

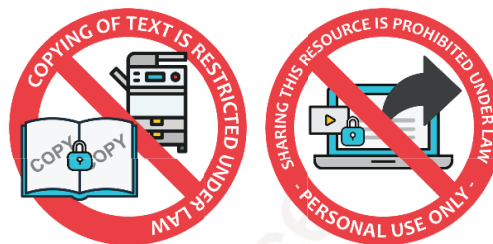
Cosmetic Formulations: A Beginners Guide

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Cosmetic Formulations: A Beginners Guide – 7th ed.

1. Cosmetic formulation.
2. Cosmetic chemistry.
3. Cosmetic safety.
4. Cosmetic ingredients.

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About the Author



Belinda Carli is the founder and Director of the Institute of Personal Care Science. She has consulted for various clients on a range of issues covering the development, manufacture, registration, importation and promotion of complementary medicine, food and cosmetic products for over 10 years. She also provides tailored training for organisations on issues specific to their needs, such as GMP and Regulatory Compliance; prepares and delivers training and guidance documents as regulations change; and training modules in the development and formulation of personal care products. She has been a regular presenter at major International events such as PCHi China, PCHi India, In-Cosmetics events globally and Australian ASCC conferences; as well as providing training to ASEAN regulators. She is also the Official Technical Advisor to the in-cosmetics Group overseeing technical content and the formulation labs at all in-cosmetics exhibitions. Her work can be found in many International publications including SPC Magazine, Australasian Journal of Cosmetic Science and Professional Beauty.

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Chapter 1: Cosmetic product forms and ingredients

As a beginner formulating cosmetics, you don't need a chemistry degree or even much understanding about chemistry to be able to make your own products. You do need to know which ingredients to put together, what different ingredients will do when put together, and how to process them, to get a finished product. Let's start by taking a look at some introductory concepts to get you ready to make your own ingredient selections, and build your own formulations.

1. Finished product forms

Different cosmetic products will take on different forms. Some may be runny like water, others runny like honey, some semi-solid or cream like and some solid bars or balms. When we talk about product forms, we often also refer to viscosity. The viscosity of a product is its resistance to flow: how readily will it flow if the bottle, or jar, is tipped over?

The viscosity and form of a product is important for a few reasons:

- **to make it easy to apply** – for example, you need shampoo to pour from a bottle but then stay in your hand while you apply it to your head
- **to make it easy to dispense and use the right amount** – for example, a body lotion can often be pumped out and spreads easily over large areas of our body for convenience
- **to suit consumer perceptions** – for example, consumers will judge the conditioning benefits of a conditioner by how viscous (thick/creamy) it is. If a conditioner is so thick it needs to come in a jar, they will instantly perceive the product must be deeply conditioning for the hair. Body butters are also very viscous, giving the perception, before a consumer has even tried the product, that it is deeply moisturizing for the skin.

When we talk about viscosity, we are therefore talking about how the product flows. Don't worry about trying to memorise all of this information – just think about some of the cosmetic products you've used over your lifetime to picture the different product forms and it will start to make sense.

Finished products can take one of a number of forms:

- **liquid:**
 - used to describe products that flow freely. Viscosity of the product can still vary from runny like water to runny like honey.
 - needs to be packaged so as to prevent leakages during transportation and use.
 - ingredients to be used in liquid products need to maintain free flowing properties; which limits the use of materials that will alter viscosity.
 - water based liquids can only contain small amount of oils appropriately solubilized (you'll learn about solubilizing soon).
- **gel:**
 - thicker than a liquid, gels have limited flow properties.
 - usually formed through the use of gums or thickening agents, gels may also vary in their appearance; being completely transparent through to translucent (cloudy/semi-see through) or even opaque (can't see through them).

- the viscosity of gels can be altered by the addition of more or less gum or thickening agent as appropriate.
- gels may be water based, like hair styling gels; or oil based, like viscous hair oils.
- **foaming gel:**
 - used to describe foaming products with a honey like viscosity, such as shampoos and liquid body washes.
 - a gel form is preferred by consumers for such products because it prevents product from running out of the hand during application.
 - these products have limited flow capacity for ease of use but must also foam up.
 - gums and thickening agents as well as sodium chloride and the combination of surfactants used can alter the viscosity and form of this type of product (you'll learn more about this later too).
- **serum:**
 - serums can vary from low viscosity gels through to almost lotion-like.
 - the key feature of serums is that they are used to deliver key ingredients in a light product form.
 - they may be water based or oil based, depending on the ingredients they are being used to deliver.
 - they may be formulated much like a gel or like a very low viscosity lotion depending on whether you want a transparent, translucent or milky looking product.
- **lotion:**
 - lotions are low viscosity emulsions.
 - an emulsion is a mixture of two normally immiscible substances by use of a material to hold them together (an emulsifier). For example, most lotions are what we call 'oil in water (o/w) emulsions'. This means they are composed of finely dispersed oil droplets suspended in a continuous water phase. What we see is a white milky product, because the oil droplets are too small to be seen without the use of an electron microscope!
 - lotions can vary in viscosity from low viscosity lotions suitable to be used as serums or moisturising 'milks' to high viscosity lotions that are almost the same viscosity as light creams.
 - lotions can often readily be pumped or squeezed from packaging with little effort, or may run semi-freely.
 - the viscosity of lotions can be altered through the use of different emulsifying agents (emulsifying waxes), consistency factors (such as beeswax or other waxes) or gums and thickening agents.
 - higher quantities of internal oil phase ingredients often also increase the viscosity of these products.

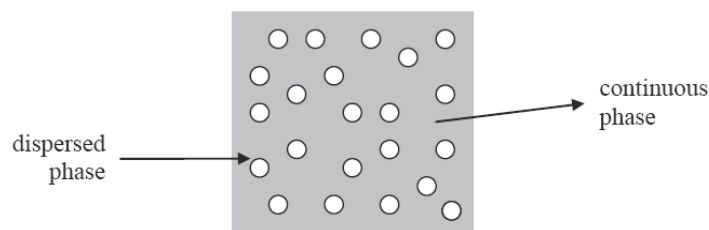


Figure 1: emulsions are a mixture of immiscible substances:

an internally suspended dispersed phase, and an external continuous phase

- **cream:**
 - creams are emulsions of medium to high viscosity.
 - creams may be:
 - o/w = oil in water emulsions = droplets of oil in a water continuous phase
OR
 - w/o = water in oil emulsions = droplets of water in an oil continuous phase
 - w/o creams tend to be higher in viscosity because they have a high oil content.
 - o/w emulsions tend to have a light after-feel on the skin being water based; while w/o tend to have a greasier after feel and are oil based.
 - creams are ideally packaged in jars or small bottles with wide serum or pump nozzles. Higher viscosity creams are only suitable in jars because they are too thick to pump effectively.
 - the viscosity of creams can be altered through the use of varying quantities of emulsifying agents (emulsifying waxes), consistency factors (various waxes) as well as gums and/or polymer thickening agents.
 - higher quantities of oil phase ingredients can alter the skin feel of these products (tending toward more moisturising and/or more greasy) as well as increase the viscosity of the product.
- **powders:**
 - utilised readily in the colour cosmetics industry to make eye shadows, blushes, pressed and loose powders and mineral make up.
 - powders rely on various consistency factors, oils and viscosity modifying agents to set into pressed powders.
- **other forms:**
 - **balms:** often mostly or completely oil based, balms are usually a semi-solid consistency. Their consistency may be altered through the use of more or less, and various types of, consistency factors such as waxes.
 - **muds:** using clays, these are often semi-solid products that vary greatly through the use of different clays and presence of oils, water, gums and thickeners in the base product.
 - **scrubs:** using various bases such as oil, emulsions (creams), gels and foaming gels, scrubs contain various sized particles to mechanically exfoliate the skin.

When selecting ingredients to be used in a personal care formulation, you need to start thinking about the types of ingredients that are going to provide you with the required finished product form consistency. This may help you streamline your selections as well as steer you away from the use of various other ingredients.

2. Cosmetic ingredient functions

The International Cosmetic Ingredient Dictionary and Handbook lists over 70 different functions for ingredients found in personal care products today. We will consider the more commonly used ones here, along with their primary role in products. Remember, ingredients may serve more than one role, and may have secondary roles in a formulation besides those listed here.

When reviewing these ingredients, we have provided you with information as to the general natural/synthetic status of the named materials; but please make sure you request and check the material flow chart and processing methods used for the exact material you intend to use or make claims about to ensure accuracy of information, as different suppliers may use

different sources of materials to those we have listed here. You'll learn more about the natural or synthetic status of ingredients in a coming section.

Key to abbreviations:

(N) = natural

(NDM) = derived from nature with minimal processing

(NDS) = derived from nature complexed with, or processed using, synthetic chemicals

(NI) = nature identical ingredients

(S) = synthetic ingredients

- **abrasives** – used to remove skin cells or plaque from teeth, these functional ingredients are commonly found in body scrub/exfoliating products and toothpastes. Common abrasives, by product types, include:
 - body exfoliants – Avena sativa (oat) kernel meal (N), Juglans regia (walnut) shell powder (N), hydrogenated jojoba wax (NDM).
 - toothpaste abrasives – silica (*normally S, check documentation*), sodium bicarbonate (N).
- **antioxidants** – used in products to reduce oxidation or rancidity from occurring over time. These supportive ingredients not only help lengthen the shelf life of the product, but may also be marketed as nurturing for the skin. Common vitamin and plant extract antioxidants include:
 - vitamin –tocopherol (vitamin E) (*may be NDM or S, depending on source, further documentation checks would be required to determine*).
 - plant extracts – Camellia sinensis leaf extract (green tea extract), Chamomilla recutita (chamomile) flower extract, Rosmarinus officinalis (rosemary) leaf extract, Vitis vinifera (grape) seed extract (*normally N but you will need to check the status of any solvents and/or preservatives present on the product CofA*)
- **chelating agents** – also known as sequestrants, these supportive ingredients help improve the stability of products by binding with metal ions that may be present in other raw materials. Chelating agents are also important in foaming products to bind to the ions in hard water and prevent the deterioration of foam under such conditions. Common chelating agents include:
 - citric acid (NI), disodium EDTA (S), tetrasodium EDTA (S).
- **colourants** – used to colour a product or colour the skin. Colours in cosmetics such as eye shadows or blush products are considered functional ingredients; while colours in personal care products to improve its appearance in a bottle are considered added extras. Examples include:
 - superficial colour in a product – Acid Green 1 (S), Basic Yellow 40 (S).
 - colouring cosmetic products – iron oxide red (*considered to be NDM*), chromium oxide green (*considered to be NDM*).
- **cosmetic astringents** – commonly used in skin toners, cosmetic astringents induce a tightening and toning effect on the skin. They are also used in aftershave lotions. Common examples of these functional ingredients include:

- alcohol (*may be N or S depending on source, further documentation checks would be required*), Hamamelis virginiana (witch hazel) extract (*normally N but you will need to check the status of any solvents and/or preservatives present on the product CofA*).
- **emulsion stabilisers** – emulsions are the white, creamy complexes formed when oil and water are mixed; such as body lotions and skin creams. Emulsion stabilisers do not form the emulsion, but help improve the stability of emulsions once formed, preventing it from separating out into separate oil and water phases. These supportive ingredients can be either derived from natural sources, or composed of synthetic materials; and may also be thickening agents. Common examples include:
 - xanthan gum (*N*)
 - cellulose gum, hydroxyethyl cellulose (*both NDS*)
 - acrylates/C10-30 alkyl acrylate crosspolymer, carbomer (*S*)
- **exfoliants** – exfoliants help remove dead skin cell layers by dissolving the intracellular ‘cement’ holding surface skin cells together. Chemical exfoliants are functional ingredients and usually found in skin whitening or skin peel products, in the presence of a low pH. Common exfoliants include:
 - glycolic acid, lactic acid, salicylic acid (*normally N or NDM but may be NI; further documentation checks would be required*)
- **fragrances** – required only to be listed as ‘fragrances’ on a product label, they are added to enhance the consumers experience of using a product or can be used to mask undesirable odours. Essential oils would also be classified as fragrances, although their full name must appear on product labels. Fragrances are considered added extras (*may be a combination of N, NDM, NDS, NI and S; further documentation checks would be required*), while essential oils (*normally N*), depending on their application, may be considered functional ingredients (if used to control oily skin, for example) or added extras (if used for their scent only). Since the scope of fragrances is so large and varied, no examples are provided here.
- **hair conditioning agents** – used to condition the hair, these functional ingredients also improve the appearance, gloss and shine of hair while facilitating styling and reducing static of the hair. They can also be used to improve the texture of hair that has been dried through styling, chemical exposure or environmental drying. Hair conditioning agents can be synthetically made or derived from and/or complexed with natural ingredients. Common examples include:
 - guar hydroxypropyltrimonium chloride, behentrimonium methosulfate (*both NDS*)
 - amodimethicone, cetrimonium chloride, polyquaternium-7, quaternium-22 (*all S*)
- **hair fixatives** – used to hold hair styles in place, fixatives are functional ingredients that form a continuous film to hold hair in its place. Common examples include:
 - acrylic acid/VP crosspolymer, VP/VA copolymer (*both S*)
- **opacifying agents** – added to shampoos and shower gels to make them appear pearlescent; opacifying agents are considered added extras, and give consumers the impression the product is rich and creamy simply because it looks pearly in nature. Common examples include:
 - glycol stearate (*S*), propylene glycol stearate (*S*), stearamide MEA stearate (*NDS*).

- **pH adjusters** – used to adjust the pH of the finished product to a desired range, these supportive ingredients are also commonly referred to as acids (lower the pH) or bases (raise the pH). Common examples include:
 - acids – citric acid (*NI*), lactic acid (*normally N*).
 - bases – potassium hydroxide (*N*), sodium hydroxide (*N*), triethanolamine (TEA) (*S*).
- **preservatives** – used to prevent or retard microbial growth, preservatives are supportive ingredients. A lot of misinformation exists about the natural status of some preservatives; so it is best to check any claims you wish to make with the raw material supplier by asking them for a statement of natural or synthetic origin for the preservative in question. Common preservatives include:
 - diazolidinyl urea, methyl paraben, phenoxyethanol, propyl paraben, sodium hydroxymethylglycinate (*all S*).
- **skin conditioning agents** – one of the two biggest categories in cosmetic chemistry, skin conditioning agents are functional ingredients that can be broken into the following categories:
 - **emollients** – used to impart softness to the skin by remaining on or in the upper layers of the skin, reducing flaking and improving the appearance of smoothness. They include ingredients such as:
 - cocoglycerides, caprylic/capric triglycerides (*both NDM*).
 - PEG-6 caprylic/capric glyceride, isopropyl myristate (*both NDS*).
 - dimethicone, mineral oil (*both S*).
 - **humectants** – retard moisture loss by holding water within the surface layers of the skin and drawing in moisture from the surrounding air. Humectants can also have a supportive role in helping retard moisture loss from the finished product. Common examples include:
 - glycerin (*may be NDM or NI depending on source, further documentation checks would be required*), propylene glycol (*S*) and sodium hyaluronate (*may be NDM or NI depending on source, further documentation checks would be required*).
 - **miscellaneous** – with the many specialty ingredients available today, there is seemingly endless choices when it comes to skin conditioning agents. These are grouped together under the heading of ‘miscellaneous’ and include various plant extracts, algae extracts (*normally N but check solvents and preservatives*), dimethicone complexes (*S*) and hydrolyzed proteins (*may be NDM or NDS depending on source, further documentation checks would be required*).
 - **occlusive** – these agents block the evaporation of water from the surface of the skin, keeping it moist and increasing its water content. They include ingredients such as:
 - Butyrospermum parkii (shea butter), Simmondsia chinensis (jojoba) seed oil (*both N*)
 - caprylic/capric triglyceride (*NDM*).
 - dimethicone, propylene glycol dioleate (*both S*).
- **solvents** – liquids used to dissolve constituents or act as carriers in cosmetic and personal care products. Solvents are predominantly classified as structural ingredient but may serve a functional role as well. Common examples are:
 - water (*N*), alcohol (*may be N or S depending on source, further documentation checks would be required*), butylene glycol (*S*), glycerin (*may be NDM or NI depending on source, further documentation checks would be required*), propylene glycol (*S*).

- **sunscreen agents** – used to protect the skin from UV radiation, these functional ingredients can be chemical (act by absorbing UV light; also known as organic sunscreen agents) or physical (act by reflecting or scattering UV light; also known as inorganic sunscreen agents). Common examples include:
 - organic (chemical) sunscreen agents – benzophenone-3, butyl methoxydibenzoylmethane, ethylhexyl methoxycinnamate (*all S*).
 - inorganic (physical) sunscreen agents – titanium dioxide, zinc oxide (*both considered NDM*).
- **surfactants** – the biggest category in cosmetic chemistry, surfactants are functional ingredients also known as surface-active agents because of their ability to modify the surface of a substance. They can be broken into the following categories:
 - **cleansing agents** – cleansing surfactants are able to produce a foam and clean the surface of the skin and hair. They can be synthetic in origin or derived from natural sources. Common cleansing agents include:
 - cocoyl glucoside, decyl glucoside (*both NDM*).
 - cocamidopropyl betaine, sodium lauryl sulfate, sodium methyl cocoyl taurate (*all NDS*).
 - sodium C14-16 olefin sulfonate (*S*).
 - **emulsifying agents** – used to mix the oil and water phases in an emulsion, these functional ingredients enable creams and lotions to be made. They are predominantly derived from natural sources. Common examples include:
 - cetearyl alcohol, stearic acid (*both NDM*).
 - cetareth-20, PEG-100 stearate (*both NDS*).
 - **solubilisers** – used to solubilise a substance that is normally insoluble in a continuous medium. A common example of this is face toners or room fresheners, where a fragrance oil is solubilised in an aqueous (water) base. Solubilisers enable the oil phase to be homogeneously dispersed in the aqueous base, and prevent an oil layer from forming at the top of the finished product. Common examples include:
 - laureth-20, PEG-40 hydrogenated castor oil, polysorbate 80 (*all NDS*).
- **viscosity increasing agents – aqueous** – structural ingredients used to thicken the water soluble components of a personal care formulation, they can be natural, derived from nature or synthetic. Common viscosity increasing agents – aqueous include:
 - agar, xanthan gum (*N*).
 - guar hydroxypropyltrimonium chloride, hydroxyethylcellulose (*both NDS*).
 - acrylates/C10-30 alkyl acrylate crosspolymer, carbomer (*both S*).
- **viscosity increasing agents – nonaqueous** – structural ingredients used to thicken the oil soluble components of a personal care formulation, they can be natural, derived from nature or synthetic. Common viscosity increasing agents – nonaqueous include:
 - beeswax, Euphorbia cerifera (candelilla) wax (*N*).
 - stearalkonium bentonite (*NDS*).
 - microcrystalline wax, silica dimethyl silylate (*S*).

