10 to 20 g. The cylinder is then rotated in a vertical plane, 180° up and down for a certain period of time. The volume of foam is then measured. This is *flash foam*. The cylinder is then shaken for another period of time and the foam volume is measured again. This is *maximum foam*. The foam is then allowed to drain to the original level and the time taken to do so is noted. This is the *drainage time*.

3. pH

The pH of shower gel formulations is adjusted around skin pH 5.5, and the pH of liquid hand soap formulations is generally adjusted from 5.5 to 7. (The pH of hand soap formulations is sometimes higher than skin pH because of technical requirements for viscosity and the type of surfactant used.) A change in pH over time is often indicative of some sort of chemical interaction between the ingredients and hence is monitored during testing the product for stability to make sure that the pH stays in the specified range. The pH changes are generally controlled by using buffering agents such as citric acid/sodium citrate. The pH is measured using conventional pH meters.

4. Color

The dyes used in shower gel and liquid hand soap formulations are required by regulations in U.S. and Europe to be FD&C (food, drug, and cosmetic) or D&C (drug and cosmetic). Generally, two or three dyes are blended together to obtain a desired color. Initial color is then measured using conventional instruments such

as Macbeth colorimeters and the results are reported in CIELAB color space [14]. The color is then monitored during stability testing to ascertain that change (ΔE) in the chromaticity (intensity) and hue (shade) stays within the specified range. Although ΔE is still widely used, it is being replaced by more efficient parameters such as ΔE_{cmc} [15].

B. Mildness

One of the key attributes of skin cleansing products such as shower gels and liquid hand soaps is that they are nonirritating and mild to skin. Testing for this starts from the early stages of formulations. The ingredients or combination of ingredients in the formula are evaluated for mildness and safety based on the information from the literature and available *in vitro* data. Some of the commonly used surfactants such as sodium laureth sulfate and cocoamidopropyl betaine show synergistic behavior toward mildness.

As a next step, the formulation is tested using *in vitro* skin irritation tests such as the Zion test [16], collagen swelling test [17], or pH rise test [18]. If the results of these tests show that the product is suitable for human clinical research, then it undergoes the following tests.

Exaggerated arm wash test [19]. This method is useful in evaluating relative irritation potential or mildness of personal cleansing products and is generally used for formulations that have undergone minor modifications. The protocol is based on consumer washing habits. In a standard arm wash test only two products are compared. However, in a split arm design of this test, four products can be tested simultaneously. The test involves 12 to 16 panelists. Two sites on the forearm are treated with the experimental formula, the third site is treated with water only, and the fourth site is the untreated control. The sites are washed twice a day for 6 days and evaluated for erythema and dryness by visual assessment and by bioengineering techniques such as TEWL (transepidermal water loss), corneometry (instrumental measurement of redness), and skin capacitance (skin surface hydration and dehydration). Generally, the instruments used for this purpose are Skicon 200, Corneometer CM820, and Nova DPM 9003 Dermaphase Meter, respectively.

Modified soap chamber test [20]. This is a more elaborate test and is generally used in the case of a major modification of the formulation or use of new ingredients. It involves 25 to 30 panelists. In this test the solutions of the products are applied to panelists under occlusion for two 24-hour periods and visual assessment of erythema and dryness is done by the same techniques as for the exaggerated arm wash test. The instrumental measurement of redness is done after 3 hours of each application and the TEWL measurement is done after 3 hours of first application. The measurement of skin capacitance is done 3 to 5 days after the second application [21].

Cumulative irritation test. This is another test that is commonly used to evaluate the absence of skin reactions to the formulation. It involves a minimum of 25 panelists. The solutions of test products as well as reference products with well-known skin tolerance are applied to the backs of panelists under occlusion for several consecutive days (generally 5 or 21 days) and the absence of skin reaction is then evaluated by trained professionals [22].

C. Moisturization

Skin moisturization or hydration is measured by the water holding capacities of the stratum corneum and one of the techniques used to measure it is the water sorption–desorption test [23]. Instruments such as Skicon, Corneometer, and Dermaphase Meter are used in this case. The base line electrical measurement is taken with these instruments before the skin is hydrated (PHS, prehydration state). The skin surface is then hydrated with distilled water/sample for less than a minute, blotted dry, and electrical capacitance is recorded again which represents the hygroscopicity or the ability of the stratum corneum to take up water (sorption). Measurements are then taken at intervals ranging from 20 to 30 seconds for a period of 2 minutes as the electrical conductance rapidly falls. Water holding capacity or moisturization is then determined by plotting percentage sorption vs. time and calculating the area under the curve. The water holding capacity of moisturizers such as lotions is found to be higher than the control (cream O/W, 627DPM.min vs. water 273 DPM.min). Generally, water sorption is similar in both cases but the desorption is slower in the case of moisturizers.

D. Antibacterial

Antibacterial agents are used in many liquid hand soap products but are not so common in shower gels. The commonly used antibacterial agents in liquid hand soap formulations are Triclosan, TCC (Trichlorcarban), and PCMX (*para*-chloro-*meta*-xylenol). These agents are incorporated in the formulation generally at a very low concentration (fraction of a percent). Triclosan provides broad-spectrum antibacterial activity whereas the other two are limited in their scope, generally effective in killing gram-positive bacteria. The methods outlined below are used to evaluate the antimicrobial activity of formulations. Further details of these methods can be found in Barel *et al*. [24].

Minimal inhibitory concentration (MIC) test. In this test, various concentrations of test product in a growth medium are inoculated with the test strain. After incubation, the lowest concentration that does not exhibit bacterial growth gives the MIC level.

Zone of Inhibition test. Antibacterial products are applied to a substrate, generally an agar plate, previously seeded with the test bacteria. During the incubation,

the test product diffuses into the agar layer and creates a zone that inhibits microbial growth. The larger the inhibition zone, the higher the antibacterial efficacy.

Time kill test. In this test, a diluted antibacterial formulation is inoculated with specified bacteria and kept in contact for a certain period of time. The antibacterial agent is then inactivated by dilution into a neutralizing broth and the reduction in bacteria is counted on solid culture media. A 90% reduction in bacteria is reported as 1 log reduction, 99% reduction in bacteria is reported as 2 log reduction, and 99.9% reduction is reported as 3 log reduction.

E. Consumer Test

A consumer validation of the various benefits of shower gel and liquid hand soap formulations, evaluated in the various tests mentioned above, is critical to the success of the product in the marketplace. The consumer test not only provides this validation, but it also provides much more valuable information, such as consumer likes and dislikes about product attributes and aesthetics and purchase intent.

Consumer tests involve a large number of panelists, generally over 100. The panelists are selected from a target group to which the product is intended to be sold. The product is then tested with these panelists in a home use test. If a single product is to be tested, it is generally done in a monadic test. If a test product is to be compared to a reference product, the testing is done by either comparing monadic tests of the product and its reference, or sequential monadic test, i.e., one product is used for a period of time, followed by the other product. A number of other designs are also used depending on the desired information. At the completion of the test, the panelists are debriefed via a written questionnaire, interviews, or focus groups. If the results of this test show a strong consumer appeal and strong purchase intent, then the decision is made to commercialize the product. Also, as discussed earlier, the results of such tests provide a detailed evaluation of various product attributes and are used as a diagnostic tool to improve the weaknesses.