3. Vocabulary of cosmetic science

In addition to the different ingredient classifications presented in section 2, there is also a vocabulary of cosmetic science you need to be introduced to. Shortly, we'll be looking at how you make ingredient selections and put formulas together – but we'll use some of these words to describe certain ingredients, and differentiate between them.

Every trade has its own 'vocabulary' – its own special use of words or terminology that get used frequently to describe certain things. Here is the vocabulary of cosmetic science that you will need as a beginner – a list of common terminology you'll see us use in your beginner studies. If you continue on to more advanced studies with us, these will become even more common use terms for you.

You don't need to memorise this list – but it would be a good idea to flag it so that you can refer back to it when you need to, or see a word you're not so familiar with. This list is presented alphabetically to make it easy for you to find certain terms when you need to.

Some of these terms may not make complete sense right now either – don't panic, it's like learning a new language and these are its key terms. It's a vocabulary provided as a reference tool, so that when we start to discuss ingredient selection and formulation development in the next chapter, you'll know where to look to better understand any terms you don't already know.

Amphoteric: an amphoteric substance can be positively or negatively charged, depending on the pH environment. In cosmetic science, amphoteric substances are usually positively charged in an acidic pH ($\text{pH} < 7$) and negatively charged in an alkaline pH ($\text{pH} > 7$).

Anhydrous: without water. For example, powders and oils are completely anhydrous, as they do not contain any water.

Anionic: negatively charged. An anionic substance is always negatively charged whether it be a gum, emulsifier or surfactant. Anionic substances are not usually compatible with cationic substances, although exceptions do occur. Anionic substances are typically used in face and body care in lotions and creams. Anionic surfactants are very effective cleansing agents for the body and hair but should not be used in conditioning products, which usually carry a cationic (positive) charge.

Absorption: where a product is taken in through the pores of the skin.

Adsorption: the adhesion of a substance on the surface of another material.

Cationic: positively charged. A cationic substance is always positively charged whether it be a gum, emulsifier or surfactant. Cationic substances are not usually compatible with anionic substances, although exceptions do occur. Cationic substances are usually used in hair conditioners as they make the hair feel slippery and soft.

Chelating agent: chelating agents are used to sequester (bind to) metal ions that may be present in a product from water, manufacturing equipment or raw materials. They can also help boost preservative and antioxidant effectiveness.

Emulsifier: a chemical used to form an emulsion and/or help stabilise an emulsion from separating.

Emulsion: a suspension of droplets within a continuous phase; for example, an oil in water (o/w) emulsion is common in the personal care industry where oil droplets are suspended throughout a continuous phase. Since water is the continuous phase, this type of product would be water compatible (dispersible), would require hydrophilic emulsifiers and gums/polymers (water loving – see below) and would tend to feel non-greasy on the skin. Water in oil (w/o) emulsion means water droplets are suspended throughout an oil continuous phase. Since oil/lipid is the continuous phase, this type of product would not be water dispersible, requires specific emulsifiers and gums/polymers that suit an oil/lipid continuous phase and could feel greasy on the skin unless esters, mineral oils or silicones are used. Emulsion products, both o/w and w/o, look white and milky, like a lotion or cream.

Esterification: the formation of an ester through reaction of acid and alcohol functional groups in chemicals. Esters are commonly emollient lipids (oil like substance) but may also be emulsifiers.

Ethoxylation: treatment or reaction with ethylene oxide. This is done to make a substance more hydrophilic (water loving).

GMP: Good Manufacturing Practice. A set of rules that govern how cosmetic products should be made so as to ensure finished products contain their specified quantity and type of ingredients and meet quality requirements, without human, microbial or cross-contamination with non-specified inputs.

Hydrogenation: the reaction of hydrogen with another substance, usually under pressure and high temperatures in the presence of a catalyst. Oils are commonly hydrogenated to make them more butter-like.

Hydrolysis: a chemical reaction whereby a water molecule is added to a substance resulting in the split of that substance into two parts.

Hydrophilic: water loving/compatible with water. These substances are lipophobic; not compatible with oil.

Hydrophobic: water fearing/not compatible with water; means the same as lipophilic (oil loving).

Lipid: an oil like substance, can include oils, fats, waxes, mineral oil, esters and silicones. To be classified as a lipid, the substance would be lipophilic.

Lipophilic: oil loving/compatible with oil. These substances are hydrophobic; not compatible with water.

Lipophobic: lipid fearing/not compatible with lipids/oils; means the same as hydrophilic (water loving).

Non-ionic: no charge. A non-ionic substance never carries a charge and is not affected by charge whether it be a gum, emulsifier or surfactant.

Oxidation: a reaction where the atoms of an element lose electrons and become unstable. In personal care products, oxidation creates discolouration and/or rancid odours to develop in a product and can make a product unsaleable/have a short shelf life.

Petroleum derivatives: substances that are created by using the hydrocarbon backbone of crude oil. They are highly refined for personal care products and do not resemble the petroleum used to fuel vehicles.

Polymer: a large molecule that has many repeating sub-units.

Preservative: a substance that prevents or retards microbial growth in a product.

Propoxylation: the addition of a propyl functional group to a molecule.

Rancidity: a change in aroma to display off notes or undesirable characteristics in an oil.

Sequestrants: a compound that forms chelates (bonds) with metal compounds to prevent metal catalysed oxidation and/or formation of scum in hard water areas.

Shelf life: the period of time over which suitable performance characteristics of a personal care product are maintained.

Solvent: a liquid that dissolves a solid or liquid substance.

Stability: a measure of how well a formulation remains suitably unchanged over its shelf life.

Sulphonation/sulfonation: the addition of a sulfonic acid functional group to a molecule.

Superfating agent: a lipid derivative that has been made partially hydrophilic, a superfating agent is one which can help provide a more emollient/skin conditioning feel to a foaming product with its lipid portion whilst being able to be washed easily from the skin or hair due to its hydrophilic portion.

Surfactant: a substance with water loving and oil loving portions, making it surface active. Note: in Cosmetic Chemistry, 'Surfactant' is used to describe a surfactant substance that is used to cleanse the hair or body and creates foam. While an emulsifier is, chemically speaking, a surfactant, the term 'emulsifier' is used in Cosmetic Chemistry to describe substances which create lotions/creams compared to those which foam.

Synthetic: produced through chemical means using non-renewable sources.

Transesterification: the reaction of an ester with an alcohol functional group to create a new ester.

Viscosity: a measure of resistance to flow of a substance, commonly referred to as how readily a product will move when tipped.

%w/w – ‘% weight per weight’ is a term used to describe how many grams of a substance has been added to make up a certain weight. For example, a 50% w/w solution would contain 50g of solid per 100g of final solution.

%w/v – ‘% weight per volume’ is a term used to describe how many grams of a substance has been added to make up a certain volume of solution. For example, a 50% w/v solution would contain 50g of solid per 100mL of final solution.

%v/v – ‘% volume per volume’ is a term used to describe how many milliliters of a liquid has been added to make up a certain volume of solution. For example, a 50% v/v solution would contain 50mL of a certain liquid per 100mL of final solution.

4. The role of pH in personal care science

pH is a measure of acidity or alkalinity of a solution, and is dependent on the concentration of hydrogen (H^+) or hydronium ions (H_3O^+).

The pH scale goes from 0 to 14; where 0 is the most acidic, and 14 the most basic (or alkaline). Water, which has an equal balance of hydrogen ions (H^+) and hydroxide ions (OH^-), is neutral with a pH of 7.

The pH scale is a logarithmic scale, which means that each whole number change in pH is actually a 10-fold change in H^+ concentration. For example, a pH change from 5 to 6 represents a 10-fold decrease in H^+ concentration; while a pH change from 5 to 7 represents a 10×10 – fold (or 100-fold) decrease in H^+ concentration. This is compared to a linear scale, where a change from 5 to 6 would only represent a change of 1. The point to remember is that each whole number on the pH scale actually represents quite a large difference in the acidity or alkalinity of a solution.

Substances are defined as weak or strong acids or bases by the effect they have on a finished solution. For example, a weak acid is citric acid, commonly used in the personal care industry; and although it has a very acidic pH, it has only a weak effect on changing the pH of a solution, with small amounts adjusting the pH in decimal places rather than whole digits at a time.

The skin has a pH of around 5.5. Therefore, most personal care products should be pH balanced to 5.3 - 5.8, and rarely up to 7.0 (neutral). Exceptions do apply, and in some cases are necessary for stability. Some common examples include:

- naturally saponified solid and liquid soaps which have a pH around 9.5 and will separate into a fatty layer if adjusted much below this
- products containing zinc oxide which must be pH adjusted to around 7.0 - 8.0 to be stable
- hair conditioners which are generally pH adjusted to 4.0 – 4.5 to increase functionality and performance
- skin peel products which usually require a pH of around 3.5 – 4.0
- cosmeceutical actives which may have individual requirements to ensure efficacy and stability

Rarely does a formula yield a finished product at just the right pH, and adjustments are usually necessary to ensure it is safe to apply to the skin. You do not need to pH adjust formulas that do not contain water – pH is only relevant where water is present.

To adjust the pH of personal care products:

- to decrease the pH, that is, to make the finished product more acidic, (for example, from 9.0 to 5.5), a dilute concentration of citric acid (50%w/v solution) or lactic acid (88% w/v) is commonly added until the desired pH is reached.
- to increase the pH, that is, to make the finished product less acidic (for example, from 3.0 to 5.5), a dilute concentration of sodium hydroxide (NaOH, 10%w/v solution or tromethamine 30%w/v solution) is commonly added until the desired pH is reached.

In cosmetic science, we use pH buffer solutions to help us adjust this pH. Here is how to make buffer solutions:

NOTE: WHEN PREPARING BUFFER SOLUTIONS, ALWAYS ADD POWDERS **TO** WATER; **NEVER** water to powder. Wear safety glasses and gloves when preparing these solutions; if you get any powder or solution on your skin wash off thoroughly immediately. Observe all other safety precautions on the SDS.

To make 50 grams of a citric acid 50%w/v solution:

1. Measure out 25g purified water in a bowl.
2. Add 25g citric acid to the water.
3. Heat gently and stir to dissolve.
4. Allow to cool completely then pour off into container and cap.

To make 50 grams of a tromethamine 30%w/v solution:

1. Measure out 35g purified water in a bowl.
2. Add 15g tromethamine to the water.
3. Heat gently and stir to dissolve.
4. Allow to cool completely then pour off into container and cap.

To make 50 grams of a sodium hydroxide 10%w/v solution:

1. Measure out 45g purified water in a bowl.
2. Add 5g sodium hydroxide to the water.
3. Stir to dissolve – it will be warm enough just from adding the powder to the water.
4. Allow to cool completely then pour off into container and cap.

We do not recommend Beginners make anything stronger than these solutions.

When you make a formula with water as the continuous phase (so basically any formula containing water other than w/o emulsions) you will need to check and adjust the final pH. Sometimes you need a little pH adjuster, sometimes you need a lot – you can't ever know until you make that first sample how much impact your buffer solutions will have.

Watch how it's done!

Here is a great video on how to test and adjust pH: <https://youtu.be/kwvLAK3KauM>

Chapter 2: How cosmetic formulas get put together

Now that we've covered off on some essential terminology, let's take a look at how we put formulas together.

1. How to read (and write) cosmetic formulas

When you first start to read cosmetic formulas, you could liken them to following a recipe. When we make a formula, we have ingredients, just like a recipe, and method to follow, just like a recipe. But there are some important differences when it comes to cosmetic formulas that you need to know about, right from the start.

When reading and writing cosmetic formulas, make sure you take note of the following 'rules' – you'll see an example of how this applies in a moment:

1. **Cosmetic formulas must be written by %w/w (weight for weight).** While some materials come as liquids, to ensure batch-to-batch consistency and ensure your formulas comply with rule number 2, you must use weight for all inputs in your formulas from this point forward.
2. **All formulas must total 100%w/w.** We write in %w/w rather than grams, because we need to be able to scale formulas up to larger batches. It is very difficult to do this if its written like a recipe, in grams; or a mixture of volume for liquids and grams for solids. But if you have a formula in %w/w, you can calculate how much of each ingredient to use in larger batches very easily, and accurately.
3. **Ingredients that should be processed together should be 'phased' together.** It helps make sense when the method is put together to refer to 'phases' rather than individual ingredients, just in case one gets missed!
4. **Formulas that contain water must have a 'q.s' pH adjustment at the end,** with statement of what that pH must be. 'q.s.' – translates to 'quantum sufficit' – it is a latin term that means 'as required'. You can't predict what the final pH of a formula will be, and whether it will need to go up, or down, until you've made a sample and can check the pH. So we write 'q.s' pH adjuster – and what it needs to be – so that we know we need to adjust it with whatever we need, and how ever much of it we need, to get the required final pH.
5. **The method must be written to suit the materials selected.** Even the best ingredient choices won't work together if the method doesn't suit the materials. We'll spend time explaining how to get this right later in this book.

Here is a really basic example of how a formula looks when put together:

Phase	% w/w	Material name
A	88.6	Water
A	5.0	Glycerin
B	5.0	Polysorbate 20
B	0.4	Lavender essential oil
B	0.1	Vitamin E natural
B	0.9	Phenoxyethanol, Ethylhexylglycerin (Euxyl PE9010)
	q.s	pH adjuster
	100.0%	Total

METHOD	1. Combine ingredients in phase A.
	2. Combine ingredients in phase B.
	3. Add phase B to phase A slowly while constantly stirring; if product starts turning milky slow down your addition of phase B until solution clears between additions.
	4. Check and adjust final pH to 5.0 – 5.5.
	Final pH required: 5.0 – 5.5

Notes on this formula:

Welcome to your first formula! There are a few things you will notice from the ‘rules’:

- Notice how everything is now measured by weight, NOT volume, even essential oils! This is so there is batch to batch consistency as only 1mL of water = 1 gram; every other material has its own volume:weight ratio, and that makes it practically impossible to convert a sample into a large scale production batch if some ingredients were written by weight, while others were written by volume. If you have been writing up formulas in drops or mL, they now need to be written to %w/w; and must ALWAYS total 100%.
- Materials are ‘phased’ and this same nomenclature is written into the method. This is so that materials are added in the correct order and nothing gets missed.
- pH adjuster is written as q.s. = ‘quantum sufficit’ = as much as needed. In this case, it is ‘as much as needed to achieve a final pH of 5.0 – 5.5’. You can’t ever know what pH a formula is going to come in at when writing it up; you can’t know how much you’ll need; and you also can’t know if you need citric acid, tromethamine or sodium hydroxide to adjust it! So, the pH adjuster is commonly written as ‘q.s. pH adjuster’ so that when you are in the lab, you can adjust your formula with the right material to achieve the required pH, as specified in the method, using however much you need to adjust it to the required pH without impacting your 100%w/w requirement.

Watch how it’s done!

Here is a great video to help you understand how to read a formula, prepare your pH buffer solutions and adjust final pH; our Beginners Cosmetic Science first workshop:

<https://youtu.be/s0I7ZsGqUhk>

2. Formulation Development

How do chemists know what to put into a formula? How will YOU know what should go into a formula to make an actual product?

When we are formulating products, especially innovative or advanced product forms, we need to think in terms of the roles that different ingredients will play in the formula. Each ingredient has a specific role to play within a formulation. The four main categories are:

- **functional ingredients** – these ingredients are selected by the product type. For example, to make a shampoo, you need to use cleansing agents, classified as surfactants. The product may contain more than one functional ingredient, and may also include secondary functional ingredients to serve a secondary purpose. For example, a 2-in-1 shampoo first needs to clean the hair; and secondly provide a

conditioning function. Another example is a foundation with sunscreen in it. Its primary function is to provide colour to the skin, while the secondary function is to protect the skin from UV light.

- **structural ingredients** – provide the structure for the product. Continuing with the shampoo example, structural ingredients such as viscosity increasing agents may be added to increase the ‘thickness’ of the product and help create the impression it is more concentrated and effective.
- **supportive ingredients** – added to improve the stability and shelf life of the product. In order to maintain the integrity of your shampoo, you will need to add preservatives and may choose to add a chelating agent to improve suitability in hard water conditions.
- **added extras** – these ingredients, usually added in small amounts, have no functional, structural or supportive role in the product but add to consumer acceptance. For instance, the smell and colour of your shampoo.

In addition, many ingredients may have more than one role in a formulation. For example, cetearyl alcohol is a common emulsifying agent enabling emulsions to form, making it a functional ingredient; however it can also alter the viscosity of a product making it a structural ingredient; and support long term stability of the emulsion, thereby also making it a supportive ingredient. In such instances, the most important role of the ingredient would be considered its primary role, while the other roles would be considered secondary.

So, how do different formulas come together? It relies on the answer to 4 key questions:

- **what do you need to create that type of product?** The answer will tell you what type of *functional* ingredients you need to use.
- **what ingredients do you need to get the desired form of the product?** The answer will tell you what type of *structural* ingredients you need to use.
- **what do you need to include in the formula to get a good shelf life?** The answer will tell you what *supportive* ingredients you need to use.
- **what ingredients do you need to use to attain good consumer aesthetics?** This also includes what you need to add to achieve required marketing claims. The answer will tell you what *added extras* you will need to include.

Here is a table to help you see how different products are put together using the different roles of ingredients. If you are continuing on to advanced or Diploma studies with IPCS, you will learn full formulation development in a lot more detail in later units.

Don't worry - you do not need to memorise this table!

This table is provided as a guide to show you how the roles of ingredients get used to put formulas together. We've also got some great formulation builds that puts this information into a ready-to-use format so you can focus on ingredient selection. We've also got some great starter formulations in the Formulary Section of this book to make it easy for you to get making cosmetics straight away!

Product Form	Role + Function
Toners/Mists/Gels	Functional: Solvent, cosmetic astringent (optional), skin conditioning agent (humectant), surfactant (solubiliser) Structural: Viscosity modifier (optional - if serum/gel structure required) Supportive: Preservative, antioxidant Added extras: Skin conditioning agent (miscellaneous), fragrances, colourants.
Crème facial cleanser	Functional: Surfactant (emulsifying agent), solvent, skin conditioning agent (emollient) Structural: Viscosity modifiers, emulsion stabilisers, surfactant (emulsifying agent) Supportive: Viscosity modifiers, emulsion stabilisers, preservatives, antioxidant Added extras: Skin conditioning agents (emollients, humectants, miscellaneous), fragrances, colourants. Also abrasives or exfoliants, if a crème abrasive or chemical exfoliation product, respectively.
Moisturisers (creams, lotions, body butters)	Functional: Surfactant (emulsifying agent), solvent, skin conditioning agent (emollient) Structural: Viscosity modifiers, emulsion stabilisers, surfactant (emulsifying agent) Supportive: Viscosity modifiers, emulsion stabilisers, preservatives, antioxidant Added extras: Skin conditioning agents (emollients, humectants, miscellaneous), fragrances, colourants.
Balms	Functional: Skin conditioning agents (emollients), viscosity modifiers (non-aqueous) Structural: Viscosity modifiers (non-aqueous) Supportive: antioxidant Added extras: Fragrances, colourants, skin conditioning agents (miscellaneous, emollients)

Product Form	Role + Function
Foaming face/hand/body wash/shampoos	Functional: Surfactant (cleansing agents) Structural: Solvent, viscosity modifiers, surfactants Supportive: Viscosity modifiers, preservatives, chelating agent, antioxidant Added extras: Skin conditioning agents (emollients, humectants, miscellaneous), fragrances, colourants. Also abrasives or exfoliants, if a foaming abrasive or chemical exfoliation product, respectively. Opacifying agents may also be used to 'pearlise' the look of these products.
Hair conditioner	Functional: Solvent, surfactant (emulsifying agent), hair conditioning agents, solvent, skin conditioning agents (emollients) Structural: Surfactant (emulsifying agent), solvent, viscosity modifiers Supportive: Viscosity modifier, preservatives, antioxidant Added extras: Skin conditioning agents (emollients, humectants, miscellaneous), fragrances, colourants.

Shortly we'll be taking a look at how to make different ingredient selections – so let's take a look now at how the formulas come together, so you can pick and choose which ingredients you use in your formulas as you learn about them later.

Below each formula build is also an explanation of how these products typically come together, along with a proper 'method' as it would be written. You can also watch how these products come together in our free videos.

Hydrating mist/toner build

- Mists and hydrating toners are humectants with solubilised fragrances/essential oil.
- Always use solubilisers in a 5x or 10x ratio to the oil content – the best ratio will vary depending on what fragrances, essential oils and antioxidants are used; it may take a couple of samples to make it just right.

Phase	%w/w	Material function
A	To 100	Water (solvent)
A	5.0 – 10.0 (1 humectant only)	Glycerin, propanediol or propylene glycol
A	Up to 5.0	Water soluble extracts or actives – for your product story
B	Up to 5.0	Polysorbate 20 OR Capryl/capryl Glucoside OR PEG-60 Almond Glycerides OR other solubiliser
B	Up to 0.5 total (combined)	Fragrance, essential oil, lipid, antioxidant
B	Refer Preservatives table	Broad spectrum preservative
C	q.s.	pH adjuster (to suit actives and preservatives or around 5.5)

To make a mist or toner:

1. start by pre-combining the water phase ingredients such as the water, humectants, preservatives and astringent agents
2. in a separate vessel, pre-combine the oil ingredients which include the fragrances and essential oils, and the solubiliser
3. slowly add the oil phase to the water phase while stirring slowly
4. adjust the pH to 5.3 to 5.8 or as appropriate to the formula

This is how this would usually be written up officially:

METHOD:

1. Combine phase A and stir until homogenous.
2. Combine phase B and stir until homogenous.
3. Add phase B to phase A slowly while stirring under low shear.
4. Check/adjust final pH to 5.3 – 5.8*

**note: you set the final pH to suit the skin (around 5.5) OR other pH if required by the actives or preservatives. You'll learn more about pH needed by preservatives in a coming chapter.*

Please remember this is a generalised manufacturing procedure and specific formulas may need specific manufacturing requirements.

Watch how it's done!

How to make a mist and gel: <https://youtu.be/AkBXRf5Ynow>

Serum build (with emulsifiers)

- ‘Serums’ are usually milky looking gels, gel-creams or light lotions. They can vary considerably in desired viscosity and may be more gel like or more cream like, depending on what your target market considers a ‘serum’.

Phase	%w/w	Material function
A	To 100	Water (solvent)
B	5.0 – 10.0 (1 humectant only)	Glycerin, propanediol or propylene glycol
B	0.2 – 0.4 (1 gum only)	Xanthan gum or sclerotium gum
C	3.0- 4.0 (1 blended material only)	Cetearyl glucoside, Cetearyl alcohol blend OR Sorbitan olivate, Cetearyl olivate blend OR Cetearyl alcohol, Ceteareth-20 blend OR Glyceryl stearate, PEG-100 Stearate blend
C	Up to 5.0 total (combined)	Caprylic/capric triglyceride and/or vegetable oils and/or light skin feel esters
D	Up to 5.0	Water soluble extracts or actives – for your product story
D	Refer Preservatives table	Broad spectrum preservative
D	0.1 – 0.2 (Frag) OR 0.3 – 0.5 (EO)	Fragrance OR Essential oil blend
D	0.2 – 0.5 (Toco) OR 0.05 – 0.2 (Rosemary)	Tocopherol OR Rosemary extract
E	q.s.	pH adjuster (to suit actives and preservatives or around 5.5)

To make a serum with emulsifier:

1. first combine the water and humectant/gum slurry. This makes up the water phase. Stir until the gum is hydrated and heat this phase to 75°C.
2. in a separate vessel, combine the oil phase ingredients such as plant oils and emulsifying waxes, and heat this to 75°C as well
3. next, add the oil phase to the water phase and stir vigorously – a whisk will help you break down the oil droplets into a fine dispersion for even mixing
4. allow this mixture to cool below 40°C and add fragrances, essential oils, actives and preservatives
5. finally, when the product has cooled to 25°C, you would adjust the pH, depending on the product specification and requirements. This would make the product compatible with the skin's chemistry.

This is how this would usually be written up officially:

METHOD:

1. Measure out phase A.
2. Combine phase B and stir until a homogenous slurry forms.
3. Add phase B to phase A while stirring under low shear. Continue stirring until a homogenous gel forms. Heat to 75°C.
4. Combine phase C and heat to 75°C.
5. Add phase C to phase A/B and stir under high shear until a smooth, glossy emulsion forms.
6. Allow to cool <40°C while stirring under low shear.
7. When <40°C, add phase D and stir through until homogenously mixed.
8. Check/adjust final pH to 5.3 – 5.8*

**note: you set the final pH to suit the skin (around 5.5) OR other pH if required by the actives or preservatives. You'll learn more about pH needed by preservatives in a coming chapter.*

Please remember this is a generalised manufacturing procedure and specific formulas may need specific manufacturing requirements.

Watch how it's done!

How to make creams/lotions: <https://youtu.be/WR08f77Iht8>

Crème Cleanser formula build

- Crème cleansers are emulsions that are a high excess of emulsifier with small input of lipid. The excess of emulsifier means empty micelles that are able to pick up dirt, debris and oils from the skin and wash them away.

Phase	%w/w	Material function
A	To 100	Water (solvent)
B	3.0 – 5.0 (1 humectant only)	Glycerin, propanediol or propylene glycol
B	0.3 – 0.5 (1 gum only)	Xanthan gum or sclerotium gum
C	1.0 – 2.0	Stearic acid OR Glyceryl Stearate Citrate
C	5.0 (1 blended or single material only)	Cetearyl glucoside, Cetearyl alcohol blend OR Sorbitan olivate, Cetearyl olivate blend OR Cetearyl alcohol, Ceteareth-20 blend OR Glyceryl stearate, PEG-100 Stearate blend OR Cetearyl alcohol
C	Up to 3.0 total (combined)	Caprylic/capric triglyceride and/or vegetable oils and/or light skin feel esters
D	Up to 5.0	Water soluble extracts or actives – for your product story
D	Refer Preservatives table	Broad spectrum preservative
D	0.1 – 0.2 (Frag) OR 0.3 – 0.5 (EO)	Fragrance OR Essential oil blend
D	0.1 – 0.3 (Toco) OR 0.05 – 0.1 (Rosemary)	Tocopherol OR Rosemary extract
E	q.s.	pH adjuster (to suit actives and preservatives or around 5.5)

To make a crème cleanser:

- first combine the water and humectant/gum slurry. This makes up the water phase. Stir until the gum is hydrated and heat this phase to 80°C.
- in a separate vessel, combine the oil phase ingredients such as plant oils and emulsifying waxes – BUT DON'T heat them. Because there is such a small liquid portion, you risk burning your waxes in larger batches trying to get these to melt, so instead, we add the oil phase to a very hot water phase so it can melt and emulsify in one step.
- next, add the oil phase to the water phase and stir vigorously – a whisk will help you break down the oil droplets into a fine dispersion for even mixing
- allow this mixture to cool below 40°C and add fragrances, essential oils, actives and preservatives
- finally, when the product has cooled to 25°C, you would adjust the pH, depending on the product specification and requirements. This would make the product compatible with the skin's chemistry.

This is how this would usually be written up officially:

METHOD:

1. Measure out phase A.
2. Combine phase B and stir until a homogenous slurry forms.
3. Add phase B to phase A while stirring under low shear. Continue stirring until a homogenous gel forms. Heat to 80°C.
4. Combine phase C. When phase A/B is at 80°C, add phase C to phase A/B and stir under high shear until a smooth, glossy emulsion forms.
5. Allow to cool <40°C while stirring under low shear.
6. When <40°C, add phase D and stir through until homogeneously mixed.
7. Check/adjust final pH to 5.3 – 5.8*

**note: you set the final pH to suit the skin (around 5.5) OR other pH if required by the actives or preservatives. You'll learn more about pH needed by preservatives in a coming chapter.*

Please remember this is a generalised manufacturing procedure and specific formulas may need specific manufacturing requirements.

O/W Lotion/Cream formula build

Lotions are low to medium viscosity; creams are medium to high viscosity.

- Waxy emulsifiers are best to build viscosity and 'creaminess'
- Gum/polymers to help stabilise

Lipid content is usually around 10% (total) in this type of product but may be slightly higher or lower depending on the needs of your target market.

Phase	%w/w	Material function
A	To 100	Water (solvent)
B	5.0 – 10.0 (1 humectant only)	Glycerin, propanediol or propylene glycol
B	0.3 – 0.5 (1 gum only)	Xanthan gum or sclerotium gum
C	0.5 – 2.0	Stearic acid OR Glyceryl Stearate Citrate
C	4.0 - 5.0 (1 blended material only)	Cetearyl glucoside, Cetearyl alcohol blend OR Sorbitan olivate, Cetearyl olivate blend OR Cetearyl alcohol, Ceteareth-20 blend OR Glyceryl stearate, PEG-100 Stearate blend
C	Up to 3.0	Glyceryl Stearate OR Beeswax OR Sorbitan Stearate – <i>use in body butter/highly viscous products only</i>
C	Around 10.0 total (combined)	Caprylic/capric triglyceride and/or vegetable oils and/or light skin feel esters <i>(up to 15% may be used in body butters where more emulsifiers are also used to stabilise)</i>
D	Up to 5.0	Water soluble extracts or actives – for your product story
D	Refer Preservatives table	Broad spectrum preservative
D	0.1 – 0.2 OR 0.3 – 0.5 OR 0.3 – 0.5 OR 0.6 – 1.5	Fragrance – face OR fragrance - body OR essential oil blend – face OR essential oil blend - body
D	0.3 – 1.0 (Toco) OR 0.1 – 0.2 (Rosemary)	Tocopherol OR Rosemary extract

To make a cream:

1. first combine the water and humectant/gum slurry. This makes up the water phase. Stir until the gum is hydrated and heat this phase to 75°C.
2. in a separate vessel, combine the oil phase ingredients such as plant oils and emulsifying waxes, and heat this to 75°C as well
3. next, add the oil phase to the water phase and stir vigorously – a whisk will help you break down the oil droplets into a fine dispersion for even mixing
4. allow this mixture to cool below 40°C and add fragrances, essential oils, actives and preservatives
5. finally, when the product has cooled to 25°C, you would adjust the pH, depending on the product specification and requirements. This would make the product compatible with the skin's chemistry.

This is how this would usually be written up officially:

METHOD:

1. Measure out phase A.
2. Combine phase B and stir until a homogenous slurry forms.
3. Add phase B to phase A while stirring under low shear. Continue stirring until a homogenous gel forms. Heat to 75°C.
4. Combine phase C and heat to 75°C.
5. Add phase C to phase A/B and stir under high shear until a smooth, glossy emulsion forms.
6. Allow to cool <40°C while stirring under low shear.
7. When <40°C, add phase D and stir through until homogeneously mixed.
8. Check/adjust final pH to 5.3 – 5.8*

**note: you set the final pH to suit the skin (around 5.5) OR other pH if required by the actives or preservatives. You'll learn more about pH needed by preservatives in a coming chapter.*

Please remember this is a generalised manufacturing procedure and specific formulas may need specific manufacturing requirements.

Watch how it's done!

How to make creams/lotions: <https://youtu.be/WR08f77lht8>

Balm formulation build

Phase	%w/w	Material function
A	To 100	Lipids/oils – <i>use majority oxidative stable lipids e.g. castor oil for lip products; caprylic/capric triglyceride for body products</i>
A	10.0 MAXIMUM combined	Low melting point waxes/butters COMBINED INPUT (melting point <55°C) e.g. cocoa butter, coconut oil, shea butter, mango butter
A	12.0 - 22.0	Single or combination of: beeswax, candelilla wax, carnauba wax – the more you use, the harder your balm will set!
B	0.1 – 0.2 OR 0.3 – 0.5 OR 0.3 – 0.5 OR up to 1.0 OR 0.6 – 1.5	Fragrance/flavour – face OR fragrance - body OR essential oil blend – face OR essential oil blend - flavour OR essential oil blend - body
B	0.5 – 2.0 (Toco) OR 0.1 – 0.2 (Rosemary)	Tocopherol OR Rosemary extract
B	Up to 5.0	Oil soluble actives or added extras (product story) – must be oil soluble!

To make a balm:

1. pre-combine your oils and waxes. Note you should not add your fragrances, essential oils, actives or antioxidants at this stage.
2. heat the oils and waxes until they are melted, which is usually around 75°C; but be careful not to overheat the product
3. ensure the mixture is homogenous, and allow to cool to just above setting point, which would usually be around 60°C. Now you would add your fragrances, essential oils, actives and antioxidants and stir through until homogenous and you are ready to pour off.
4. allow the product to cool completely before capping so as to avoid condensation forming in your product.

This is how this would usually be written up officially:

METHOD:

1. Combine phase A and heat to 75°C. Stir until combined and all melted.
2. Remove from heat and allow to cool slightly, but still above setting point (approx. 60°C).
3. Add phase B and stir through until homogenous.
4. Pour off while still molten. Allow to set fully overnight.

Please remember this is a generalised manufacturing procedure and specific formulas may need specific manufacturing requirements.

Watch how it's done!

How to make balms: <https://youtu.be/3syi256HRy8>

Surfactant (foaming products) build

Note: Surfactants often come as liquid dilutions – so you need to check the suppliers information to find out how much ACTIVE surfactant is present to use the right amount! You will learn more about this when you learn how to select surfactant materials.

Phase	%w/w	Material function
A	1.5 – 5.0 ACTIVE content (combined total)	Polysorbate 20 and/or PEG-60 Almond Glycerides and/or PEG-40 Hydrogenate Castor Oil and/or Coco/ Decyl/ Lauryl/ Caprylyl Glucoside
A	Up to 1.0 MAX	Vegetable oil – for your marketing story
A	0.1 – 0.2 OR 0.3 – 0.5 OR 0.3 – 0.5 OR 0.6 – 1.5	Fragrance – face OR fragrance - body OR essential oil blend – face OR essential oil blend - body
A	0.5 – 2.0 (Toco) OR 0.1 – 0.2 (Rosemary)	Tocopherol OR Rosemary extract
B	3.0 -5.0 (face) Or up to 10.0 (body/hair) ACTIVE content (combined total)	Sodium lauryl sulfoacetate OR Sodium lauryl sulfate (+ 0.2 sodium EDTA) OR Sodium lauroyl sarcosinate OR Sodium cocoyl sulfate (+ 0.2 sodium EDTA) OR Sodium cocoyl glutamate OR similar
B	3.0 – 5.0 (face) Or up to 10.0 (body/hair) ACTIVE content	Cocamidopropyl betaine
B	Up to 3.0 ACTIVE content (combined total)	Coco/ Decyl/ Lauryl/ Caprylyl Glucoside (optional)
C	To 100	Water (solvent)
C	Up to 10.0 combined	Hydrolysed protein, polyquaternium, vitamin B5 and/or water soluble extract/active
D	Up to 6.0	Glycerin
D	0.5 – 1.2 And/or 0.2 – 0.6	Xanthan gum OR Guar hydroxypropyltrimonium chloride
E	Refer Preservatives table	Broad spectrum preservative
F	q.s.	pH adjuster to suit materials used; normally 5.0 – 6.5

To make a foaming gel:

1. start by combining any solid surfactants with the liquid surfactants, and heat to melt and form a liquid if necessary
2. allow to cool, and predisperse fragrances, oils or superfatting agents in the surfactant blend
3. next, add the surfactant blend, preservatives and other water soluble ingredients to the water phase and stir under low shear until homogenous – be careful not to introduce too much air into your formulation at this point
4. then, add the gums in a slurry method and stir through until homogenous and your mixture is thickened – again be very careful not to introduce too much air, especially now you have added the gum – otherwise you will be left with a very frothy mixture that may take days to settle
5. adjust the pH as appropriate and you could adjust the viscosity using salt (up to 3% may be needed) in anionic systems if suitable

This is how this would usually be written up officially:

METHOD:

1. Combine ingredients in phase A under low shear until homogenous.
2. Combine ingredients in phase B – heat if any solid materials present until melted.
3. Add phase A to phase B under low shear until homogenous.
4. Combine phase C ingredients. Add phase C to phase A/B and stir under low shear until homogenous.
5. Combine phase D until a smooth, homogenous slurry forms.
6. Add phase D slowly to phase A/B/C and stir under low shear until dispersed evenly – gum may not form until pH is adjusted.
7. Add phase E to phase A/B/C/D and stir through under low shear until homogenous. Check/adjust pH to 5.3 – 5.8

**note: you set the final pH to suit the skin (around 5.5) OR other pH if required by the actives or preservatives. You'll learn more about pH needed by preservatives in a coming chapter.*

Please remember this is a generalised manufacturing procedure and specific formulas may need specific manufacturing requirements.