IV. FORMULATION TECHNOLOGY

A. Formulation Considerations

The basic requirements for a liquid hand soap or body wash/shower gel product are listed in Table 11.4. The formulation of these kinds of products starts with the consideration to satisfy these basic requirements.

In recent years more and more new benefits have been added to these products (see Section V) to appeal to consumers. To deliver these added special benefits, additional considerations will include:

1. Capability to emulsify skin conditioning agents which are generally hydrophobic in nature.

TABLE 11.4 Basic Requirements for a Liquid Hand Soap or Body Wash/Shower Gel

Effective cleansing
Sufficient lather
Mild to skin
Appealing aesthetics, such as color and fragrance
Skin care benefits, such as moisturization
Preservation — stable against contamination by microorganisms
Adequate pH for formulation stability and skin mildness
Adequate viscosity for ease of dispensing and use
Product stability — stable under extreme environmental conditions such as heat and cold
At least two years of shelf life
Comply with government regulations if the product is regulated, such as antibacterial liquid hand soap
Competitive cost

2. Capability to suspend particulate matter for visual aesthetics or to deliver benefits such as exfoliation.
3. Capability to suspend particles encapsulating active ingredients to deliver various skin benefits.
4. Capability to deliver actives onto skin to provide benefits that are consumer perceptible and able to be clinically documented.

The last requirement is very challenging for rinse-off products such as liquid hand soaps and shower gels.

The ingredients used to satisfy these requirements are discussed in Section II. A good product is a result of the careful selection and balance of these ingredients.

B. Formulation

An extensive list of shower gel and liquid hand soap formulations can be found in Flick [3].

The liquid hand soap and body wash/shower gel products sold by major manufacturers can be broadly classified into four categories:

1. Clear gels. Typically for experiential products containing variety of colors and fragrances. These gels are of the lowest cost but do not have the capability to suspend particles.
2. Opaque/pearlized gels. Typically for delivering moisturizing aesthetics, with no particle-suspending properties.
3. Structured gels, clear or opaque. Typically with suspended particles for aesthetic and functional benefits.
4. Emulsions. Usually creamy, with skin conditioning oils, occlusive agents, or particulates emulsified or suspended.

1. Clear and Opaque/Pearlized Gels

The main distinction between clear and opaque/pearlized gels lies in the presence of an opacifier or pearling agent in the latter. These liquid hand soap or shower gel formulations generally contain about 50 to 80% water. The surfactants are generally miscible with water and are incorporated in these formulations at a level of 5 to 15% by simply mixing with water at room or slightly elevated temperature. Other additives such as color, fragrance, extracts, skin conditioning agents, opacifying agents, preservatives, and pearlizing agents are then added to this formulation. Antibacterial agents such as triclosan are often added to the formulation via dissolution in fragrance. The pH is then adjusted to the desired value, generally between 5 and 7, except for soap-based formulations, in which case the pH is on the higher side (9 to 10). Finally the viscosity of the formulations is built either by addition of an appropriate salt or various thickening polymers. Sodium chloride, being very inexpensive, is widely used. The order of addition of the above ingredients is sometimes critical to obtain optimal mixing and to prevent undesired interaction. The typical viscosity range for such products is 5,000 to 15,000 cP.

Typical compositions of a clear gel and an opaque or pearlized gel prepared using these methods are summarized in Table 11.5 and Table 11.6.

2. Structured Gels (Clear and Opaque)

The clear and opaque formulations discussed above do not have the capability to suspend particles. Although it may seem that a "thick" formula should suspend particles, high viscosity is not a sufficient condition for suspension. In order to suspend particles, a structured gel is created by incorporating structuring agents

TABLE 11.5 Typical Clear Gel Composition
Ingredients are generally listed as per regulations in descending order of predominance

Ingredient	Function
Water	Vehicle
Sodium C12–C13 pareth sulfate, cocamidopropyl betaine, lauryl polyglucoside	Cleaning, foaming
Perfume	Fragrance
Sodium chloride	Viscosity builder
DMDM hydantoin	Preservation
Tetrasodium EDTA	Preservation efficacy booster
Polyquaternium-7	Skin conditioner
Benzophenone-4	UV absorber/color protector
Canaga odoranta, pogostemon cabin, lavandla angustifolia	Essential oils
CI 17200, CI 60730 (Dyes)	Coloring

TABLE 11.6 Typical Opaque or Pearlized Gel Composition
Ingredients are generally listed as per regulations in descending order of predominance

Ingredient	Function
Water	Vehicle
Sodium laureth sulfate, cocamidopropyl betaine	Cleaning, foaming
PEG-7 glyceryl cocoate	Skin conditioning agent
Disodium cocoyl, glutamate	Skin conditioning agent
Citric acid	pH adjuster
PEG-40 hydrogenated castor oil	Fragrance solubilizer
Sodium chloride	Rheology modifier
Sodium benzoate, sodium salicylate	Preservation
Styrene/acrylate copolymers	Opacifiers
Polyquaternium-10	Skin conditioning agent
PEG-90 glyceryl isostearate	Skin conditioning agent
PEG-200 hydrogenated glyceryl palmate	Skin conditioning agent
Laureth-2	Skin conditioning agent
Perfume	Fragrance

such as xanthan gum, guar gum, or acrylate copolymers. These polymers provide a gel network with significant strength to have an adequate yield point to suspend the particles. The yield point is the minimum force required to make the gel flow. The polymers that only thicken but do not suspend particles do not have such a yield point. Rheologically, the structuring polymers are characterized by $G' > G''$ as described in Section III.A.1. These ingredients are generally solids, although acrylate copolymers are now available as dispersions. These ingredients are carefully dispersed at a level of 1 to 3% (solids) in water to obtain a homogenous gel. Surfactants are then added, followed by other ingredients as described above.

Acrylate copolymers are supplied in the acidic form and have to be neutralized in order to form the gel. Until neutralized, the formulation stays thin, thus facilitating the incorporation of minor additives. The neutralization is generally done after most of the ingredients are added to the formulation. These gels are fairly viscous and possess high yield point. The latter is critical to suspend particles.

The above mentioned structuring agents are anionic in nature and hence interact with cationic surfactants and are precipitated out. Therefore cationic surfactants should be avoided if high-clarity gels are desired.

The manufacturing complexity and cost of these formulations are generally greater than the clear and opaque gels and therefore they are generally used in applications where particle suspension is required. A typical structured gel formulation is shown in Table 11.7.

TABLE 11.7 Typical Structured Gel Composition

Ingredient	Function
Water	Vehicle
Ammonium lauryl sulfate, ammonium laureth sulfate, cocamidopropyl betaine	Cleaning, foaming
Propylene glycol	Viscosity modifier
Acrylate copolymers	Structuring agents
Perfume	Fragrance
Glycerin, Polyquaternium-10	Skin conditioning agents
Cocamide monoethanolamide	Foam stabilizer
Methylcellulose	Rheology modifier
Benzophenone-4	UV absorber
Tetrasodium EDTA	Water softener, preservative
Carbomer	Structuring agent
Methylchloroisothiazolinone, methylisothizolinone, etidronic acid, guanine	Preservation
CI 75710, mica (CI 77019), red 33 (CI 17200), titanium dioxide (CI 77891)	Colorants, pearlizers

3. Emulsions

These formulations deliver very high levels of skin conditioning oils and hence are the most complex and expensive of all the formulations discussed above. Some of the major brands containing these types of formulations are Dove and Olay, with high levels of sunflower seed oil and soybean oil. Petrolatum is another water-insoluble ingredient used in this kind of formulation.

In order to suspend high levels of oils and hydrocarbons such as petrolatum in these formulations, a combination of emulsifiers and sometimes structuring agents are used. The oils are dispersed in the formulation in the presence of emulsifiers and then homogenized to break them down into fine particles. A proper balance of emulsifiers (determined by HLB, the hydrophile/lipophile balance) is required in order to obtain a stable emulsion. These emulsions are tested for stability at various temperatures for an extended period of time. Accelerated stability testing can be done using techniques such as centrifugation, coupled with measurement of particle size distribution as a function of time. It is a general principle of emulsions that those with smaller droplets are generally more stable, and agglomeration of the droplets into larger particles is a step toward destabilization of the system.

The theoretical background behind stabilizing emulsions has been discussed in the literature very extensively. Two such sources are Tadros [25] and Becher [26].

Table 11.8 shows an example of a typical emulsion formulation.

TABLE 11.8 Typical Emulsion Composition

Ingredient	Function
Water	Vehicle
Sodium laureth sulfate	Cleaning, foaming
Glycine soja (soybean oil)	Skin conditioning oil
Sodium lauroamphoacetate	Cleaning, emulsifying agent, foam booster
Glycerin	Humectant
Cocamide monoethanolamide	Foaming agent
Palm kernel acid	Emulsifying agent
PEG-6 caprylic/capric glycerides	Emulsifying agent
Citric acid	pH adjuster
Magnesium sulfate	Rheology modifier
Perfume	Fragrance
Maleated soybean oil	Skin conditioning agent
Tocopheryl acetate, niacinamide, retinyl palmitate	Vitamins
Polyquaternium-10	Moisturizing agent
Sodium benzoate, DMDM hydantoin, disodium EDTA, benzyl salicylate, butylpheryl methylpropional, hydroxylsohexyl 3-cyclohexene carboxaldehyde	Preservation

V. NEW PRODUCTS AND FUTURE TRENDS

For liquid hand soap, new products introduced to the market in the last decade continue to focus on superior cleaning plus antibacterial and skin moisturization benefits. Some new benefits introduced to liquid body wash products, as discussed below, have also been extended to hand soaps such as Softsoap's Aromatherapy Hand Soap by Colgate-Palmolive. Table 11.9 lists some representative liquid hand soap products on the market around the world and the benefits these products claim.

For liquid body wash, there has been an explosion of new products in the marketplace. The rapid pace of innovation in the bath and shower market in the last decade has transformed the traditional bathing and showering practice from the necessity of basic cleaning and hygiene to pampering and caring for well being of body and mind. The high-end products that were being sold only in specialty stores are now coming to mass market, to deliver special skin care benefits. Relaxation of body and mind is being offered in the shower by the introduction of aromatherapy shower gels based on essential oils, traditionally known to soothe the nerves

TABLE 11.9 Commercial Liquid Hand Soaps

Brand	Manufacturer	Ingredients	Claims
Foamy Liquid Gel Soap (Argentina)	Foamy	Vegetable proteins and essential oils	Deep cleans and leaves a pleasant sensation of softness and freshness
Shampoo for Hand and Body (Argentina)	Palacios	Irgasan DP 300	Prevents contamination by germs
Campbell Bathroom Handwash (Australia)	Campbell	Vitamins E and B5	Cleans and moisturizes hands
Softwash Liquid Handwash (Australia)	Colgate-Palmolive		Kills germs; moisturizes
Country Life Hand Wash (Australia)	Faulding		Cleans and moisturizes
Soft as Soap Handwash (Australia)	Reckitt Benckiser	Aloe vera with moisturizer	Gently cleanses and moisturizes leaving the skin feeling clean, soft, and refreshed
Softsoap Liquid Hand Soap (U.S. and Canada)	Colgate-Palmolive	Triclosan	Provides both thorough cleansing and light moisturizing. Its antibacterial action combined with an exclusive blend of light moisturizers leaves hands fresh, clean, and soft
Alpen Secrets Hand Sanitizer (Canada)	Delhar Group		Kills bacteria and germs on contact where water and soap are not available
Pooh Extra Gentle Antibacterial Soap (Canada)	Funcare	Royal honey	Combats the spreading of germs transmitted through hand-to-hand contact
Jergens Antibacterial plus Cream Hand Soap (Canada)	Kao		Kills bacteria; contains moisturizer
Ivory Skin Cleansing Liqui-gel (Germany)	Procter & Gamble		Specially designed to wash away dirt and bacteria; so gentle to the skin that it can be used on the face
Palmolive Liquid Soap (Czech Republic)	Colgate-Palmolive	Keratin for hands and nails	Neutral pH, delicately washes and dries out skin. Strengthens nails and cares for hands
Carex Antibacterial Moisturizing Handwash (Czech Republic)	Cussons	Aloe vera and eucalyptus	Removes germs and stubborn odors
Palmolive Pouss Mousse Hyperallergenic Hand Soap (France)	Colgate-Palmolive		Protects skin against dryness and helps to minimize risks of allergy. pH neutral for skin. Suitable for the most sensitive skin types

(continued)

TABLE 11.9 (Contd.)

Brand	Manufacturer	Ingredients	Claims
Fa Spirit of Freshness Fluid Soap (Germany)	Henkel	Hydro-Balance system	Pleases the body, protects the skin. Leaves skin noticeably fresh and supple. With Hydro-Balance system to prevent dryness
CD Wash Lotion (Germany)	Unilever	Avocado extracts; calming, natural ingredients	For sensitive skin. pH neutral. Colorant free. Effective beauty care. Naturally mild and soap free
Lux Moisturing Cream Soap (Germany)	Unilever	Natural water lily extracts and vitamin E	Helps skin to maintain its natural moisture balance. Gently cleanses to leave skin feeling soft, smooth, and supple
Palmolive Fresh & Clean Liquid Soap (Italy)	Colgate-Palmolive		Cleans hands in a nonaggressive way with a unique action against bad odor. The active ingredient neutralizes all odors of garlic, onion, fish, gas, bleach, etc. Ideal for the kitchen. pH neutral and helps to maintain the natural balance of skin. Moisturizers help prevent drying due to frequent washing
Palmolive Douss' Douss' (France)	Colgate-Palmolive		Ideal for kitchen use. Unique formula, pH neutral, helps eliminate persistent odors from hands. Leaves a fresh lemon scent
Palmolive Vitamins Liquid Cleanser (Italy)	Colgate-Palmolive	Vitamin E + A complex	For healthy- and younger-looking hands. With a special complex with vitamin E which replenishes hands' supply of that vitamin, known for its antiaging properties
Badedas Super Soap (Italy)	Sara Lee	Proteins and vitamins E and F	Ideal for use in the kitchen. Eliminates from hands persistent odors like garlic, onion, and fish. Combines antiodor properties with emollient and moisturizing properties, leaving skin soft and gently fragrant
Pouss Mousse Liquid Body Cleanser (Japan)	Colgate-Palmolive		Thoroughly cleans the skin. Refreshing and smooth finishing
Kazoku Seiketsu Hand Soap (Japan)	Kao	Tea essence	Medicated. Contains tea essence. Thoroughly sterilizes and does leave fragrance on hands

(continued)

TABLE 11.9 (Contd.)