Watch how it's done!

How to make easy natural surfactants: https://youtu.be/mp_9vhLfjIY

Conditioner formula build

- Consumers look at the viscosity of a conditioner as an indication of conditioning benefits, even though the viscosity of these products may not have anything to do with the actual conditioning benefits!

Phase	%w/w	Material function
A	To 100	Water (solvent)
B	Up to 5.0	Glycerin if using natural guar (to slurry)
B	0.5 – 1.0	Natural guar OR Guar hydroxypropyltrimonium chloride
C	Up to 2.5	Cetrimonium Chloride OR Behentrimonium Chloride OR Behentrimonium Methosulfate <i>(check actual amount of conditioner agent listed to stay within this limit – these normally come as dilutions or blends)</i>
C	3.0 – 6.0 (1 single or blended material only)	Cetearyl Alcohol OR Cetearyl Alcohol, Cetearyl Glucoside OR Cetearyl Alcohol, Ceteareth-20 OR Glyceryl Stearate, PEG-100 Stearate
C	Up to 3.0 max total combined	Vegetable oil and/or ester
D	Up to 6.0	Polyquaternium-7, Polyquaternium-9 (9% active)
D	Refer Preservatives table	Broad spectrum preservative to suit low pH environment.
D	0.3 – 0.6 OR 0.5 – 1.5	Fragrance OR essential oil blend
D	0.5 – 1.0 (Toco) OR 0.1 – 0.2 (Rosemary)	Tocopherol OR Rosemary extract
D	Up to 5.0	Water soluble actives and/or vitamins – for your product story
E	q.s.	pH adjuster to 4 – 4.5

To make a conditioner:

1. first combine the water and humectant/gum slurry. This makes up the water phase. Stir until the gum is hydrated and heat this phase to 80°C.
2. in a separate vessel, combine the oil phase ingredients such as plant oils and emulsifying waxes – BUT DON'T heat them. Because there is such a small liquid portion, you risk burning your waxes in larger batches trying to get these to melt, so instead, we add the oil phase to a very hot water phase so it can melt and emulsify in one step.
3. next, add the oil phase to the water phase and stir vigorously – a whisk will help you break down the oil droplets into a fine dispersion for even mixing
4. allow this mixture to cool below 40°C and add fragrances, essential oils, actives and preservatives

5. finally, when the product has cooled to 25°C, you would adjust the pH, depending on the product specification and requirements. This would make the product compatible with the skin's chemistry.

This is how this would usually be written up officially:

METHOD:

1. Measure out phase A.
2. Combine phase B and stir until a homogenous slurry forms.
3. Add phase B to phase A while stirring under low shear. Continue stirring until a homogenous gel forms. Heat to 80°C.
4. Combine phase C. When phase A/B is at 80°C, add phase C to phase A/B and stir under high shear until a smooth, glossy emulsion forms.
5. Allow to cool <40°C while stirring under low shear.
6. When <40°C, add phase D and stir through until homogeneously mixed.
7. Check/adjust final pH to 4.0 – 4.5*

**note: you set the final pH of conditioners to 4.0 – 4.5 to make them compatible with the conditioning needs of the hair.*

Please remember this is a generalised manufacturing procedure and specific formulas may need specific manufacturing requirements.

Watch how it's done!

How to make conditioner: <https://youtu.be/JobkDBh2Qmk>

Now that you know what sort of ingredients we use in each type of formula, let's go through how you make your selections.

Chapter 3: How to select ingredients

When choosing which ingredients you'll use in your formulas, your decision will be based on:

- your company philosophy – this drives your selection of certain ingredients over others; or avoiding certain ingredients sometimes too!
- the types of ingredients your formulas 'need' to contain for functional, structural, supportive or added extra purposes – this is how your formula comes together, and we've just taken a look at how formulas get put together using different ingredient categories.
- Price and availability – some materials you may not be able to get because of price, or may not be available for purchase at all! We've got some great tips on how to source materials and build your networks later in this chapter to help you out with this.

All of these features come together to influence your ingredient selection – and is the focus of this chapter.

1. Company philosophy

Each company should have their unique story – what makes them different to everyone else. When considering the company philosophy, it must be remembered that a personal care company cannot be thought of as exclusive to their products; because it is their philosophy that drives the development of products with a certain marketing story. However, since the end product is that which is used by the consumer, it is often the story of the products, or range of products they provide that defines the company philosophy in the mind of the consumer.

The company philosophy may include one or more of the following approaches:

- **price** – where a company releases products that compete with others based on price. The concept here is to present a product that is the best it can be, within the constraints of a strict budget. Home brand products are an example of a price-driven philosophy.
- **using certain ingredients in every product** – where the company releases products based on the addition of certain key ingredients in every product in the range. For example, this may be a combination of herbal extracts or essential oils with a proprietary blend or name; or a signature fragrance across a range of products with the same branding.
- **avoiding the use of certain ingredients** – where the company's product philosophy is based on what the company chooses to avoid in all of their products. For example, it is a popular trend these days to avoid the use of parabens as preservatives.
- **natural or organic branding** – a growing trend is for companies to promote their products based on their natural and/or organic content. This can be in part, by the addition of certain herbal extracts or plant oils to an otherwise synthetic product base; in full, by developing a Certified Organic range; or somewhere in between, with a mix of synthetic, natural and/or organic ingredients present.
- **product features** – where the philosophy of the company is that the product should have unique, stand out features; such as smell, feel, performance or results. There is usually a budget involved but is more flexible than a company whose products are

driven solely by price. Luxurious, elite brands and the companies behind such brands are an example of a philosophy driven by the features of a product.

- **technology and innovation** – where the products released by the company represent the latest technological advances. These products also tend to have a higher price tag than others in the market place; and the companies who release such products often strive to be the market leaders by being the first with the ‘latest and greatest’. Examples of this are evolving all the time; consider the launch of skin whitening products several years ago, and more recently, launch of botox-alternative skin care and non-surgical face lift ‘kits’.
- **target market** – where the company launches products based on the needs of their target market. No matter what the company philosophy, every product should be promoted to the target market; however some companies will launch a product or range of products based on the ‘gaps’ within the industry. In this case, product development revolves solely around a target market ‘gap’ being first identified, and then accommodated for specifically. Examples of this are the emerging men’s skin care ranges and the personal care market for young teens.
- **‘me too’ products** – where a company releases products simply because they are the most popular trend at the time. ‘Me too’ products need to compete in a crowded marketplace so often compete on price with other similar products. Walk along the aisles of just about any supermarket and you will see many examples of ‘me too’ products; only ever moderately successful or often unsuccessful in the market place because they are just too similar to everything else available and unable to compete on price or market presence compared to the larger brands.

Companies often have more than one philosophy. This usually consists of one primary philosophy which would apply over the company’s entire product range and be the main philosophy that is promoted in accordance with the brand; and two to three secondary philosophies that further define the types of products and formulations offered by that company. Think about what is your company philosophy, and what makes your brand or products special. That will help you define what your company philosophy is going to be. Then, all your ingredient selections will revolve around that philosophy.

2. How to choose your ingredients by functionality

Let’s now take a look at how or why you might choose certain ingredients over others, but what they do – their role – in a product formulation.

2.1 Preservatives

We are going to start with preservative selection because this is perhaps one of the most important selections you can make. Too little preservative, or the wrong type, and your product won’t be fit for consumer use and will need to be thrown out; too much, and your product could be irritating or harmful to the user.

Let me also preface this by saying: there is no 1 perfect preservative. Some consumers avoid perfectly safe preservatives because of misinformation on the internet; and brands need to avoid them to keep their consumers happy! Many preservatives have strict limits over inputs (regulatory and safety reasons) whether they are natural or not; and many have strict pH limits that make them either effective or not effective in a formula.

A vast majority of common micro-organisms such as bacteria, yeast and mould need nutrients, nice ambient temperature conditions, a decent water source and a pH of around 5 – 6 to grow well. These are the conditions found in most personal care products! Preservatives are essential in personal care formulations with a high content of water because otherwise they are generally excellent growth mediums for bacteria, yeast and mould. Personal care products are generally pH regulated to 5.5, and are composed of water, oils, protein, carbohydrates and plant extracts, so provide a ready food source for microorganisms. When developing your formulations, you would ideally look to achieve shelf life of at least 2 - 3 years. In many cases personal care products are expected to have a shelf life longer than this, so adequate preservation is a must!

Preservatives work by one of two actions: they may be micro-bicidal, which means they kill microorganisms causing their numbers to decrease; or they may be micro-bistatic, which means they inhibit growth and multiplication of microorganisms but do not kill microorganisms already present. This means that growth can recommence or occur if ongoing contamination affects the finished product beyond its micro-bistatic capacity. In general, micro-bicidal preservatives are the preservatives of choice because they provide better long-term protection. Micro-bistatic preservatives should only be used where there is limited exposure to the product during use; for example, single use sachets, airless packaging, or at worst, pump packs. Micro-bistatic preservatives should NEVER be used in open mouth jars, where consumers can contaminate product and overpower the preservative.

When considering which preservative is best to use for your product, you need to ensure:

- **broad-spectrum activity** – this means that the preservative or preservative blend is effective against bacteria AND yeast AND mould. Broad spectrum activity is a must for all personal care products, particularly those with a normally slightly acidic pH to match that of the skin. Some personal care products may be purposely pH adjusted to be either very low (3.5 – 4.0) or higher (7.0 – 8.0) to suit specific raw material requirements/compatibilities, however **broad-spectrum preservation is still essential.** While bacteria mostly prefer more neutral conditions (pH around 7.0) and fungi (yeast and mould) mostly prefer acidic environments (pH below 6.0), you will still get some opportunistic organisms from both categories that are able to grow in normally adverse conditions – making broad spectrum preservation an essential formulation requirement in any water based product with a pH above 3 and below 10. In order to get broad-spectrum activity from a preservative, it often requires two or more preservatives to be used in a blend. A synergistic blend of preservatives is when a combination of preservatives is shown to work better together than each preservative when used on its own. Using synergistic blends reduces the amount of preservative required in the formulation which also helps reduce potential irritation from the use of that preservative blend.
- **chemical compatibility with the formulation** - this means the preservative/blend must be suitable:
 - for the pH of the finished product – **this is incredibly important and usually where beginners make bad preservative selections.** There is no point using a preservative that needs to be at pH below 5.0 in a product that has a pH of 5.0 or more – the preservative simply won't work. pH of a product may drift over time by up to 10-20%, so whatever the finished pH of your product is, make sure there is an allowance of at least 20% either up or down and that your selected preservative will still provide coverage if the pH drifts this much over time. For example, if you are using a preservative that has a pH limit of activity of 5.5, your finished product should be pH

- adjusted to 4.0 – 4.5 to ensure it will still have adequate coverage if the pH should drift to 5.5 over the 2 or 3 years of that products life.
- in the presence or absence of any charge as appropriate for the product - such as anionic or cationic emulsifiers or surfactants which you will learn more about in a moment.
 - for the packaging that the products will be put in – product that is packed into packaging with a wide open neck, where it is constantly exposed to consumer contamination and air during use, will require stronger preservation than product that is packed into airless serum dispensers, which do not have any air or consumer contact once packed.
 - with the temperature the formulation goes through during manufacture - some preservatives will not work well when exposed to temperatures above 40°C, in which case they must be added at the last stage of manufacture once the product has cooled to below this point.
 - with any processing methods required for the products during manufacture - preservatives can come in an array of forms such as powders or liquid; they may also come as powders pre-dispersed in a liquid phase such as parabens in propylene glycol, for example. Whether you use a preservative that is a powder or liquid form, it must be homogenously distributed throughout the product when manufactured otherwise it will not be able to provide adequate coverage, and contamination could occur.
 - **regulatory compliance** – being able to check regulatory compliance of ingredients is for more advanced learning; suffice to say stick to the limits provided in this book to ensure you comply with preservative use in AU, EU, US and JP. Your supplier will usually also give a maximum input based on these regulations and safety data too. You may also need to consider what preservatives are allowed in certified organic products if you are attempting to make a product that is certified organic. The requirements of certified organic products can also vary in different countries, and is another consideration you may need to make. If you are planning to formulate organic products or advanced formulations, you should consider taking more advanced courses offered by the Institute of Personal Care Science once you are comfortable with the teachings in this book.

When adding your selected preservative into your formula, you should add your preservative to the formula as early in the processing as possible; however you must not de-activate it. If you are mixing a cold processable product, that is, one that does not need heating, then you can add it directly into the water phase at the start. However, if you are heating your product, for example, like when you make an emulsion, then you will need to check if your preservative is heat sensitive. If it is not, then add it at the start. If it is heat sensitive, then add it after the product has cooled to below 40°. If you are adding a powdered preservative, you might need to first slurry it in some glycerin or other similar solvent and add it like that to ensure homogenous dispersion.

Here is a table of common preservatives you may be able to source. We've provided:

- BROAD SPECTRUM choices only, so you can't get it wrong
- preservatives with a good pH range – to suit various personal care; but please still check your final pH as some of these materials are still somewhat pH limited
- temperature limits so you know if they can handle heat or not
- input rates – we've listed amounts we know to be effective – your supplier may list a lower input but please stick to the minimums we have listed here – or up to the maximum listed here, to ensure efficacy in your formula
- additional notes on natural status or processing considerations.

Formulating note: **PLEASE ONLY USE ONE** of these materials in each formula – they are all broad spectrum. Double check the pH will suit your formula and take note of any additional considerations we've provided.

Trade Name & INCIs (your supplier may call these by different names; check the INCI to see if it is the same material as listed below)	Microbi -cidal or static?	Input range %w/w*	pH	Heat tolerance	Notes
Euxyl PE 9010 INCI: Phenoxyethanol, Ethylhexylglycerin	Cidal	0.8-1%	3.0 - 12.0	Stable in heat	Broad spectrum, liquid, will not affect colour or fragrance. High surfactant load can affect efficacy. Synthetic.
Geogard ECT INCI: Benzyl Alcohol, Salicylic Acid, Glycerin, Sorbic Acid	Cidal	0.8-1.0%	3.0 - 8.0	Stable in heat	Broad spectrum, liquid, natural and nature identical (synthetic) but Ecocert/Cosmos suitable. Tends to pull pH of formulas down (more acidic)
Geogard 221 INCI: Dehydroacetic Acid, Benzyl Alcohol	Cidal	0.9 – 1.0%	2.0 - 7.0	<40°C	Broad Spectrum, liquid Synthetic but Ecocert/Cosmos suitable.
Geogard Ultra INCI: Gluconolactone, Sodium Benzoate	Cidal	1.2-2%	3.0 - 6.0	Stable in heat	Broad Spectrum, powder Naturally derived and nature identical (synthetic) Ecocert/Cosmos suitable. Note low pH required.
Leucidal liquid complete INCI: Leuconostoc/Radish Root Ferment Filtrate, Lacobacillus, Cocos Nucifera (Coconut) fruit extract	Cidal – but not strong	3.5-4%	3.0 - 8.0	<70°C	Not strong, don't use where high risk (clays/masks), warm to 40°C before adding, stir with low shear. Use airless packaging. Natural.

* Your supplier may provide you with lower minimum inputs; however we have raised these to what we know to be effective in various formulas to help you avoid using too little in your formulas.

Trade Name & INCIs (your supplier may call these by different names; check the INCI to see if it is the same material as listed below)	Microbi -cidal or static?	Input range %w/w*	pH	Heat tolerance	Notes
Naticide INCI: Parfum	Cidal	0.8-1%	4.0 - 9.0	<40°C	Natural; Ecocert/COSMOS compliant. Broad Spectrum, liquid. Can clash with citrus aromas.
Nipaguard SCE INCI: Sorbitan Caprylate, Propanediol, Benzoic Acid	Cidal	1.2-1.5%	6.5	<80°C	Note low pH required. Nature identical but suitable to use in Ecocert/COSMOS.
Spectrastat INCI: Caprylhydroxamic acid, Caprylyl Glycol, Glycerin	Static	0.8-1%	3.0 - 9.0	<90°C	Use airless packaging. Synthetic.
Spectrastat G INCI: Caprylhydroxamic acid, Glyceryl Caprylate, Methylpropanediol	Static	1-1.2%	4.0 - 7.0	<90°C	Not compatible with iron/clay; use airless packaging. Synthetic.
Optiphen plus INCI: Phenoxyethanol, Sorbic acid, Caprylyl glycol	Cidal	1.2-1.5%	<6.0	<80°C	Note low pH requirement. Synthetic.
Optiphen INCI: Phenoxyethanol, Caprylyl Glycol	Cidal	1.0-1.5%	4.0-8.0	<37°C	Broad Spectrum, liquid but not water soluble. Synthetic.

* Your supplier may provide you with lower minimum inputs; however we have raised these to what we know to be effective in various formulas to help you avoid using too little in your formulas.

Find out more...

Watch our Preservative video for a narrative on preservative selection:

<https://youtu.be/0pnEdg6ZaAU>

2.2 Antioxidants

Antioxidants are NOT preservatives; but they can help contribute to the shelf life of your product when needed.

Antioxidants provide two functions in a personal care product:

- act as antioxidants on the skin to reduce free radical damage to skin cells; as is caused by environmental conditions (this aspect will not be covered here but will be discussed in the unit on formulating skin care).
- act as antioxidants to protect the stability of the formulation from free radical damage and possible rancidity (this will be discussed in detail here).

Some materials may be excellent antioxidants for the skin, but have no antioxidant effect in a formula. Examples of this are dl-alpha-tocopherol acetate and ascorbic acid – both great on the skin but no protective benefits on the formula.