Brand	Manufacturer	Ingredients	Claims
Naïve Hand Soap (Japan)	Kanebo	Aloe extract	Preserves moisture in the skin while cleansing hands thoroughly
Kao White Medicated Hand Soap (Japan)	Kao	Vitamin E	Maintains the skin smooth, preserving water and preventing chapping and drying. Contains vitamin E, which promotes blood circulation, and glycylrecine acid stearyl, which controls inflammation. Nonsticky type
Kirei Kirei Liquid Hand Soap (Japan)	Lion	Triclo acid	Clean hands with sterilizing ingredient. Rich lather quickly rinses off. 100% plant cleansing ingredients
Kitchen Lime SOAP Liquid (Japan)	Lion	Lime oil	Eliminates odor of fish, meat, and onions on hands. Especially made for kitchen use. It leaves not even the smell of soap on hands after rinsing
Dove Hand Care Wash (Japan)	Unilever	Contains 1/4 moisture milk	Moisture milk wash. Prevents chapping and drying
Dial Liquid Soap (Mexico)	Dial	Vitamin E	Kills bacteria and moisturizes at the same time
Natusan pH 5.5 Liquid Soap (Sweden)	Johnson & Johnson	Glycerin	Has a pH of 5.5, and therefore it does not interrupt the skin's natural protection. Remoisturizes the skin
Palmolive Fruit Essentials Liquid Hand Soap (Thailand)	Colgate-Palmolive		Refreshes and leaves hands feeling soft
Protex Liquid Hand Soap (Thailand)	Colgate-Palmolive	Triclosan	Keeps hands clean and protected. It contains moisturizers to leave hands feeling soft and smooth
Dettol Liquid Hand Soap (Thailand)	Reckitt Benckiser	Extra moisturizer	Protects and cleans sensitive hands from unseen bacteria and dirt. With extra moisturizer that is pH balanced
Lifebuoy Plus Liquid Handwash (Thailand)	Unilever	Puralin Plus and moisturizer	Protection and care for healthy skin
Boots Antibacterial Handwash (U.K.)	Boots	Triclosan	Removes germs and leaves hands feeling refreshed
Palmolive Nourishing Liquid Handwash (U.K.)	Colgate-Palmolive		Nourishes the skin after washing hands, leaving it supple and soft to the touch

(continued)

TABLE 11.9 (Contd.)

Brand	Manufacturer	Ingredients	Claims
Johnson's pH 5.5 Handwash (U.K.)	Johnson & Johnson		pH 5.5. Soap free. Extra gentle. Fragrance free
Carex Antibacterial Moisturizing Handwash (U.K.)	Cussons	Aloe vera and eucalyptus	Removes dirt, germs, and stubborn odors. Added moisturizers help protect against moisture loss and actively condition the skin
Dettol Fresh Moisturizing Handwash (U.K.)	Reckitt & Colman		Antibacterial protection from germs and dryness. Kills germs, including *E. coli* and salmonella. Actively moisturizes the skin
Softsoap Liquid Hand Soap (U.S.)	Colgate-Palmolive	Triclosan	Antibacterial with light moisturizers. More than just cleans — cares for the skin
Softsoap Antibacterial Hand Soap (U.S.)	Colgate-Palmolive	Triclosan	Provides strong antibacterial protection. Contains light moisturizers to help leave hands clean and soft
Softsoap 2 in 1 Antibacterial Hand Soap (U.S.)	Colgate-Palmolive	Triclosan, Polyquarternium-7, and Polyquarternium-39	Combines proven antibacterial formula with real moisturizing lotion; helps retain more of the skin's natural moisture
Softsoap Lavender & Chamomile Liquid Hand Soap (U.S.)	Colgate-Palmolive		Helps one feel relaxed while leaving the skin feeling silky and smooth after washing the hands
Liquid Dial for Kids (U.S.)	Dial		Kills germs. Fun to use
Softsoap FoamWorks Foaming Hand Soap (U.S.)	Colgate-Palmolive		Makes hand washing fun and easy for children and the whole family
Lysol Antibacterial Hand Gel (U.S.)	Reckitt & Colman		Helps reduce the risk of illness by killing 99.9% of the germs on hands without water. It contains emollients that moisturize hands
Suave Antibacterial Hand Sanitizer (U.S.)	Unilever	Vitamin E	Kills germs instantly without water

and relax the muscles. Desire for youthful appearance and willingness to pay for products that would promise such benefit is leading to the development and introduction of a multitude of antiaging shower products such as those offering firming, exfoliation, etc.

A. Aromatherapy Products

Aromatherapy is becoming a very popular trend in cleansing products. The aromatic fragrances make the showering or bathing experience an indulgence rather than a chore. A number of products have been introduced in the market under brands such as Palmolive, Dove, and Ohm (Olay). A number of experiential benefits such as relaxing, soothing, and energizing are being delivered via various essential oils such as lavender, chamomile, and ginseng. Table 11.10 lists some aromatherapy products on the market, the essential oils contained in the products, and the benefits claimed.

Essential oils have been widely investigated in the medical field for their effect on brain and heart and the therapeutic benefits they deliver. They have been used for centuries by the Chinese, Egyptians, Greeks, and others and are well covered in the patent literature. A U.S. patent by Fletcher *et al*. [27] presents a good cross-reference for essential oils.

Essential oils are highly scented droplets found in minute quantities in the flowers, stems, leaves, roots, and barks of aromatic plants. It takes 440 lb of fresh lavender flowers to produce 2.5 lb of lavender essential oil.

These oils are complex mixtures of terpenes, alcohols, esters, aldehydes, ketones, and phenols. The chemical composition of the oils is strongly related to the season, month, and time of the day and therefore these oils need to be extracted at the right moment. These factors make the oils very expensive and scarce and therefore synthetic oils are made with the predominant constituents of the oils while still maintaining the aroma of the natural oil.

The effectiveness of a perfume containing valerian oil as an active ingredient in the reduction of stress is described in a European patent by Shoji and Sakai [28] and a measurement of such a reduction is stress is described in a U.S. patent application by El-Nokaly *et al*. [29]. The latter describes a method and apparatus to measure the stress level resulting from an application of stimuli such as fragrance, flavor, or product or while test subjects are performing an activity task. The method involves measuring both physiological and psychological responses of humans. The physiological measurements include electrocardiography and blood volume pulse and the psychological data are collected via questionnaires.

Besides reduction of stress, essential oils are known to provide a number of other benefits. Table 11.11 [30] gives examples of some of the essential oils and their corresponding potential benefits.