Antioxidants are not preservatives – they provide no anti-microbial activity in a formula at all. In fact, they actually add to the food source! However they do help prolong shelf life where there is a high oil content in the product. For example:

- massage oils or similar products where they contain a high content of vegetable and/or essential oils, should contain a high proportion of antioxidant. This will help protect the product against rancidity.
- products that contain only triglycerides, esters, silicones and/or mineral oils will not normally need antioxidant protection of the lipid content.
- essential oils can quickly lose their top notes and begin smelling 'off'; an antioxidant should be added to a finished product containing essential oils at moderate to high proportions to help slow the loss of top and middle notes.

Suitable antioxidant ingredients can include:

- **tocopherol** (vitamin E):
 - comes as d-alpha tocopherol (NDM) or dl-alpha tocopherol (S) or as mixed tocopherols (NDM).
 - mixed tocopherols provide the best antioxidant benefit; d-alpha tocopherol the next best benefit and dl-alpha tocopherol the next best benefit.
 - comes as various % concentrates.
 - low use would be 0.3%; moderate use would be 0.5%; high use would be 1-2% (raw material – NOT active content).
 - too much antioxidant can have a 'pro-oxidative' effect and can actually INCREASE the rate of oxidation and IRRITATE the skin – this is believed to happen because of irritant effect of increased oxidation on the skin.
 - **tocopherol acetate has no antioxidant protective benefits in formulas** – it only provides antioxidant benefits to the skin.

- vitamin E is oil soluble and commonly used in a variety of personal care products.
- products that are ‘hot filled’ (e.g. balms, which are poured off while still molten) will need a high % of tocopherol if they are composed of vegetable and/or essential oils – part of the tocopherol is ‘used up’ protecting the formula during the hot fill process so more is needed to ensure adequate amounts are present in the finished product after filling/the product has cooled.
- **rosemary extract:**
 - moderate use would be 0.1%; high use would be 0.2%.
 - you will need to make sure it is a high quality rosemary extract (NDM) to impart effective antioxidant protection.
 - usually available as an oil soluble form, it can be used in a variety of personal care products but does have a rosemary aroma and will often taint the finished product a pale yellow.
- **chelating agents** can also boost antioxidant activity where metal ions are present, by protecting a formula from changes that may occur in a formula resulting from the presence of metal ions. You’ll be learning about chelating agents in a moment.

Antioxidants should be added to formulas <40°C, as they themselves get oxidized by heat – and you really need them there over the 2-3-year shelf life of a product rather than being partially or wholly used up during the manufacturing process. Where you are making a hot fill product (for example, a lipstick or a balm) you have no choice but to add them when the formula is hot, but you add them at the last stage once all other ingredients have been melted/combined – this then exposes them to a slightly lower heat for less time than other materials. You would also use more antioxidant to protect a hot fill product as some gets used up protecting the formula during the filling process.

In addition to the use of antioxidants, dark or opaque packaging can also help to reduce the rate of oxidation of a product by reducing exposure of the product to light sources.

We can’t give you a ‘standard’ input amount for each of the antioxidants because it depends on your formula. Where there is a high oxidative risk, use a higher input of antioxidant. Where there is a low oxidative risk, use a low input. Where there is no risk, you can still add antioxidant for label claims and to provide a skin protective benefit. The only way you can check, and know for sure, how your chosen anti-oxidant and input will perform over the shelf-life of a product is to conduct ‘accelerated stability testing’ – storing the product at 35°C or 40°C for an extended period to see if off-notes or colour changes develop. If they do, not enough antioxidant has been added! If they don’t, the product is sufficiently protected. You will also learn more about this in the unit on Stability testing.

Find out more...

Watch our Antioxidant video using vitamin E: <https://youtu.be/ioucAvsnziw>

2.3 Chelating agents

Chelating agents are NOT preservatives against microbial growth, however can improve the shelf life of a product from discolouration or other deterioration as a result of free metal ions and enhance the efficacy of preservatives.

Chelating agents are used to sequester (bind to) metal ions that may be present in a product.

Free metal ions can cause oxidation and discolouration in products – speeding up oxidative changes which can lead to discolouration, unfavourable aromas forming, pH shifts and even separation of emulsions over time.

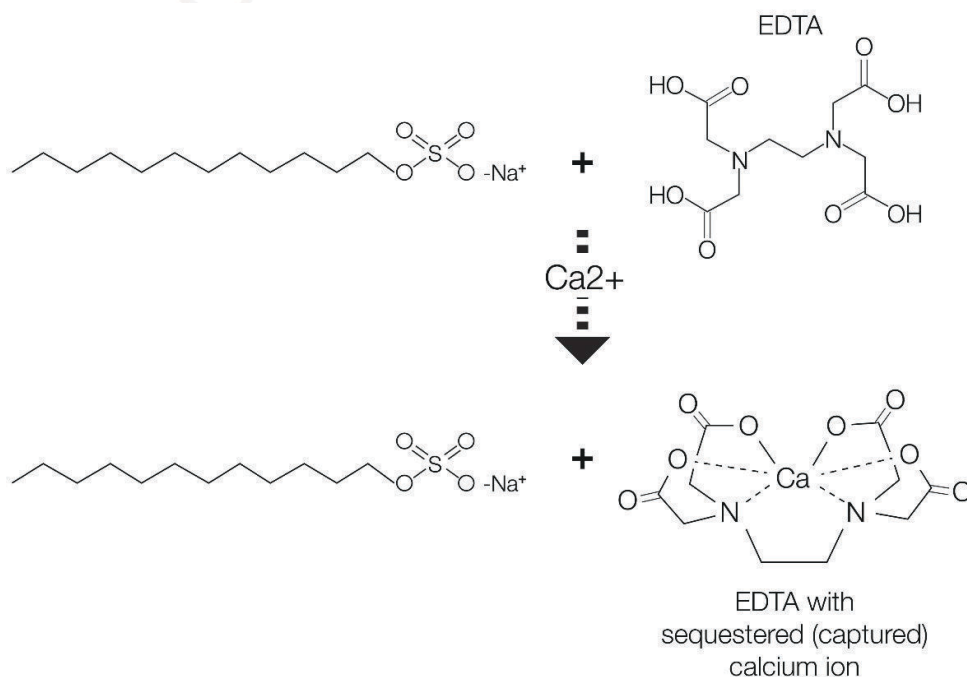


Figure 2: how EDTA ‘chelates’ calcium ions in hard water sources

Chelating agents may be used:

- in formulations where there may be free metal ions that could otherwise cause oxidation or discolouration of a product and thereby reduce its shelf life.
 - this includes magnesium or calcium that may be present in unsuitable process water
 - actives and pigments may contain magnesium, or ions from clays and even iron oxide from colourants and zinc and titanium dioxide
 - a chelating agent can help ensure ‘free’ ions don’t degrade the formula sooner than expected, without impacting the performance of the materials
 - some acid-based preservatives can have free ions – so the use of a chelating agent can also assist not only the preservative activity, but also support long term shelf life of the formula

- in products such as shampoos or shower gels to reduce the formation of 'scum' when used by consumers in hard water areas. Surfactants that 'need' a chelating agent present to perform in hard water areas include traditionally saponified soaps and shaving creams as well as sulphate systems (whether naturally derived or not).
- some actives and sunscreen agents require chelating agents to 'protect' the efficacy of an ingredient or stability of a formulation.
- to boost preservative efficacy – the use of chelating agents can in many cases boost preservative efficacy, making them more effective.
- to enhance antioxidant efficacy - the use of chelating agents to protect from free ion oxidative changes can help prevent some oxidative reactions from happening, enabling the antioxidant to protect the formula for longer, and more effectively.

So, if chelating agents are so useful, should they be used in every formula? The short answer is no. They are best suited to:

- ingredients containing oxidisable ingredients where there is also magnesium, sodium, calcium, iron oxides, zinc oxide, titanium dioxide or other ions present
- ingredients containing oxidisable ingredients where clays are added
- where acid-based preservatives are used (if there is 'acid' in the INCI name of the preservative)
- traditionally saponified products including shaving foams
- foaming products where a sulphate is used (naturally derived or not)
- where the supplier information for a sunscreen agent or active ingredient specifically states it is required
- in highly nutrient rich formulas to boost preservative efficacy
- in oxidative-risk formulas to boost anti-oxidant efficacy

Chelating agents can be heated – they are NOT affected by heat – so you can add them either at the start or the end of the formula, whichever is easiest for processing.

The use of chelating agents is NOT suited to:

- formulas where there is an electrolyte sensitive polymer e.g. carbomer and polymers
 - it may not totally destroy the effect of the polymer, but it can reduce its efficacy which in some cases may defeat the point of adding it
 - in some formulas, adding a chelating agent with a polymer can cause irreversible thinning and stability issues
- conditioners and cationically charged products – chelating agents carry a negative charge and can create insoluble substances where cationic emulsifiers or surfactants are present
- w/o emulsions – don't use chelating agents in w/o emulsions because they will destabilise the system especially where magnesium sulphate heptahydrate is used to help stabilize the system

Common chelating agents are:

- disodium edta and tetrasodium edta (both S):
 - usually used between 0.05 and 0.2%.
 - synthetic; NOT biodegradable.
- phytic acid/sodium phytate (usually NDM – check source):
 - input varies on grade of material, check supplier recommendations

- can enhance anti-oxidant efficacy by binding to enzymes which may otherwise cause oxidative reactions.
 - naturally derived and biodegradable
 - citric acid:
 - usually added to a product formulation as a 50% w/v solution.
 - used as required for pH adjustment, it can also act as a chelating agent but not usually used in sufficient quantities to provide significant chelating benefits.
 - naturally derived and biodegradable.
-

Find out more...

Watch our Chelating video: <https://youtu.be/hWZru1xkeNE>

2.4 Gums and thickeners

Gums and thickeners are used in personal care products for ease-of-use of the personal care products, and consumer perception. Personal care products must be easy to dispense, easy to apply, and must suit all climates in which the product will be sold. In order for consumers to value the product, sometimes you need to make it appear as they would expect. For example consumers often associate products that feel and look thick and rich as premium; compared to products that are thin and flow easier. You need to make sure the product you're providing the consumer is what they expect.

Personal care products must suit the packaging that they will be stored in, which must be selected to suit the flow of the product. Gums and thickeners can also be used to suspend pigments in place and ensure even distribution of colour throughout use. They can also be used to suspend actives or functional ingredients in place within the formulation during storage, and ensure even distribution of the actives or functional ingredients throughout use for good results.

Gums and thickness can also impart stability to personal care products. They can be used to form networks that prevent or slow creaming and/or sedimentation within emulsions, and movement of particles. By doing so, they can add significantly to long-term stability. They are also used for flow control, to make sure they are suitable for packaging and that they will spread on application, but not run out of the hand.

When selecting gums and thickeners for your formulation, you will need to base your selection on the required viscosity and flow properties of the product, the required price point, the pH and/or charge of the product, the required appearance of the product, its compatibility with other materials used, manufacturing steps, microbiological concerns, and natural or organic claims associated with the product.

You will need to use different thickeners for formulas that are water based (mostly water and water soluble ingredients), compared to those that are oil based (mostly oil or oil soluble ingredients). When formulating water based products, you should only use water compatible gums; there are natural, naturally derived and synthetic polymers you can choose from depending on your formulation needs and organizational philosophy.

The beginner cosmetic chemist can usually only obtain the common water suitable gums and thickeners, so that is what we will cover here. For oil compatible thickeners, refer to the section on lipids or if you progress with your formulating skills then read our advanced guide or follow through with our courses to learn about oil compatible thickeners.

Natural gums you will commonly encounter include carrageenan, guar and xanthan gum. These are great to use in formulas where you want to make all natural claims.

- carrageenan (lamda) has excellent viscosity and stability effects in formulas, but can feel a bit tacky in high inputs in leave on products. In wash off products this is not an issue. It can be used around 0.6 – 1.2%. Carrageenan gum is anionic.
- guar gum has limited viscosity and stabilizing effects but can feel a bit slimey on the skin in leave on products. It can be used around 0.6 – 1.2% in combination with xanthan to achieve the required viscosity and a nice skin feel. Guar gum is non-ionic.
- xanthan gum provides the best thickening and viscosity benefits however can be tacky and sticky on the skin when used much above 0.5% (used around 0.2 – 0.4% it provides significant viscosity and stabilizing benefits). Xanthan gum is anionic and works best at a pH <7.0.

To hydrate your natural gums make sure to use one of the following methods:

- slurry method: blend the gum in a non-aqueous substance such as glycerin and then add it to the water phase under high shear
- high temperature method: slowly sift the gum into hot water above 50° under constant stirring

Find out more...

Watch our natural gums video: <https://youtu.be/p9HtxqYwIeM>

Watch our natural gums for stabilizing particles video: <https://youtu.be/Mce63s9UGwk>

Natural clays include bentonites and aluminum magnesium hydroxide. These clays can also be used where all natural claims are required and are particularly useful to help suspend particles, as in the case of scrubs and coloured pigments like foundations. You would normally need to use around 1 – 2% to get full viscosity and stabilizing benefits; and provide a pleasant skin feel.

They have very specific processing needs, so be sure to use the following method exactly:

- high shear method: you **MUST** add natural clays to the water phase first before anything else, and then expose to high shear for at least 30 minutes to enable them to hydrate effectively. You can also use high temperatures to bring the high shear time down to 15 – 30 minutes.

Natural derivatives with some synthetic processing steps include cellulose and guar derivatives. These are not suitable to be used in products making all natural claims, but can be used where naturally derived ingredients are permitted with some synthetic processing.

Cellulose derivatives such as hydroxyethyl cellulose, hydroxypropyl methylcellulose and methylcellulose are non-ionic, so are compatible with anionic and cationic surfactants and

emulsifying agents. These provide moderate viscosity and stabilizing benefits when used around 0.3 – 1.2% with a non-tacky skin feel. They can help provide a clear/slightly translucent gel depending on the concentration used but can be a little tricky to hydrate when you first use them. If you don't hydrate these sufficiently you will return to your product sample the next day and find a gloopy gum layer resting at the bottom of your container.

Make sure to use one of the following processing methods carefully to ensure proper hydration:

- high shear method: add the cellulose derivative directly to water or using the slurry method, and then expose to high shear for 30 minutes until it appears evenly dispersed and forms a homogenous gel
- alkalizing method: add the cellulose derivative directly to water or using the slurry method and ensure evenly dispersed. Then use sodium hydroxide to bring the pH up to around 8.0 under constant stirring. Your gel will form as the mixture is alkalized. After it has swelled thoroughly you can adjust the end product pH to what is required (eg pH 5.5)

Guar derivatives include guar hydroxypropyltrimonium chloride, and hydroxypropyl guar hydroxypropyltrimonium chloride. These are particularly useful in hair conditioners where their cationic charge is beneficial. Some grades of guar derivatives, although cationic, are also suitable to be used in anionic shampoos and body washes – make sure to check with your supplier before using in an anionic system to make sure they are suitable because cationically charged substances are not usually compatible in an anionic environment unless specifically stated. While generally easier to use than cellulose derivatives, these too require careful processing to avoid the formation of a separate gum layer. The amount of guar derivative you use should be based on supplier information and recommendations; and is typically 0.2 – 1.5%.

Use the following method to ensure thorough hydration:

- acidifying method: add the guar derivative directly to water or using the slurry method and ensure evenly dispersed. Then use citric acid to bring the pH down to around 4.0 under constant stirring. Your gel will form as the mixture is acidified. After it has swelled thoroughly you can adjust the end product pH to what is required (although in many conditioners, a pH of 4.0 – 4.5 is desirable).

Synthetic polymers are anionic and include carbomer and alkyl acrylate polymers and crosspolymers, and can provide clear, viscous gels without any tack; but are not suitable to be used in products making all natural and naturally derived claims. They can be used to provide significant viscosity and stability enhancing benefits at very low rates – usually 0.25 – 0.4% is all you will need - and can in some cases be used in combination to create emulsifier free emulsions. It is essential that you never expose these to high shear at ANY time.

To process effectively, use the following method:

- alkalizing method: sprinkle the polymer into the water phase. Do not use the slurry method. Then stir under low shear until evenly dispersed. There will be slight thickening at this point but not much. You can then proceed straight away to the alkalizing step or you can do this at the very end after all other ingredients have been added. When ready, slowly add sodium hydroxide (30% solution at a 10:1 ratio) or triethanolamine (TEA at a 1:1 ratio) under continued low shear. Your formulation will now thicken rapidly. You can adjust the pH a little after the mixture has been neutralized but most of the time the best

viscosity is achieved around the 5.5 – 6.0 mark anyway. Do not adjust pH too much otherwise your mixture will lose its viscosity and stability.

2.5 Oils, butters and waxes

Lipids, also known as oils, butters and waxes, in personal care formulas provide a variety of benefits. They can be used to increase the lipid content of the skin, they can be used to enhance the spreadability and feel of a formulation, and they can be used to provide an occlusive barrier to reduce trans epidermal water loss through natural evaporation. They may increase the viscosity of a product, they may improve the consumer perception of the product, they provide a lasting moisturising benefit to creams, lotions and balms, and they may be used as marketing tools to enhance a product story.