B. Exfoliating Body Wash

Incorporation of cosmetic benefits into body wash and liquid hand soap products is becoming a trend of the future. Exfoliation was used in the past as a beauty treatment, delivered as a facial scrubber. It is now being introduced for the whole body via body wash. These products have begun appearing in specialty stores,

TABLE 11.10 Commercial Aromatherapy Liquid Body Wash Products

Product	Manufacturer	Essential oils/herbs	Claims
Palmolive Aromatherapy Body Wash — Antistress (France, U.K., Italy, Hungary)	Colgate-Palmolive	Lavender, ylang-ylang, and patchouli	Antistress. Helps to give radiance to skin as it softens it. Its calming fragrance envelops the user in an aura of peace and tranquility
Palmolive Aromatherapy Body Wash — Energy (France, U.K., Russia, India, Thailand)	Colgate-Palmolive	Mandarin, ginger, and green tea extract	Helps skin feel revitalized and softened while the awakening scent gives an energy boost to body and soul
Palmolive Aromatherapy Sensual Shower Gel (South Africa)	Colgate-Palmolive	*Rosa damascene* extract, *Jasminum officianale* oil, *Vanilla plantifolia* fruit extract	Creates an aura of sensuality and warmth
Herbaflor Aromatherapy Herbal Shower Gel (Canada)	Bellmira	Essential oil of rosemary	Feel refreshed after bathing
Switch On Aromatherapy Body Wash (U.K.)	Tesco	Grapefruit and mandarin	Helps revitalize and invigorate skin. The refreshing and uplifting effects of grapefruit and mandarin working together to help awaken the mind and body
NO-AD.Aroma Bath and Shower Therapy Soothing Body Wash (U.S.)	Solar Cosmetics	Lavender and chamomile	Stimulates the senses and cleanses the skin. Helps promote a sense of emotional well-being. Brings a sense of balance, comfort, and relaxation
Vitamin & Herbal Indulgence Energizing Ginseng Body Wash (U.S.)	Vogue	Ginseng	Revitalizes the mind and body. Stimulates the senses and restores health and glow to the skin. Revives and nourishes the skin
Vitamin & Herbal Indulgence sensual Sunflower Body Wash (U.S.)	Vogue	Sunflower	Provides a romantic escape from daily stress. Cleanses without drying
St. Ives Swiss Formula Body Wash (Australia)	Alberto Culver	Vanilla and vitamins E and A	Conditions and soothes skin
Beautiful Bath Bath Gel (U.S.)	Freeman	French vanilla and tangerine	Calms and soothes a tense body and sore muscles. Leaves skin soft, smooth, and radiant
Ohm Body Wash (U.S.)	Procter & Gamble	Jasmine and rose extracts	Cleanses skin gently and then calms it with a moisturizing recipe. For soothed and supple skin
Ohm Body Wash (U.S.)	Procter & Gamble	Sandalwood and chamomile extracts	Cleanses skin gently and then restores skin's serenity. For soft skin and harmonious spirit
Ohm Body Wash (U.S.)	Procter & Gamble	Citrus and ginger	Cleanses and helps restore the look and feel of younger, healthy skin. Reenergizes the mind and helps restore skin's youthful appearance

TABLE 11.11 Examples of Essential Oils and Their Possible Benefits

Essential oil	Traditional uses (possible benefits)
Angelica root	For relieving fatigue, migraines; to ease anxiety and nervous tension; to regulate menstrual cycles and relieve dysmenorrhoea; for coughs; to restore sense of smell; for releasing accumulated toxins in the body
Atlas cedar	To relax tense muscles, calm emotions, help breathing; for enhancing meditation, easing pain, repelling insects; for hair loss
Balsam fir	To relieve muscle aches and pains; for relieving anxiety and stress-related conditions; to fight colds, flu, infections; for relieving bronchitis and coughs; said to ground one mentally
Bay	As a stimulant for hair growth; for relieving muscle spasms and strains; to improve circulation; to relieve melancholy, nervous exhaustion; as an insect repellent
Bay laurel	As an immune system stimulant, to regulate the lymphatic system; for relieving melancholy and anxiety; to stimulate the mind; for healing bronchitis and sinus infection
Bergamot	Balancing nervous system; relieving anxiety and stress; lifting melancholy; for restful sleep; as an antiviral; treatment of cold sores, psoriasis, eczema; insect repellent
Black pepper	To energize, for increasing circulation, to warm and relieve muscle aches and stiffness, for fighting colds, flu, infections
Calendula	All skin complaints; varicose veins; for treating enlarged lymph nodes, cysts, skin lesions
Cardamon	Relieving mental fatigue, nervous strain, and heartburn; for healing coughs and bronchitis, anorexia; to uplift and warm; as an aphrodisiac
Carrot seed	For toning and rejuvenating mature skin, wrinkles, scars; for eczema and psoriasis; as a stimulant to immune and lymphatic systems; for relieving premenstrual syndrome and regulating monthly cycles; to ease anxiety and stress
Citronella	As a mosquito repellent; for colds, flu, neuralgia; to relieve pain of rheumatism and arthritis; to relieve melancholy. Use on sensitive or damaged skin should be avoided
Clary sage	Relieving stress and tension; lifting melancholy; easing pain; for restful sleep; as an aphrodisiac; contains estrogen-like hormone, for menopause and premenstrual syndrome; relieving nervous exhaustion
Clove bud	For toothache, colds, flu, fungal infections; as a mosquito repellent; to relieve fatigue and melancholy; as an aphrodisiac
Coriander	Relieving muscular aches and pains; increasing circulation; for colds, flu, rheumatism; for help with sleep and nervous exhaustion

(continued)

TABLE 11.11 (Contd.)

Essential oil	Traditional uses (possible benefits)
Cypress	To increase circulation; relieve muscular cramps, bronchitis, whooping cough, painful periods; reduce nervous tension and other stress-related problems; as an immune stimulant
Eucalyptus	For colds, as a decongestant; to relieve asthma and fevers; for its bactericidal and antiviral actions; to ease aching joints
Frankincense	To calm, enhance meditation, elevate mind and spirit; to help breathing; for psychic cleansing; for care of mature skin and scars
Geranium	Reducing stress and tension; easing pain, balancing emotions and hormones, premenstrual syndrome; relieve fatigue and nervous exhaustion; to lift melancholy; reduce fluid retention; repel insects
German chamomile	To relieve muscular pain; to heal skin inflammations, acne, wounds; as a sedative; to ease anxiety and nervous tension; to help with sleeplessness
Ginger	Reducing muscular aches and pains; increasing circulation; relieving bronchitis and whooping cough; for nervous exhaustion; in healing colds, flu, fever; to stimulate appetite
Grapefruit	To lift melancholy; relieve muscle fatigue; as an astringent for oily skin, to refresh and energize the body; stimulate detoxification; as an airborne disinfectant
Helichrysum	To heal bruises (internal and external), wounds, scars; to detoxify the body, cleanse the blood, increase lymphatic drainage; for healing colds, flu, sinusitis, bronchitis; to relieve melancholy, migraines, stress, tension
Hyssop	To heal bruises; for healing respiratory complaints and bronchitis, low or high blood pressure, indigestion, stress, tension
Jasmine	To lift melancholy; for muscular spasm, painful periods, labor pains; to relieve anxiety and nervous exhaustion; an aphrodisiac
Juniper berry	To energize and relieve exhaustion; ease inflammation and spasms; for improving mental clarity and memory; purifying the body; to reduce fluid retention; for disinfecting
Lavender	Balancing emotions; relieving stress, tension, headache; to promote restful sleep; heal the skin; to lower high blood pressure; help breathing; for disinfecting
Lemon	To balance the nervous system; as a disinfectant; to refresh and uplift; for purifying the body
Lemongrass	As an insect repellent and deodorizer; for athlete's foot; as a tissue toner; to relieve muscular pain (from sports); increase circulation; for headaches; for nervous exhaustion and other stress-related problems
Lime	To purify the air; for alertness; to relieve coughs or congestion; for uplifting and cheering the spirit; to heal colds, flu, inflammations

(continued)

TABLE 11.11 (Contd.)