Lipids are classified as oils, fats or waxes. Oils are generally liquid at room temperature, while fats are generally soft, semi-solids at room temperature with higher melting points than oils. Waxes are generally hard, solid and brittle at room temperature with higher melting points than fats. There are some exceptions to this generalisation, such as jojoba oil, which is liquid at room temperature and is a wax ester; but in general the above description applies to most oils, fats and waxes used in the personal care industry. There is a vast selection of lipids you can use and obtain as the beginner chemist in the cosmetics industry; below is a brief summary of what you will find:

- **natural lipids** – include vegetable oils such as almond or sunflower oil, and can include many exotic oils that are being introduced into the marketplace today.
 - natural butters include shea, mango and cocoa butter as well as exotic butters. Limit inputs of butters to 10% maximum in ALL formulation types, otherwise you may find you have climate induced viscosity changes in your formula (e.g. what sets as a balm in cool climates may become runny in warmer climates).
 - ALWAYS add antioxidants to formulas containing natural oils and butters.
 - natural waxes include beeswax, candelilla wax and carnauba wax. Different waxes give different effects, for example:
 - beeswax = some flexibility, no shine
 - candelilla and carnauba = great shine, not flexible
 - combine wax input for best shine & flexibility
 - alter inputs to achieve balm or stick consistency
- **naturally derived lipids** (using approved and synthetic processing methods and materials) – these include natural lipids that undergo processing such as hydrogenation, esterification, transesterification, and ethoxylation. This can be used to produce a large variety of natural lipid derivatives such as fatty acids, fatty alcohols, fatty acids, and fatty acid esters. Fatty acids are used to alter the consistency of emulsions and act as emulsifying agents. Fatty alcohols are used to alter the consistency of emulsions, and may act as emulsifiers and emulsion stabilisers. Esters are used as emollient and skin feel agents – some may be naturally derived and silicone replacements while others may be partially synthetic or totally synthetic. These materials do NOT need antioxidant.
- **synthetic lipids** - include mineral oil, which is also known as paraffin and petrolatum. Synthetic waxes include microcrystalline wax, ozokerite, and paraffin wax. Silicone is synthetic, and can be manipulated to produce a wide variety of silicon derivatives. Silicones have exceptional skin feel and performance within products. They include dimethicone, dimethicone copolymers, cross polymers, and silicone blends.

Liquid lipids can be used in very large ranges, depending on the type of product they are being used to create and the budget of the development. For example:

- face creams, body lotions and butters may contain as much as 10% natural lipids or sometimes a little more
- wash off products with a 'natural' story will generally contain less than 1% natural lipids otherwise their performance can be affected – superfatting agents (various lipid derivatives - agents with part water loving and part oil loving portions) tend to be used in preference to enhance the products performance
- balm products with a lipid base may use 20% or more natural lipids depending on the price and aesthetic requirements of the finished product
- the harder waxes may be used at between 2 – 10% to modify the viscosity of balm products; and may be used in combination to provide a mix of hardness without brittleness at up to 20% in stick type products.

Now lets take a look at how you incorporate lipids into a formulation:

- if you are adding a lipid to an all oil phase product, then all you have to do is blend your lipids together.
- if you are mixing the lipid with water, then you will need to create an emulsion or solubilise the lipid phase ingredients, which you will learn about in the section on surfactant selection and again in the practical section on formulation development.
- if the lipid you want to add is a semi-solid or solid form, then you will need to heat and melt it first, then mix it with lipids that are liquid at room temperature.
- make sure you do not heat cyclomethicones or cyclopentasiloxane as these are volatile substances and will evaporate if heat is introduced; which defeats the purpose of adding them to a formulation; but you can heat non-volatile dimethicones.

Find out more...

Watch our natural waxes video: <https://youtu.be/Ez1VsiBRQX0>

Watch our overcoming graininess in balms video: <https://youtu.be/RCSlVGff9o>

Watch our silicone and silicone alternatives video: <https://youtu.be/hsIvkAFVojo>

Watch our oily separation video: <https://youtu.be/-6aA0koN3R0>

2.6 Fragrances and essential oils

Fragrances and essential oils are used in most personal care products and can be potential irritants and allergens; so you could be forgiven for wondering why so many companies add potentially allergenic ingredients to their products! They are often used:

- for **tangible benefits** – ever noticed how a fragrance or essential oil can provide a positive experience or enjoyment to using a product, such as how amazing or refreshing it smells?
- to **cover undesirable odours** or leave a lasting desirable aroma or subtle fresh smell
- to **provide some performance benefits** to the product; such as the use of citrus essential oils to normalise and balance oily skin

- for **intangible benefits** - benefits that you can't feel, touch or smell; such as the perception of a product. Ever noticed how an aroma can evoke emotions or feelings when used?
- to **brand a product range** - several products in a company's range can be grouped together by having the same, or similar, fragrances

It is important to keep essential oil and fragrance use limited as they can be potential allergens and irritants. A typical guideline is:

Part of the body/consumer group	Typical maximum input (w/w) ESSENTIAL OILS	Typical maximum input (w/w) FRAGRANCES
Face products	Up to 0.5%	Up to 0.2%
Body products	Up to 1.5%	Up to 0.5%
Wash off products (body and hair)	Up to 1.8%	Up to 0.6%
Around the eyes and mucous membranes	Up to 0.3%	Up to 0.1%
Baby products	Up to 0.3%	Up to 0.1%

Essential information on essential oils!

Essential oil aromas are described by making reference to the top, body and dry out notes:

- the top note is the immediate aroma that is smelt
- the body or middle note is the aroma that lingers 1 - 2 hours after the fragrance or essential oil has been applied
- the dry out or base note is the aroma that can be detected the day after the fragrance or essential oil has been applied

In order to be balanced and carry a long-lasting and desirable smell, essential oil blends should contain approximately:

- 20 - 30% of top notes,
- 40 - 80% of middle notes, and
- 10 - 25% of base notes.

If an essential oil blend does not contain enough top notes, you won't get an immediate impact of its aroma. If the product does not contain enough base notes, it will not have a lingering fragrance. In order to have a nice and well rounded essential oil blend you need to pay careful consideration to ensuring appropriate quantities of top, middle and base notes for maximum impact. The table below provides guidance on essential oils with predominantly top, middle and base notes for your reference.

Top Notes	Middle Notes	Base Notes
Bergamot (FLO)	Chamomile, German (HER)	Cedarwood (WDY)
Clove (SPI)	Cardamom (SPI)	Clary sage (HER)
Cinnamon (SPI)	Geranium (FLO)	Frankincense (SPI)
Grapefruit (CIT)	Ginger (SPI)	Myrrh (SPI)
Lemon (CIT)	Lavender (HER)	Patchouli (WDY)
Lemongrass (CIT)	Marjoram, sweet (CAM)	Sandalwood, East Indian (WDY)
Lime (CIT)	Palmarosa (FLO)	Vetiver (WDY)
Mandarin (CIT)	Pine (CAM)	
Neroli (FLO)	Rosemary (HER)	
Petitgrain (FLO)	Rosewood (WDY)	
Orange, sweet (CIT)	Ylang ylang (FLO)	
Peppermint (HER)		
Thyme (HER)		

Table 1: Top, middle and base notes of common essential oils
 From: Battaglia, Salvatore, 2003. *The Complete Guide to Aromatherapy, 2nd Edition*. The International Centre of Holistic Aromatherapy: Brisbane. p362.

Limit your blending to the use of 3-5 essential oils, to avoid notes becoming confused or incompatible. When blending by aroma, use the following guide:

- **floral oils:**
 - use extenders for more expensive oils.
 - suitable with woody, fruit, sweet and musty oils.
 - may not be suitable with some herbaceous oils.
 - not suitable with camphorous oils.
- **fruity oils:**
 - suitable with most oils except woody and camphorous oils.
- **green oils:**
 - suitable with most oils when used in small amounts.
- **herbaceous oils:**
 - suitable with camphorous and woody oils.
 - not suitable with most florals.
- **camphorous oils:**
 - suitable with herbaceous and woody oils.
 - not suitable with floral and fruity oils.
- **spicy oils:**
 - use only in small amounts with care; they may or may not be suitable with the blend in any amount.
- **woody oils:**
 - can be used in just about any blend.
- **earthy oils:**
 - suitable in most blends up to 10%.

Here is a table to summarise compatibilities:

	Citrus	Floral	Fruity	Herb.	Camph.	Spicy	Woody
Citrus <i>e.g. Lemon</i>	√	C	√	√	√	√	√
Floral <i>e.g. Ylang Ylang</i>	C	√	√	C	X	X	√
Fruity <i>e.g. Roman Chamomile</i>	√	√	√	C	X	C	X
Herbaceous <i>e.g. Clary sage</i>	√	C	C	√	√	C	√
Camphorous <i>e.g. Marjoram</i>	√	X	X	√	√	√	√
Spicy <i>e.g. Myrrh</i>	Use only in small amounts with care; may not be suitable in any amount						
Woody <i>e.g. Sandalwood</i>	√	√	X	√	√	√	√

√ = a potentially compatible combination

C = use with caution; may not be compatible in some cases

X = not a compatible combination

Table 2: Compatibility when blending by aroma type

Just because they are natural, essential oils should not be considered safe without checking further. There are some things you must be careful of when using essential oils:

- some essential oils are considered poisons and need care with their use, such as tea-tree and eucalyptus*. Check with your supplier about local country regulations and limits of input. *(You learn how to do this yourself if you study more advanced topics with the Institute of Personal Care Science).*
- some essential oils can be photo-sensitising and not suitable to be used in leave on products when skin is exposed to the sun – like lime and bergamot*. Check with your supplier about local country regulations and limits of input. *(You learn how to do this yourself if you study more advanced topics with the Institute of Personal Care Science).*
- you should not make insect repellent claims about essential oils unless the product is appropriately registered with your local authorities.
- you must also be careful not to make therapeutic claims about the use of essential oils in cosmetic products, even if they have traditionally been used that way, cosmetic products must NOT make therapeutic claims
- if you are preparing a formula for the EU, you will need to declare allergens information. The presence of allergens (as defined by the EU Cosmetics Directive) must be indicated in the list of ingredients when its concentration exceeds 0.001% in leave-on products or 0.01% in rinse-off products. *For more details and to ensure regulatory compliance, we recommend that you study our unit on Ingredient Compliance*
- some essential oils are not suitable to be used in products marketed toward pregnant women; please refer to the table below which gives a list of the essential oils you should avoid if marketing your products for specific use by pregnant women. Guidelines for cosmetic products marketed specifically for pregnant women are:
 - **all over body use** - limited to 0.5% in total for non contra-indicated essential oils.

- **spot treatments** – can be used at normal concentrations; so long as they do not contain contra-indicated essential oils.
- **frequent use products** – products intended to be used several times a day, even when intended for use as spot treatments, should contain low concentrations of non-contraindicated essential oils (maximum 0.5% in total).

Table 3: Essential oils generally contra-indicated for use by pregnant women

Oestrogenic agents	Aniseed, fennel
Emmenagogue agents	Cedarwood, clary sage, cypress, peppermint, rosemary, rose, sweet marjoram
Teratogenic agents	Wormwood, sage
Abortifacient agents	Mugwort, parsley seed, pennyroyal, rue, thuja, tansy, wormwood

Note: this list is not intended to be exhaustive and the use of any essential oils during pregnancy should be evaluated by referring to several essential oil specialty texts before use.

** If you are hoping to make essential oils an important part of your product range, we recommend you take our Compliance Program to ensure you complete full ingredient checks on safety and regulatory compliance for more detailed information.*

To incorporate your essential oil or fragrance into a formulation, you need to make sure it is in a liquid form; if it is resinous or solid, mix it first with some ethanol or oil. When liquid, make sure you add it to the formulation and stir through until homogenous once the product has cooled below 40°. If you are adding to a balm, which is poured off hot, then reduce the balm to as low as it can go before starting to set – which is usually around 55°C. You will need to include an antioxidant into a formulation where you are adding essential oils.

2.7 Emulsifiers

Emulsions are the mixing of two immiscible substances. You would recognise these products as creams, lotions and hair conditioner. They are usually the mixing of oil droplets finely dispersed throughout a larger water phase.

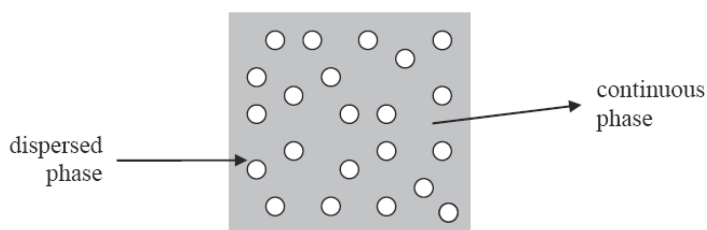


Figure 2: a simple emulsion where the white droplets represent the dispersed phase homogeneously distributed throughout a continuous phase

It is important to note that the two substances are not combined, but are blended such that the dispersed phase exists as small droplets finely spread throughout the continuous phase. Emulsion stability, that is, making sure the droplets remain finely dispersed and do not come together to separate out into a single layer, is a fundamental element of emulsion formulation that must be mastered in order to make stable creams and lotions with a 2 or 3 year shelf life.

Emulsions generally have a creamy appearance. The most common emulsions are oil in water, or water in oil. Oil in water emulsions are composed of oil droplets dispersed throughout a continuous water phase like in the diagram here. They have a creamy texture but do not feel greasy, and are light to apply. Water in oil emulsions are water droplets finally dispersed throughout a continuous oil phase. They can tend to feel greasy except where silicone is used as the majority of the continuous phase because the silicone is a light feeling emollient and constitutes the majority of the formula. When the continuous phase is oil, the product can tend to feel quite greasy on the skin. Water in oil emulsions require oil soluble dyes for colouration.

So just how are emulsions formed? To create an emulsion you need two things: mechanical energy, provided by machines which stir the product at high speeds and break the dispersed phase into tiny droplets; and chemical energy, in the form of emulsifiers, to help keep the droplets apart once they have formed. Emulsifiers have water loving and oil loving portions which are aligned to allow the two immiscible substances to mix. Emulsifiers provide the chemical energy needed to enable emulsions to form. Other stabilising methods used to help stabilise emulsions include the use of gums or polymers. Gums may be used to increase the viscosity of the continuous phase and enhance stability. The longer you can keep neighbouring dispersed phase droplets from coming into contact with each other, the more stable your end product will be. In general, always remember that the most stable oil in water emulsions are formed by combining anionic emulsifiers with a non-ionic high HLB emulsifier blend (what this means will be explained shortly) and the use of a suitable water compatible gum or polymer.

In addition, emulsifiers may be classified as:

- anionic:
 - negative charge – do not use with cationic emulsifiers (below)
 - used in face creams, crème cleansers and some lotions
 - common examples include sodium stearyl glutamate (use at 0.25 – 1.0%) or stearic acid (use at 0.5 – 2.0%)
- cationic:
 - positive charge – do not use with anionic emulsifiers (above)
 - used in hair conditioners – provide a slippery hair feel and detangling
 - common examples include behentrimonium chloride and cetrimonium chloride; come in varying % active content. You would normally use around 0.5 – 4.0% of the active substance depending on the product and hair type you are preparing the formula for.
- non-ionic:
 - no charge – very mild on the skin and hair – compatible with both anionic and cationic emulsifiers
 - use emulsifiers with a 'HLB' of 9.0 – 15.0 (more on what this means in a moment)
 - generally used at around 2 – 6% depending on the end viscosity you are hoping to achieve and the amount of oils/lipids present; these blends usually contain a varying combination of cetearyl alcohol, cetareth-20, glyceryl stearate, PEG-100 stearate, cetearyl glucoside etc

OR may be blends. 'Blends' are simply combinations of emulsifiers provided by different suppliers. The types of emulsifiers provided as blends varies significantly, so you will need to investigate a blends components to decide if it is suitable for your purposes before use. The

charge on blends will depend on the emulsifiers used in that blend. Stable emulsions are best formed when a combination of anionic OR cationic, plus a non-ionic blend, are used. Anionic and cationic emulsifiers are not usually stable in the presence of each other.

Emulsifiers are classified by their ability to form oil in water or water in oil emulsions using a system known as the HLB system. Basically, this refers to the hydrophile (water loving)/lipophile (oil loving) balance of the emulsifier; or the preference the emulsifier has to form an oil in water, or a water in oil emulsion. When selecting an emulsifier for an oil in water emulsion, you should make sure your emulsifier or blend has a HLB value greater than 8; 12 - 15 is ideal. If you want to create a water in oil emulsion, then you should select an emulsifier or blend with HLB value lower than 8; around 4 or 5 is usually ideal. A blend of emulsifiers will help you create the most stable system regardless of whether it is to be an oil in water or water in oil emulsion; but make sure your blend of emulsifiers has the right HLB value for the type of emulsion you are trying to create. The HLB value of emulsifiers is usually available from your raw material supplier and makes the right emulsifier selection relatively easy compared to the days of old where cosmetic chemists needed to make long HLB calculations to determine suitability!

While you are a beginner, stick to o/w emulsions using the build we have provided here, and use non-ionic emulsifiers with a HLB of 9 – 15.0 to make ‘fail safe’ emulsion formulas.

2.8 Surfactants

Emulsifiers are technically surfactants; since a surfactant is the term given to a substance with both hydrophilic (water loving) and hydrophobic (water hating) portions. But for you, the beginner chemist, I am trying to make the selection process easier by referring to surfactants that specifically form emulsions as emulsifiers (as discussed in the previous section) and referring to the branch of surfactants we would use to make foaming cleansers and clear mists as surfactants (in this section).

Let's start with solubilisation. Solubilisation is the formation of stable solutions of small amounts of insoluble or partially soluble materials – we use solubilization when we make mists and toners with small inputs of fragrance present.

In order to be effective, solubilisers must have a HLB relative to the substance that must be solubilised; and in any case, a HLB value above 15; and they must be pre-mixed with the insoluble substance before addition to water; so they can form spherical droplets called ‘micelles’ before they are dispersed throughout the water phase. This will yield a clear product as the insoluble substance is finely distributed throughout the aqueous medium.

Surfactants are classified into 1 of 4 categories:

- **anionic surfactants** carry a negative charge. They are used as primary surfactants in cleansing products; and are generally incompatible with cationic surfactants. Common anionic surfactants include sodium/ammonium lauryl sulphate, sodium/ammonium lauryl ether sulphates, sodium lauroyl sarcosinate, sodium methyl cocoyl taurate, sodium cocoyl glutamate and sodium cocoyl isethionate. You would normally add around the equivalent of 3.0 – 5.0% of active surfactant. Surfactants usually come pre-diluted so this would mean adding 9.0 – 15.0% of a 30% dilution to your formulation.