Essential oil	Traditional uses (possible benefits)
Myrrh	To heal wounds and nurture mature skin; for bronchitis and colds; to relieve apathy and calm
Neroli	For healing thread veins and scars; nourishing mature skin; increasing circulation; for relieving anxiety, melancholy, nervous tension, bronchitis; as an aphrodisiac
Nutmeg	For warming muscles; easing muscle aches and pains; to invigorate or stimulate the mind; an aphrodisiac; to stimulate heart and circulation; for relieving nervous fatigue
Oregano	As a muscle relaxant and to ease muscle aches and pains; to heal colds, flu, bronchitis; as a stimulant, to energize the mind and body; for relieving headaches
Palmarosa	To stimulate cellular regeneration and moisturize skin; for nervous exhaustion and stress conditions; to calm and uplift
Patchouli	For athlete's foot; as an aphrodisiac; to relieve stress and nervous exhaustion. Emotional profile: to relieve indecision, lethargy, mood swings
Peppermint	For energy and brighter mood; reducing pain; to help breathing; improve mental clarity and memory
Petitgrain	For relieving respiratory infections; to ease nervous tension muscle spasms; for relieving joint inflammation; to balance the central nervous system; for stress relief and restful sleep
Pine	To ease breathing; as an immune system stimulant; to increase energy; for relieving muscle and joint aches; to repel lice and fleas
Roman chamomile	To relieve muscular pain; as a sedative; to ease anxiety and nervous tension; to help with sleeplessness
Rose maroc absolute	For brighter mood; menopause; to help reduce wrinkles; for calming and reducing nervous tension; to promote restful sleep; as an aphrodisiac
Rosemary	To energize; for muscle pains, cramps, sprains; brighten mood; for improving mental clarity and memory; easing pain; to relieve headaches; for disinfecting
Rosewood	To relieve stress and balance the central nervous system; for easing jet lag; to create a calm for meditation; for easing colds and coughs; to stimulate the immune system; as an aphrodisiac; in skin care
Sandalwood	To lift melancholy, enhance meditation, heal the skin; help breathing; for calming and reducing stress; restful sleep; for disinfecting; as an aphrodisiac
Spearmint	For relieving bronchitis and sinusitis; to ease nausea and headaches; for relieving colds or flu; to stimulate, energize, relieve fatigue
Spikenard	To relieve migraines, stress, tension; for rejuvenation of mature skin; to calm and promote restful sleep; for wounds; to inspire devotion

(continued)

TABLE 11.11 (Contd.)

Essential oil	Traditional uses (possible benefits)
St. John's Wort	For fungal infections, oily hair, dandruff, sinusitis, sore muscles
Sweet basil	To brighten mood, strengthen nervous system, improve mental clarity and memory; for relieving headache and sinusitis
Sweet fennel	For neuromuscular spasms, rheumatism and arthritis, bronchitis, whooping cough; as a nerve tonic in relieving stress and nervous tension
Sweet marjoram	To relax tense muscles and relieve spasms; calm and promote restful sleep; ease migraine headache; for comforting the heart; lowering high blood pressure; to help breathing; for disinfecting
Sweet orange	To brighten mood, calm, reduce stress; as an environmental disinfectant
Tangerine	For relieving muscle spasms; to soothe and calm nerves; for stress relief and relaxation; to stimulate the liver and increase lymphatic drainage
Tea tree	As an immunostimulant particularly against bacteria, viruses, fungi; for relieving inflammation; as a disinfectant
Thyme	To heal colds and bronchitis; for relieving muscle aches and pains; to aid concentration and memory; for relieving fatigue; said to heal anthrax
Vetiver	For muscular aches; to increase circulation; to relieve melancholy and nervous tension; for restful sleep
Ylang ylang	Brightening mood; relieving anger and anxiety; relaxing tense muscles; to calm and promote restful sleep; lower high blood pressure; as an aphrodisiac

Source: From Essential Oil Details, Ancient Healing Art, www.AromaMarket.com. With permission.

containing exfoliating agents such as sugars, salt, and rice, well known in ancient cultures. In the mass market, the Dove brand has taken a lead in this category by introducing an exfoliating body wash and Dial has introduced a liquid hand soap. Besides offering cleansing and moisturizing benefits, these products promise exfoliation of skin during the shower by abrasive particles incorporated in the formula. Table 11.12 lists some of the commercial body wash products that offer exfoliating benefits.

The practice of exfoliation to remove dead cells and oils from skin was well known in ancient cultures. Crushed nut seeds such as walnut were commonly used to provide abrasion as well as nutritional benefits. It is believed that removal of dead cells leads to improved skin elasticity and firmness by regeneration of epidermal tissues thus making the skin look smoother, supple, healthier, and younger.

TABLE 11.12 Commercial Exfoliating Liquid Body Wash Products

Brand	Manufacturer	Ingredients	Claims
Neutrogena Visibly Even Exfoliating Body Wash (U.S.)	Johnson & Johnson	Soybean seed extract, grapefruit extract, *Morus bombycis* root extract, *Scutellaria baicalensis* root extract	Provides toning, moisturizing, and exfoliating benefits to make skin look more radiant
John's pH 5.5 Daily Exfoliating Body Wash (U.K., South Africa)	Johnson & Johnson	Hydrogenated jojoba oil, sodium/styrene/acrylate copolymer, acrylates/C10–C30 alkylacrylate cross-polymer	The massaging action of the natural jojoba beads removes rough skin to reveal new, silky smooth skin after every shower
Herbal Essences Daily Body Smoother Exfoliating Body Wash (U.S.)	Clairol	Hydrogenated jojoba oil, coneflower (*Echinacea purpurea*) extract, *Magnolia acuminata* extract	Formulated to smooth and soften the skin, cleanse, and gently polish away dry rough skin
Sue Devitt Studio Lavender Exfoliating Body Wash (U.S.)	New Kingdom	Sea plant loofah and bamboo shoots	Naturally exfoliates skin. It is infused with hints of lavender and silver shimmers "to add subtle gleam"
Farmaervas Celulan Exfoliating Body Wash (Brazil)	Labolatorio Farmaervas	Jojoba microspheres	Removes dead cells and hydrates and cleanses skin. Helps to lighten skin
Aromamor Exfoliating Body Wash (Brazil)	VLD	Merguard, fennel extract, glycolic extract of fennel, fennel seed, vegetable luffa	Gently exfoliates with essential oils
St. Ives Apricot Exfoliating Body Wash (Australia)	St. Ives (Alberto Culver)	More than 50% naturally derived ingredients with jojoba beads, moisturizing apricot, and soothing Swiss botanicals	Softens, soothes, and refreshes skin as it cleanses and moisturizes the skin, improving the look and feel. It is proven to reveal healthier, brighter-looking skin
Lux 2-in-1 Skin Expert and Scrub Exfoliating Shower Gel (Netherlands)	Unilever	Exfoliant granules	Gently cleanses the skin as its exfoliant granules stimulate the skin, thus offering a refreshing sensation. Refreshes the skin while moisturizing it thoroughly
Ocean Potion Before Sunless Exfoliating Body Wash (U.S.)	Sun & Skin Care Research Inc.	Hydrogenated jojoba oil beads	An all natural, organically based product that removes impurities and dead skin cells paving the way for skin revitalization
Nivea Bath Care Exfoliating Body Wash (Canada)	Beiersdorf	Vitamin E beads, magnesium aluminum silicate	Aids in revealing radiant, healthy-looking skin
Simple Exfoliating Body Wash (U.K.)	Accantia Health & Beauty	Natural loofah and chamomile oil	Gently exfoliates and cleanses, leaving skin soft and smooth

Les Actifs Marins Exfoliant Shower Gel (Belgium)	Sarbec	Microparticles, seaweed extracts, and antifree radicals	Gently eliminates impurities and dead cells which may asphyxiate and dull the skin. Gently cleanses the skin, returning to it luster, softness, and firmness
Obao Exfoliating Shower Gel (France)	L'Oreal	Microbeads, AHA	Softens the roughness of skin and eliminates dead cells. New skin effect contains AHA to help the renewal of the cells. Exfoliated skin sees its texture transformed. A skin like new, soft, velvety, toned
Veet Exfoliant Shower Gel (Germany)	Boyle	Finely ground granules	Speeds up the removal of dead skin cells and softens rough areas on the skin. Sheds off the old skin cells when rubbed over the skin. Makes skin smooth and soft
Neutro Roberts Shower Foam (Italy)	Manetti-Roberts	Microgranules derived from natural jojoba oil, vitamin E + B5 complex	Eliminates impurities, renews skin. Ideal for sensitive skin. Cleans the skin, giving it vitality and moisturization. Protects and reintegrates the moisturization of the skin surface, reinforcing the skin, leaving it soft and elastic
Profil Exfoliate Shower Gel (Germany)	Gemey	Microparticles	Eliminates dead skin and softens, revitalizes, and cleans
Citric Essentials Body Wash (U.K.)	Boots	*Luffa cylindrica*	Cleanses the skin to leave it toned and refreshed
Dove Exfoliating Body Wash (Australia)	Unilever	Ultrafine exfoliants (hydrated silica)	Gently smoothes away dull, lifeless skin to reveal beautifully fresh, new skin. Moisturizes skin, leaving it smooth to the touch
Suave Naturals Body Wash (U.S.)	Unilever	Vitamin E, aloe vera, and natural apricot exfoliants (apricot seed powder)	Gently cleanses and smoothes skin. Helps restore natural moisture while gently exfoliating to remove rough, dull surface cells and reveal the healthier skin below

The formulation of skin cleansing products with exfoliating benefits has been subject of several patents. The materials claimed to provide exfoliation in these products include sugars, inorganic salts, calcite [31] and silica, clays, polymeric materials such as polyethylene powders [32], and crushed seed powders from walnut, apricot kernel, and almond.

1. Salts and Sugars

A patent by Hramchenko and Sibley [33] describes an exfoliating composition containing salts and sugars. The composition is an anhydrous cream with uniformly dispersed fine particles of inorganic salts or sugars. The salts are so chosen that their solubility and particle size make them last long enough, preferably 15 seconds, in the presence of water to provide scrubbing action and eventually dissolve in water for a clean rinse. The preferred solubility is less than 30 wt% at 40°C and less than 10 wt% at 20°C. An average particle size of about 125 to 750 μm is preferred with a hardness of 1.5 to 4 on the Mohs scale. The preferred salts are sodium tetraborate decahydrate and potassium pentaborate octahydrate, sodium citrate, monobasic sodium phosphate, and sodium pyrophosphate. The preferred sugar is sucrose.

The other ingredients of these compositions are surfactants, foam boosters, benefit agents, and water. The water is added in amounts of 10 to 30 % so that the salts are not dissolved.

2. Silica

Cordery *et al*. in a patent assigned to Unilever [34] describe a cosmetic composition containing silica as an exfoliating/massaging agent for use on scalp and body. The particle size and strength of silica is so chosen that it provides sufficient abrasion/exfoliation during normal use and thereafter breaks down into fine particles by shear and/or crush forces normally produced during use. The desired size and shape of silica is obtained by its structural modification. The preferred material is structurally modified silica derived from Sident 200 (Degussa) or Zeosyl 200 (Zeofinn), or Tixosil 333 (Rhodia). The preferred particle size of this material is in the range 0.1 to 1 mm, porosity in the region of 2 cm^3g^{-1}, surface area about 250 m^2g^{-1}, and crush strength of 10 to 34 MPa at 50% room humidity, breaking down after use to 40 μm. The composition contains silica, surfactants or surfactant mixtures, suspending agents such as clays, polyacrylates (e.g., Carbopol 910, 934, 940, and 941), heteropolysaccharide gums (e.g., xanthan gum, guar gum), and certain cellulose derivatives such as carboxymethyl cellulose, preservatives, and other aesthetic agents.

3. Nut Shells/Kernels, Dried Fruit Particles

Japanese [35] and U.S. [36] patents describe the use of natural abrasives such as ground walnut shells, apricot shells, and olive kernels to provide gentle skin cleansing without scratching.

A U.S. patent application [37] describes the use of dried and fresh fruit particles in skin care preparations. This patent describes compositions containing powder or flakes of size 100 to 200 μm and density between 0.2 and 0.45 g/ml. These powders or fakes are derived from fruit peels or cores dried by techniques such as sun drying, vacuum drying, or freeze drying and other components such as suspending agents, surfactants, and emulsifiers. The various fruits described are peach, lemon, strawberry, pear, cherry, apricot, blackberry, papaya, mango, orange, apple, cranberry, mango, kiwi, banana, etc., supplied by sources such as International Botanical Specialty Products Inc. of Wisconsin and Freeman Industries, Tuckahoe, NY. Besides providing the scrubbing action during use, these fruits also add nutritive value since they generally contain mono-, oligo-, and polysaccharides that can provide moisturizing benefits, fibers, macro- and micronutrients, vitamins, and phenolic compounds such as flavonoids which can act as antioxidants.

C. Toning and Skin Firming Products

A number of body wash products are making claims for toning skin and body and firming the skin. These products incorporate plant or seaweed extracts that are known to impart benefits to skin and body. Table 11.13 lists some examples of commercial products on the market.

D. Antiaging Products

Cleansing products that promise a youthful and younger-looking appearance are beginning to appear on the market in the U.S. and Europe. Table 11.14 lists some of the commercial body wash products on the market that claim to offer antiaging benefits.

Generally, it is a challenge to deliver the antiaging agents on to skin via cleansing agents, since they tend to get washed away in the presence of the large amounts of surfactants in these products. However, the industry has begun devising various carriers to deliver these actives onto skin via cleansing products.

A youthful state of skin is generally measured by its elasticity and tautness. Collagen and elastin in the dermis contribute to these properties. However, with age and adverse environmental effects such as UV radiation, lack of moisture, etc., the elasticity and tautness of skin decreases and the skin wrinkles and shows sign of aging. Exposure to UV radiation and aging leads to a decrease in hyaluronic acid and polysaccharides and excessive production of an enzyme called elastase. This enzyme destroys elastin and leads to loss of skin elasticity.