- **cationic surfactants** carry a positive charge. They are typically used in hair conditioning formulations and are generally incompatible with anionic surfactants because of their positive charge; when in the presence of anionic surfactants, they will tend to form insoluble complexes. Common examples include cetrimonium chloride and behentrimonium chloride. They adsorb to skin and hair in the presence of water to provide a silky feeling and anti-static properties. These come in varying % strengths and may come pre-blended with an emulsifier. You would normally want to make sure your final formulation contains 0.5 – 4.0% of active cationic agent depending on the product type you are making and the amount of conditioning power required.
- **nonionic surfactants** do not carry a charge; and are commonly used as co-surfactants, emulsifiers and/or solubilisers. Non-ionic surfactants are mild on the skin and eyes; when used in combination with anionics and cationics they can reduce the irritancy profile of the product. They are generally compatible with all types of surfactants. Common nonionic surfactants include cocoamide DEA and decyl glucoside. You would normally add around the equivalent of 1.5 - 3.0% of active surfactant. Some of these surfactants come pre-diluted so this would mean adding 3.0 – 6.0% of a 50% dilution to your formulation.
- **amphoteric surfactants** are used as co-surfactants; and they also boost foam and modify viscosity. They are compatible with all types of surfactants; where their low irritancy profile can help reduce the overall irritancy profile of a surfactant blend. Amphoteric surfactants carry a positive charge in an acidic environment; or negative charge in an alkaline environment. A common amphoteric surfactant is cocamidopropyl betaine. You would normally add around the equivalent of 5.0 – 10.0% of active surfactant. Remember, these surfactants usually come pre-diluted so this would mean adding 15.0 - 30% of a 30% dilution to your formulation.

3. Sourcing raw materials and information

How can you get more information on materials? How can you know if the information is reliable? How can you build your networks effectively, and source some of the many great materials you see out there? Here's what to do... and what NOT to do too!

DO NOT conduct general internet searches for information. There can be too much misinformation on the internet, you need to start learning about reliable sources of information. These include:

- IPCS texts and information we provide
- Large suppliers SDS, Certificate of Analysis, technical data sheets and flow charts (be careful about smaller suppliers information – try to source direct from the large suppliers where you are using their materials)
- CosIng

If you are formulating products:

- at a basic level:
 - you would normally source your materials direct from a supplier that stocks various materials direct to the public
 - look up soap suppliers in your country and the materials they provide – they are a good source of very small quantities of 'added extra' materials to value add and build product stories. Here is a great world-wide list of small suppliers that can help:

<https://createcosmeticformulas.com/IngredientSuppliers/IngredientSuppliers-897/>

- join our facebook group: cosmetic raw materials for small brands: <https://www.facebook.com/groups/1734896293290235/> - read and share posts about special materials you are trying to source in small quantities
- suppliers like this would normally have websites where products can be purchased with various information provided as well as prices and various pack sizes
- typical pack sizes could be from as small as 10g or mL through to around 20kg or 20L
- these suppliers normally purchase their materials from a larger distributor, and repack to sell to home-crafters and small personal care companies with relatively small raw material needs
- when they 're-pack' the materials from the larger suppliers into smaller containers, they often call it by a different name and won't tell you the original trade name - so you need to order the material from their website using the name they call it and should use this name in your formula along with the supplying company in brackets
- any information you ask for from this supplier will need to go to their distributor who will in turn go to the raw material supplier direct. You may not be able to get all the information you ask for using a supplier that stocks direct to the public simply because you are not dealing with the company direct and internal procedures may limit the information they can provide you with
- at an advanced level:
 - you would normally source your materials through a distributor or representative of larger companies
 - you will be provided with a lot of company brochures to search through in later units if you are studying formulation courses with us, which will enable you to contact the distributors direct
 - you would normally need to obtain information through the distributor such as minimum order quantity (MOQ), lead time and pricing of the raw materials
 - it is much cheaper to purchase through distributors than through suppliers to the public, however minimum pack sizes can be anything up from 5kg to 200kg depending on the raw material required
 - your main contact point with raw material suppliers would be their nominated distributor – they will be able to provide you with all information requirements direct from the supplier and will be a very reputable source of information for you to rely on for the ingredients they specifically sell.

How to build your network!

We often get asked for direct contacts of various supplying companies. Different suppliers will have different offices and staff around the world to support customers in different regions. In addition to this, we can't provide specific email contacts because of privacy laws. So, now is a great time to start building your networks, so you can find the person with the material or solutions you need!

Never underestimate the importance of building your networks early and well. The tips below tell you how to build your networks at each level, and get extra practical experience, but there are equally important things NOT TO DO at ANY level!

Do not – at any level or stage:

- share your contacts' details, even with close colleagues, unless it is within the same company doing the purchasing.
- order raw materials just to 'trial' if you don't have a genuine (bonafide) intent to purchase later. Suppliers realise that some of the materials they provide you won't work for a given formula, but if they continually supply you with materials and you don't ever make a purchase, they will stop supplying you with materials and information.
- contact a supplier to get information just for an assessment – we provide multiple brochures in dropbox to get more than enough information to complete your assessments – save your questions for suppliers until you are ready to purchase from them.

Now, what **TO DO** – start building a contacts list for raw material information and samples!

If not working in the industry but at a stage to start purchasing:

- join your local Society of Cosmetic Chemists (country/state specific) and make sure you attend the social and professional events to build your network of contacts.
- look up soap suppliers in your country and the materials they provide – they are a good source of very small quantities of 'added extra' materials to value add and build product stories. Here is a great world-wide list of small suppliers that can help: <https://createcosmeticformulas.com/IngredientSuppliers/IngredientSuppliers-897/>
- join our facebook group: cosmetic raw materials for small brands: <https://www.facebook.com/groups/1734896293290235/> - read and share posts about special materials you are trying to source in small quantities
- be prepared to purchase small quantities of materials for 'extra' activities you want to conduct beyond what is provided as part of our formulation training – especially if you want to be working on your own more specialised and unique projects.
- it can seem daunting at first but taking these steps to build your networks, especially being part of your local society, is INCREDIBLY important for your long-term career growth.

If working in the industry/already purchasing small to large quantities of materials:

- take the next step and build your networks using all of the above steps!
 - start compiling a database with your local contacts for the materials you have been purchasing and the materials they represent
 - for those companies you don't have contacts with already, but have a genuine interest in purchasing from, contact the company (do a google search on the company name and contact them through the contacts page) and ask for the contact email of your local supplier/distributor/representative.
-

Chapter 4: What is natural?

Every ingredient used in a cosmetic and personal care product serves a purpose. When a formulator selects ingredients, they are guided by the company philosophy and role of the ingredient within the formulation; based on information obtained from a product development brief. Depending on the company philosophy and type of formula being developed, the choice of ingredients to select from can be wide and varied, as for a product which is driven by performance with a flexible budget; or, as in the case of Certified Organic products, narrowed down to a comparatively small selection based on the certified organic and natural status of the ingredients.

It is a growing trend in the marketplace to promote products as being 'natural', 'organic' or 'naturally derived'. Claims about the natural-ness of a product are usually based on the ingredients used in the product, however these may often be misinformed and incorrect. The information below provides the current industry accepted use of these terms when marketing personal care products, and is based on the definitions provided by certifiers from around the world.

Before we look at the terminology used, it is important to emphasise, at this early stage of your learning, that natural does not mean safe just like synthetic does not mean harmful. But, there is an increasing demand for 'natural' products in the market place, so its important you can find out, properly, if an ingredient really is natural or not, and hold that evidence on file to support any claims of 'natural'-ness.

The chemical terminology presented here may appear daunting at first, and if you are working in Brand Management, you don't need to understand the full processing that is involved, beyond **recognizing the words (terms)** used here. The words/terms used here are provided so that any Certificates of Analysis, manufacturer's flow charts or other technical data sheets pertaining to an ingredient can be followed by the chemically un-initiated, and a determination about natural/synthetic status can be made **without needing to understand the actual processing involved**. You will learn how to use these terms to determine natural/synthetic status later in this unit; for now, just focus on recognising the terms presented.

To help you recognize which ingredients are commonly natural, naturally derived or synthetic, we've also got that handy list for you back in Chapter 1 where we went through the various ingredient categories.

Revisit Section 2 of Chapter 1 now to refresh your memory on this list
– it will also help you with making sure you select
ingredients to suit your company philosophy, easily!

1. Organic ingredients

The chemistry definition of an organic ingredient relates to compounds containing carbon. Carbon is found in every living (or once living) substance, as well as petrochemicals and other compounds; so for the purposes of personal care products, the chemistry definition is too broad and would encompass virtually every ingredient used in the industry! Chemical sunscreen agents are also scientifically known as 'organic sunscreens' because of their carbon

backbone; although they would be considered synthetic ingredients using cosmetic terminology as we describe here.

The cosmetic and personal care definition of an organic ingredient is generally used in marketing campaigns and by general consumers to describe a 'certified organic' ingredient. It is important to understand the difference between the chemical terminology of 'organic' and general consumer understanding of 'organic'. For this reason, it would be more correct to promote an ingredient as certified organic where it is grown without the use of synthetic pesticides and chemicals, as described here.

2. Certified organic ingredients

A certified organic ingredient is one that is completely natural, grown without the use of synthetic pesticides or fertilizers, and tests free of synthetic chemical residues. Any ingredient declared as 'certified organic' must have documentation to support its status, which enables a certifying body to trace it from the company selling the product, through the supply chain and back to the farm it was grown in. Certified organic starting materials are generally of plant or marine origin, although some can be from animal sources, like beeswax.

To be 'certified organic' the starting materials need to be fully organic according to the certifier's needs, and use only approved 'physical' processing. Words to look for on manufacture flow charts or information, that would mean 'natural' processing has occurred, include the following physical processing methods.

Physical processing which may be involved, that would still enable an ingredient to be classified as organic – if the starting materials were organic - includes:

- cold pressing (used to extract oils from seeds)
- distillation using water or steam (used to extract many essential oils)
- solvent extraction using ethanol, water or vegetable glycerin (such as herbal extracts)
- bleaching and deodorisation (if suitable inert substances are used);
- blending
- decoction
- filtration/purification
- pastillation
- roasting
- squeezing/crushing
- centrifuging
- dessication/drying
- grinding/maceration
- pressure
- sifting
- sterilization with UV/heat

Certified organic ingredients are generally more expensive than non-certified organic ingredients due to increased farming and regulatory costs. They are included in products to promote a pure and natural image to consumers, free of synthetic pesticide or chemical residue. The most common certified organic ingredients are plant oils, herbal extracts and essential oils, preceded by the words 'certified organic'.

Certified organic ingredients can cause skin irritations and sensitivity issues even though they are sourced directly from nature. Just because they are considered the most natural of ingredients does not mean certified organic are the safest. The safety of certified organic

ingredients and their finished products should be evaluated the same as for a product containing synthetic ingredients and/or a combination of both.

3. Natural ingredients (N)

A natural ingredient is one which comes direct from the source with only minimal, if any, physical changes incurred. Natural ingredients differ from Certified Organic products in that their source is natural, but not certified organic. Natural starting materials are generally of plant or marine origin, although some can be from animal sources, like beeswax.

To be 'natural' the starting materials need to be of totally natural origin, and use only approved 'physical' processing. Words to look for on manufacture flow charts or information, that would mean 'natural' processing has occurred, include the following physical processing methods.

Physical processing which may be involved, that would still enable an ingredient to be classified as natural, includes:

- cold pressing (used to extract oils from seeds)
- distillation using water or steam (used to extract many essential oils)
- solvent extraction using ethanol, water or vegetable glycerin (such as herbal extracts)
- bleaching and deodorisation (if suitable inert substances are used);
- blending
- decoction
- filtration/purification
- pastillation
- roasting
- squeezing/crushing
- centrifuging
- dessication/drying
- grinding/maceration
- pressure
- sifting
- sterilization with UV/heat

Natural ingredients should be refined to remove impurities, but again, the refining process should only involve physical processes that maintain the natural integrity of the substance. A natural ingredient should not contain any synthetic chemicals in its structure, nor be obtained through the use of synthetic chemical processing routes. Common natural ingredients are a variety of plant oils, herbal extracts and essential oils.

Be aware of the difference between these three items:

- **plant oils** are used as emollients, and are simply cold pressed vegetable oils.
- **herbal extracts** are the result of solvent extraction by immersing the plant in a suitable extraction medium (e.g. ethanol, water or glycerin) for a period of time, straining off the liquid portion to remove any solids, in order to yield the active constituents of the plant matter.
- **essential oils** are highly concentrated and most often fragrant oils obtained through one of a number of means (commonly steam distillation but may also include expression, CO₂ extraction or maceration), to yield highly refined oil based active constituents of the plant.

Natural ingredients can cause skin irritations and sensitivity issues. Natural ingredients can be tainted by naturally occurring contaminants and pesticide residues affecting their safety profile, if not removed correctly and to acceptable levels. The safety of natural ingredients and their finished products should be evaluated the same as for a product containing synthetic ingredients and/or a combination of both.

4. Derived from nature

Ingredients derived from natural sources should be split into two groups to more accurately represent their 'natural' status: derived from nature with minimal processing; and derived from nature complexed with, or processed using, synthetic chemicals.

The natural components should be refined to remove impurities either before or after their processing steps. The safety of ingredients derived from nature can cause skin irritations and sensitivity issues both through the chemical nature of the products they become after processing, and impurities and pesticide residues present when in their raw state. Careful processing will remove excess impurities but the synthetic chemicals they are complexed with, and/or the processing steps they are involved in may result in a product with an increased irritancy profile. The safety of these ingredients and their finished products should also be evaluated the same as for other personal care ingredients and products.

4.1 Derived from nature with minimal processing (NDM)

These ingredients are derived from natural substances, such as plants or marine sources, using only allowed chemical processing methods without the residue of synthetic chemicals. These ingredients can be correctly identified in marketing material or on labels as being sourced from natural substances, derived from nature or naturally derived.

To be 'naturally derived' or NDM, the starting materials need to be of totally natural origin, but use permitted chemical processing methods. Words to look for on manufacture flow charts or information, that would mean 'permitted chemical' processing has occurred, include the following processing methods.

(Remember, you don't need to know how to do this processing or even what this processing involves, you just need to be able to identify these words – we'll show you an example shortly).

Chemical processing methods that can be used, and still provide an ingredient defined as 'derived from natural sources' includes:

- alkylation
- esterification and/or transesterification
- hydration
- hydrolysis
- oxidation/reduction
- sulphation (note this is not the same as sulphonation)
- condensation
- fermentation
- hydrogenation
- neutralisation
- saponification

In order to correctly identify a substance as derived from nature with minimal processing, it may be necessary to obtain a manufacturer's declaration or flow chart detailing the exact

methods used in the ingredient's manufacture. Common examples include guar and xanthan gum (fermentation); vegetable glycerin (usually hydrolysis/saponification by product); decyl glucoside (derived from coconut oil fatty acids and corn starch); cetearyl olivate (derived from olive and palm oil fatty acids); sorbitan olivate (derived from olive fatty acids and sorbitan polyalcohols).

We'll be looking at some flow charts shortly so you can practice finding this information for yourself.

4.2 Derived from nature complexed with, or processed using, synthetic chemicals (NDS)

These ingredients are quite common in modern personal care and cosmetic products; and often misrepresented as being natural or naturally derived, when in fact, they include a natural substance but contain synthetic chemicals (rendering the ingredient no longer natural) or have been processed using synthetic chemicals to change their natural form and function, with a synthetic portion to the finished molecule. They should not be represented on labels as being totally derived from nature; because they have been processed and/or complexed with synthetic chemicals that render them no longer natural.

Some ingredients that can be derived from nature using minimal processing can also be manufactured using synthetic chemicals. This is why it is important to be able to understand a manufacturer's Certificate of Analysis and flow chart to determine the true natural status of an ingredient, according to the terminology presented here.

While starting materials may or may not be from natural sources, once this processing has been involved, the end product can no longer be considered truly naturally derived – as there is a synthetic element present. Words to look for on manufacture flow charts or information, that would mean the substance is no longer naturally derived, include the following chemical processing methods.

(Remember, you don't need to know how to do this processing or even what this processing involves, you just need to be able to identify these words – we'll show you an example shortly).

Common processing methods that cause an ingredient to **no longer** be considered natural or naturally derived include the following:

- alkoxylation
- methylation
- sulphonation
- ethoxylation
- propoxylation

This therefore includes ingredients such as sodium laureth sulfate (even where vegetable oils are used in the manufacture) and PEG-oils. PEG stands for polyethylene glycol, and when attached to oils it makes an ingredient soluble or partially soluble in water where it would normally be immiscible. Other processing methods may include the complexing of a natural and synthetic substance, with or without the presence of a chemical catalyst, to produce an end substance.

Common examples of ingredients that are derived from nature complexed with, or processed using, synthetic chemicals, making them NDS, include hydroxyethylcellulose (a common viscosity modifying cellulose derivative); cocoamidopropyl betaine (a common surfactant); and isopropyl myristate (a common emollient).

5. Nature identical ingredients (NI)

Nature identical ingredients are synthetic ingredients that are identical to their natural counterparts. These too are often promoted as being natural or naturally derived, although they are completely synthetic in origin. Being completely synthetic in origin, they are generally lower in impurities than the identical natural substance, even after refining.

The starting materials for these materials are synthetic and they may go through any of the aforementioned processing steps.

Examples of nature identical ingredients include amino acids and peptides, vitamin A, B5 and dl-tocopherol (vitamin E) and non-vegetable derived glycerin. Nature identical ingredients can also be modeled on essential oils (in the form of fragrances) and synthetic waxes, such as synthetic beeswax or synthetic candelilla wax.

Identification as to the natural or synthetic status of an ingredient can also be made by asking the raw material supplier or through Certificates of Analysis and manufacturing flow charts. Since they are manufactured from synthetic chemicals, nature identical ingredients are low in impurities, however may still have the same irritancy profile as their natural counterparts. Safety evaluation of nature identical ingredients is therefore required the same as for other personal care ingredients.

6. Synthetic ingredients (S)

Synthetic ingredients are those manufactured entirely from synthetic chemicals or petroleum derivatives. It is important to note that petroleum is used as a base product because of its high carbon content and versatility to be manipulated through chemical processing techniques to produce a wide variety of different substances. Chemically speaking, petroleum is actually a natural product because it comes from the ground and is not synthetically engineered; however the modern terminology used to define a synthetic ingredient includes petrochemical derivatives as they are non-renewable.

The starting materials for these materials are always synthetic and they may go through any of the aforementioned processing steps. Between each processing step there is often a refining process to ensure only the pure chemical progresses to the next step for further processing. Consumers who read that a product is derived from petroleum by-products may get confused and think that the end product is the same as petroleum and liken it to applying

the petroleum they use in their car to their skin; however this is not correct, and synthetic products derived from petroleum should not be mis-represented as such.