A European patent by Inomata [38] describes the use of *Uncaria gambir roxburgh* extract in effectively suppressing the activity of elastase and restoring the tautness and elasticity of skin. Also, a world patent by Fransoni [39] describes the benefit of a complex of hyaluronic acid and carnitine and its derivatives

TABLE 11.13 Commercial Toning and Skin Firming Liquid Body Wash Products

Brand	Manufacturer	Ingredients	Claims
Palmolive Naturals Toning Shower Gel (Australia)	Colgate-Palmolive	Natural extracts of kiwi and mango	Contains kiwi and mango extracts which are known to help preserve toned skin. Leaves skin clean, firm, and noticeably soft
Ricette dell'Erborista Elixir D'Aromes Shower Gel (Italy)	Conter	*Santalum album*, P*oppgostemon cablin*	Stimulates and tones the body. Cleanses the skin leaving it soft and fragranced
Prismalis Bain-Douche Bois Exotiques (France)	Prismalis	Mandarin orange, lavender, and mint	Stimulating shower gel that stimulates and protects the skin
Collistar Linea Uomo Gel Docci Tonificante Shower Gel (Italy)	Collistar	Ultra delicate skin purifying ingredient, panthenol, lime extract, and wheat germ protein	Skin toning. Alleviates muscle strain
Cosmence Douche — Soin Toning Shower Gel for a Stimulating Massage (U.S.)	LeClub des Createurs de Beaute	*Ruscus aculeatus* root extract, *Hedera helix* extract, *Arnica montana* flower extract	Helps stimulate circulation to areas of the body that have cellulite
Ushuaia Douche Tonifiante (Belgium)	Laboratoires Garnier	Atlas cedarwood	Tones skin and body
Dove Body Firming Shower Gel (U.K., Switzerland)	Unilever	Seaweed extract and ceramides	A skin firming shower gel with a new thalasso formula. For tauter skin
Jergens Skin Firming Body Wash (U.S. and Canada)	Hergens	Seaweed extract and essential moisturizers	Tightens and tones uneven skin
Bourjois Grains of Beauty Shower Gel and Draining Massage (France)	Bourjois	Holly and ivy extracts	Gently washes, reduces "cottage cheese" aspect, restructuring effect. With holly and ivy extracts known for their draining and firming properties
Venus Multi-active anticellulite shower gel (Italy)	Kelamata	Extracts of *Theobroma cacao*, *Aesculus hyppocastanum*, *Arnica Montana*, and *Centella asiatica*	With plant extracts that have been found to have dramatic effects on cellulite reduction, inhibit the body's production of cellulite tissue, and strengthen capillary walls near the surface of the skin and thus stimulate greater skin permeability. Also known to favor the removal of unnecessary water in cell tissue, reduce inflammation, swelling, and bloating, and produce an intense firming action on skin cell tissue

TABLE 11.14 Commercial Antiaging Liquid Body Wash Products

Brand	Manufacturer	Ingredients	Claims
Dove Nutrium Age-Defying Body Wash (U.S.)	Unilever	Green tea extracts, vitamins A and C	Dual formula that goes beyond cleansing and moisturizing to reduce the visible signs of aging. Smoothes fine lines and dry, rough areas to leave skin soft and younger looking
Les Actifs Marins Exfoliant Shower Gel (Belgium)	Sarbec	Seaweed extracts and antifree radicals	Gently eliminates impurities and dead cells which may asphyxiate and dull the skin. Deeply cleanses the skin, returning to it luster, softness, and firmness
Higiporo Liquid Soap (Brazil)	Davene	Sage, provitamin B5, and vitamin E	Adds softness to skin and regulates T-zone oiliness. Combats premature skin aging. Cleans and moisturizes
Health Basics Aloe Vera Body Wash (Australia)	Pharmaceutical Sales and Marketing	Aloe vera and vitamin E	Soothes and nourishes dry skin. Prevents premature aging. Protects against pollution
Rexona Shower Gel (Switzerland)	Unilever	Liposomes, vitamin E	Prevents premature epidermal signs of aging
Lux Shower & Gel (Hungary)	Unilever	Vitamin E	Slows down the skin aging process

in antiaging, and restoring or maintaining activity on skin elasticity. A U.S. patent by Arraudeau and Aubert [40] describes the use of gentisic acid and 2,3-dihydroxybenzoic acid in combination with alpha- and beta-hydroxyl acids, keto acids, or retenoids to stimulate the process of epidermal cell renewal and beneficial effects to combat the main clinical signs of aging of the skin, i.e., formation of wrinkles or fine lines and blemishes of the skin.

A European patent by Ishikawa [41] describes a method for screening antiaging agents. As the cell ages its capacity to divide itself decreases and the cell becomes senescent. This patent describes ways to produce such cells rapidly (novel transformed cell) and then testing them with the antiaging agent to determine if the agent helps to regenerate the ability of these cells to perform cell division, as measured by an aging index.

A U.S. patent by Miller *et al*. [42] describes the use of legume products for topical applications for the good health of skin. Legumes such as soybeans contain high levels of proteins, lipids, and carbohydrates, and are considered very good nutrients for maintaining skin tone and texture.

E. Spa Products

Recently a number of new "spa" lines of body wash products have emerged on the market. Colgate-Palmolive, for example, introduced three products to the European market under the Palmolive Thermal Spa Shower Gel name — the Purifying variant with sea salt, the Massage variant with white clay, and the Hydrating variant with sea algae. The Art of Beauty introduced Qtica Smart Spa Shower Gel to the U.S. market claiming to sooth, repair, and condition skin. The product is said to contain fortified vitamins C and E. Pharmagis introduced Necca Spa Shower Gel to the Israeli market that contains 33% moisturizer, cetyl palmitate and beheneth-10 hydrogenated castor oil, and glyceryl stearate that claims to moisturize and refresh skin and with a fragrance lasting 24 hours.

F. Skin Whitening Products

Skin whitening products are becoming very popular in Asian countries. Skin darkening is believed to be due to deposition of high levels of melanin in the skin, which is generated by activation of melanocyte by UV radiation. Whitening agents such as L-ascorbic acid, hydroquinone derivatives, glutathione, and colloidal sulfur have been used to inhibit the production of melanin.

A European patent by Kuno and Matsumoto [43] describes the use of olive plant extract as an effective and stable whitening and antiaging agent. This extract is believed to have strong active oxygen elimination function such that it can eliminate superoxide and hydroxyl radicals and also effectively inhibit melanin production.

A world patent by Wakamatsu *et al*. [44] describes the use of ascorbic acid and its derivatives together with purine nucleic acid to provide antiaging benefits and improve skin pigmentation.

G. Products for Men

Traditionally, the shower gel market has been for women. In recent years men have become increasingly interested in their appearance and grooming. A number of shower products specifically formulated for men are making their way onto the mass market, such as Palmolive and Softsoap's Men's Active Body Wash by Colgate-Palmolive, Old Spice Body Wash by Procter & Gamble, and Suave Body Wash by Unilever. A number of skin care products for men are also being introduced by Nivea. These products generally differ from women's products in color,

fragrance, and packaging. They have darker colors, and masculine fragrances and packaging.

VI. CONCLUSION

As consumers continue to look for more and more experiential and therapeutic benefits from bath products, liquid soap and body wash products will continue to incorporate more and more of these benefits to satisfy such demands in the future. The future trend is to bring the benefits that are currently being delivered by high-end cosmetic products to bath and shower products, for the well being of body and mind.

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