Synthetic ingredients are in general, much cheaper and more pure to produce than natural ingredients. Natural ingredients often require a refining step to remove impurities. A synthetic ingredient, however, does not normally contain many of the impurities occurring in nature in the first place; hence does not need to have them removed through a refining step. Common examples include carbomer, microcrystalline wax and mineral oil.

Synthetic chemicals are usually manufactured from non-renewable sources, meaning that once the source is used, it cannot be replaced. Certified organic, natural and derived from nature with minimal processing ingredients are renewable sources, because one can always re-grow the starting raw materials. Non-renewable sources are in limited supply, and once used, are gone forever. Renewable sources, although time is involved in reproducing, can be grown again for future generations. The biodegradability of individual ingredients should not be confused with their originating source, either. Biodegradability means the ability of the ingredient to be broken down through natural degradation processes to produce carbon dioxide, water and mineral salts. Information on the biodegradability of an ingredient should be found on its Certificate of Analysis, Material Safety Data Sheet, or by contacting the raw material supplier.

The safety of synthetic ingredients should be assessed the same way as natural ingredients. Just because an ingredient is of synthetic origin does not mean it is any more likely to impose a health risk different to natural ingredients. Synthetic ingredients are generally low in impurities, however their irritancy and allergenic profile should be assessed the same as for other personal care ingredients.

7. Determining natural/synthetic status

An increasing number of personal care products today make claims about the natural or synthetic status of the product itself and/or the ingredients it contains. Whether you are formulating products or managing the brand, it is essential that you do not misrepresent a product or ingredient as being naturally sourced if it is not. To help you make sense of how the natural/synthetic status of a material is commonly classified, refer to the guidance table below.

Note that organic materials have not been referred to, as a truly 'certified organic' material needs certification by an appropriate certifying body.

Starting Material/s	Processing Involved	Natural/Synthetic Classification
Natural (e.g. plant oils)	Physical processing (e.g. cold pressing, distillation, filtration, extraction)	Natural (N)
N starting product + Physical processing = N		
Natural and NDM (e.g. plant oils + glycerin)	Allowed chemical processing (e.g. hydrogenation, esterification)	Naturally derived with minimal processing (NDM)
N/NDM starting + Allowed Chemical processing = NDM product		
Natural and NDM (e.g. plant oils + glycerin)	Synthetic processing (e.g. ethoxylation, propoxylation)	Naturally derived with synthetic processing (NDS)
N/NDM starting + Synthetic processing = NDS product		
NDS/S (e.g. plant oils + hydrocarbon/petroleum or synthetic derivatives)	Physical, Allowed Chemical	Naturally derived with synthetic processing (NDS)
NDS/S starting + Physical or Allowed Chemical Processing = NDS product		
Synthetic (e.g. hydrocarbon backbone from petroleum derivative)	Physical, Allowed Chemical, Synthetic (e.g. any methods mentioned)	Synthetic (S) Could also be Nature Identical (NI) e.g. some vitamins
S starting + Any processing = S product		

Chapter 5: Cosmetic product safety

It is a company's responsibility to ensure the product they put on the market is safe when used as directed. This includes correct ingredient disclosure, inclusion of any required warning statements to ensure safe use (as required by regulations), ensuring suitable directions for use and packaging/flow restrictions if necessary.

Consumers using cosmetic and personal care products are entitled to believe their products are safe when used as directed. Serious reactions to personal care products are quite rare, however irritations and allergic reactions are not uncommon. There is a lot of misinformation on the internet about the so-called 'harm' of cosmetic ingredients, but **where a cosmetic ingredient is used within its regulatory limits, it should be considered safe**. It is misleading to suggest that an ingredient that is permitted for use, could cause any harm.

There is a lot of misinformation on the internet about cosmetics and animal testing. Animal testing on finished cosmetic products is banned in many countries around the world now, and is only conducted in a very few countries where it is required by regulations before allowing products to be sold in the market. However, most cosmetic chemicals, including most essential oils and naturally derived functional materials, were in the past, tested on animals. While these tests are rarely conducted anymore, you may see reference to them in literature, so it's important that you understand what they tested for, even though now they've largely been replaced by in vitro methods.

Find out the truth about animal testing, and how it isn't conducted on finished products anymore (except special use cosmetics in China, because of regulatory requirements):
Cosmetic ingredients and animal testing: https://youtu.be/W_s837dSrrA

1. Company responsibilities

The company that puts a personal care product into the marketplace is responsible to ensure it:

- is safe when used as directed
- is fit for purpose
- uses flow restrictions to ensure safe dispensing if required
- provides safe and suitable directions for use
- provides all required warnings
- provides additional warnings to ensure safe use
- only contains permitted ingredients within regulatory limits
- has a written recall procedure in place should a recall ever be needed.

When a consumer uses a product and experiences a mild irritant reaction, they will first and foremost stop using the product and never purchase again. Obviously this damages company sales where there are a number of mild irritations occurring, because this would result in less repeat purchases. The consumer may also tell friends, family and/or colleagues about their experience, which can have a damaging effect on the company's reputation and other possible sales.

Where a moderate to severe irritation reaction occurs, the company could be liable to cover medical and other expenses incurred resulting from the use of the product. Depending on the severity of the reaction, this figure could run into several thousand dollars or more; and is why insurance is required by all companies marketing and manufacturing cosmetic and personal care products.

Labels on products are required to list all ingredients in the product at the point of sale, so that consumers can determine the suitability of the product for their individual use. Accurate ingredient labeling is required on all cosmetic and personal care products sold. Company's whose products contain fragrances, should also have safety data on file relating to the fragrance used in the product, allergens it contains and its potential irritancy profile. It is a requirement that allergens found in fragrances be labeled if the product is going to be sold in the European Union (EU). Consumers who know themselves to be susceptible to fragrance reactions will usually seek 'fragrance free' products.

Even when utmost care is taken by both the company and the consumer, irritations and allergic reactions can, and do, occur. Where a company takes reasonable measures to evaluate and/or test the safety of the product before putting it on the market, and discloses ingredient information on the label accurately, they will have taken the minimum necessary steps to ensure the safety of their product. It is important for companies to ensure they have appropriate Product Liability insurance, which will be based on the types of products they provide and the inclusion of all required ingredient information, flow restrictions (where suitable) and most importantly, directions to ensure safe use.

Finally, should there be reports of issues with a product, a recall may be necessary along with reporting to the local relevant regulatory body. Returned products should be classified according to the following defects category, and action initiated appropriate to the risk imposed.

- Class I Defects:
 - potentially life-threatening or could cause a serious risk to health
 - examples include: wrong product (label and contents are different products), wrong strength, wrong active ingredient/s or chemical contamination with serious medical consequences, or mix up of some products.
- Class II Defects:
 - could cause illness or mistreatment, but are not Class I
 - examples include: mislabelling (wrong or missing text or figures), missing or incorrect information (e.g. leaflets or inserts), microbial contamination with medical consequences, chemical/physical contamination, mix up of products in containers, non-compliance with specification or insecure closure with serious medical consequences
- Class III Defects:
 - when product defects may not pose a significant hazard to health but withdrawal may be initiated for other reasons
 - examples include: faulty packaging (eg wrong or missing batch number or expiry date), faulty closure, contamination – microbial spoilage, dirt or particular matter

A recall must be initiated with any Class I or Class II Defect products; or where there are 3 or more reports of Class III Defects in a batch of product. Recalls are costly to companies not

only for the advertising required to ensure return of all faulty product and the cost of product itself, but recalls can have untold damage on the image of a brand and consumer trust. Therefore, ensuring products are safe when used as directed before they are launched is a crucial development and brand management step.

2. Reliable safety information

With so much misinformation on the internet, where can you search for reliable information on cosmetic ingredient safety, and what do you look for?

To determine the safety of an ingredient properly, you need to combine information from sites such as:

- Cosmetic Ingredient Review (CIR)
- The Scientific Committee on Consumer Safety (SCCS) opinions – accessible through CosIng ingredient searches

2.1 Cosmetic Ingredient Review (CIR)

For full searches and information, please visit www.cir-safety.org

The CIR provides peer-reviewed commentary on cosmetic ingredients with the support of the US FDA and Consumer Federation of America. With a 7 person Scientific committee, its reviews are extensive and scientifically based to ensure correct scientific evaluations on cosmetic ingredient safety are communicated.

To conduct searches for ingredients on their website, go to their Ingredients tab, and enter the chemical, by INCI name, in the search bar and click search. We're going to show you how to conduct searches on butyl paraben. Go to the cir-safety.org website and conduct the search with us.

Note: when searching for ingredient information, it helps improve your search results to use general terms to broaden the search, and don't search for plurals. For example, we want to find out the safety evaluation of butyl paraben, but instead of searching for butyl paraben, we use the term paraben. Note we don't use the plural form of the word either, and that way we get the broadest search possible.

Find Ingredient Reviews and Documents

Select a letter of the alphabet to browse ingredients by name or enter an ingredient name in the search field below.

Ingredients of interest may be found on the label of a personal care product and searched using this database. Ingredients are often referred to on the label of a personal care product by the ingredient name as it appears in the International Nomenclature of Cosmetic Ingredients (INCI), known as the INCI Name. CIR reviews ingredients, not products. Furthermore, as a matter of practice, CIR does not usually review fragrances, colors, or flavorings.



Ingredient Name:

Hints: Using part of an ingredient name might yield more hits. Don't use plurals.

You'll get a big list of different parabens return; we're going to focus on the report for butylparaben, so click on that hyperlink.

CIR Ingredient Status Report

CIR Ingredient Name:	U.S. INCI Name:
Benzylparaben	Benzylparaben
Butylparaben	Butylparaben
Calcium Paraben	Calcium Paraben
Ethylparaben	Ethylparaben
Isobutylparaben	Isobutylparaben
Isopropylparaben	Isopropylparaben
Methylparaben	Methylparaben
Potassium Butylparaben	Potassium Butylparaben
Potassium Ethylparaben	Potassium Ethylparaben
Potassium Methylparaben	Potassium Methylparaben
Potassium Paraben	Potassium Paraben
Potassium Propylparaben	Potassium Propylparaben
Propylparaben	Propylparaben
Sodium Butylparaben	Sodium Butylparaben
Sodium Ethylparaben	Sodium Ethylparaben
Sodium Isobutylparaben	Sodium Isobutylparaben
Sodium Isopropylparaben	Sodium Isopropylparaben

This will take you to another page where the reports are listed historically. You want to review the most recent published report, as well as any tentative reports. The tentative reports are still being finalised or having comments/amendments made, so it is best to review the published reports for what has been finalised, although it can be helpful to review the tentative report to see how the previous reports may have been altered.

CIR Ingredient Status Report

The following table provides a quick view of the status of CIR reports that include this ingredient. Clicking on any individual **INGREDIENT** will take you to the monograph for that ingredient in the ingredients area of the **On-Line INFOBASE**. Clicking on the **STATUS** will provide you an explanation of the status of the ingredient and a copy of the relevant report available from CIR.

For additional information about the Cosmetic Ingredient Review, see the [CIR Home Page](#)

INGREDIENT	STATUS	DATE/REFERENCE
Butylparaben	Tentative Report  PDF may take a few minutes to download	04/09/2019
Butylparaben	Published Report  PDF may take a few minutes to download	UT 27 (Suppl. 4):1-82, 2008
Butylparaben	Published Report  PDF may take a few minutes to download	JACT 3(5):147-209, 1984

Click  for PDF

To view large PDF files, you must have Adobe Acrobat Reader (6.0.1 or newer) installed on your PC.

In this case, we would review the published report of 2008 and the tentative report of 2019. Download both, and review the Conclusion section, which is located at the end of the reports but before the references and tables. You will see this for the Published report of 2008:

- Just before the conclusion:
The CIR Expert Panel considered exposures to cosmetic products containing a single paraben preservative (use level of 0.4%) separately from products containing multiple parabens (use level of 0.8%). The CIR Expert Panel recognized that in-
- And in the conclusion:
CONCLUSION
The CIR Expert Panel concluded that Methylparaben, Ethylparaben, Propylparaben, Isopropylparaben, Butylparaben, Isobutylparaben, and Benzylparaben are safe as cosmetic ingredients in the practices of use and use concentrations described in this safety assessment.

And you will see this for the Tentative report of 2019:

CONCLUSION

The CIR Expert Panel concluded that the following 20 of 21 parabens are safe in cosmetics in the present practices of use and concentration described in the safety assessment.

Butylparaben	Potassium Ethylparaben*	Sodium Isobutylparaben
Calcium Paraben*	Potassium Methylparaben*	Sodium Isopropylparaben*
Ethylparaben	Potassium Paraben*	Sodium Paraben*
Isobutylparaben	Potassium Propylparaben*	Sodium Methylparaben
Isopropylparaben	Propylparaben	Sodium Propylparaben
Methylparaben	Sodium Butylparaben	4-Hydroxybenzoic Acid*
Potassium Butylparaben*	Sodium Ethylparaben	

**Not reported to be in current use. Were ingredients in this group not in current use to be used in the future, the expectation is that it would be used in product categories and at concentrations comparable to others in this group.*

The CIR Expert Panel also concluded that the available data are insufficient to make a determination that Benzylparaben is safe under the intended conditions of use in cosmetic formulations. *(This ingredient is not reported to be in current use.)*

These reports are very extensive and compile the results of multiple animal and human studies about the use of these ingredients. While we don't conduct cosmetic testing on animals anymore, and haven't for some time, there is a lot of historical data that gets drawn on, and medical testing that still gets conducted that can also be used to determine the safety of cosmetics (since they have lower absorption than medicinal agents). If you are ever left wondering how they came to their conclusions or if they have used a publicized report in their determinations, you can review the references, tables and full report to find out how they have drawn their conclusions. If you don't need the background information, then the conclusion sections summarise their findings easily for you.

From this information, we can determine:

- A limit of 0.4% from any one paraben or combined input of 0.8% parabens from approved sources is considered safe when used in cosmetics, even when daily cumulative totals have been considered (you can read this by going back through the data in the report) AND
- There are only 11 of 21 parabens used in cosmetics today, all of which are considered safe when used within these reported limits by the CIR.

What if there is no CIR review for an ingredient? The CIR focuses on materials of concern to consumers to determine safety. If they don't have a review then:

- it may not be allowed in cosmetics anyway or
- it is not a safety concern to them, so
- review the other sites to see if they have conducted review on safety.

Find out the truth!

Watch the following videos, which provide an overview of cosmetic ingredient safety and cosmetic absorption by the skin.

- How safe are cosmetics: <https://youtu.be/VTVGCTrgUHA>
- Cosmetic absorption by the skin: <https://youtu.be/LKiZtYffteE>

3. Formulating mild products

Cosmetics and personal care products are, fundamentally, mixtures of various chemicals. Whether natural or synthetic, chemicals are composed of different 'functional' groups, which define the nature and activity of that substance.

It is not suitable to generalise about the safety of an ingredient based on its 100% concentration as noted in its SDS. In order for a safety assessment to be considered accurate, its safety must be considered based on its use, concentration and combination of other ingredients within a finished product.

It is important to note that a lot of consumers misinterpret irritations for allergies. While both present with redness, itching and even pustules, they are very different reactions.

Irritations can happen on first and subsequent exposures to a specific chemical, combination of chemicals, extremes of pH or other factors – including seasonal/climate changes, age and skin type. They tend to be very localized (i.e. where the product was applied; they don't spread far) can be soothed by cold water, ice, soothing gels or creams and will go away on their own without needing treatment. They will generally happen when a person is exposed to that chemical, combination of chemicals, pH or other factors again, in a similar localized way and will again go away on their own over time. Think of someone with hayfever – they will react seasonally, and it is generally manageable.

Allergies involve the immune system and happen on second and subsequent exposure to specific chemical/s; not usually the first exposure. Allergies will involve a more diffuse spreading of the redness/swelling/itching or pustules – remember, irritations stay very much in the local area of application. An allergic reaction will happen EVERY TIME from the second exposure to the substance, and usually GET WORSE every time – spread further, be more intense – each time someone is exposed to the allergy. Allergies DO NOT GO AWAY on their own – they usually require anti-histamines to resolve after seeing a pharmacist or doctor. Allergies are far more serious and allergy tests should be conducted with a dermatologist to discover the allergen; and then the chemical that is causing the allergy must be avoided. That is why truthful ingredient lists are so important. Think of someone with a nut allergy – even the tiniest exposure to nuts can be life threatening because of ingestion. Because cosmetics are applied externally, allergies are not life threatening, but the reaction on their skin can be severe and needs medication (anti-histamines) to subside.

Natural ingredients can cause irritations and allergies just as much (sometimes more so) than synthetic ingredients. It is incorrect to assume natural means safe and with out harm. Every ingredient must be considered in light of its available safety information. Essential oils are full of known allergens just like perfumes can be – unlike essential oils, however, some perfumes can be created free of allergens. The point here is never make assumptions based on whether a material is natural or not – ALL materials, natural or synthetic, are chemicals, and need to be considered as part of a formulation, and in light of available safety and allergen information.

3.1 General safety considerations

Studies comparing different cosmetics have shown that how, where and how often the product is used can indicate the likelihood of a product to cause irritation. Formula specific, it is the concentration of certain key ingredients, both alone and when considered in combination with others in the formula, (e.g. a complex of different sunscreen agents in a high protection sunscreen product), that is of most importance.

Allergies will happen if a person has an intolerant immune system to a specific chemical in sometimes even tiny amounts.

General considerations for the safety of a product include:

- **degree of skin penetration** – the more a product can penetrate the skin, the more likely any reactive ingredients present are to cause a reaction in individuals. This can be determined using laboratory (in vitro) testing.
- **type of formula** – is it the type of product that has a high irritant or safety risk profile?
 - for example, is it soap (high pH – irritating), OR
 - does it contain essential oils, perfume or hair dye (all contain known allergens)? (These ingredients may also cause irritations).
- **concentration of potentially irritant or allergenic ingredients** – consider the concentration present of those ingredients most likely to cause irritations or allergens (more detail on this is provided in the following notes).
- **frequency and duration of contact** – how long the product is exposed to the skin and how often will affect its likely irritant potential.
 - products left on the skin and used on large areas of the body are more likely to cause an irritant reaction than those which are used in a small area only and/or washed off soon after application.
 - allergens only need tiny amounts of the allergen present even for very short times to set off the immune reaction in someone who has an allergy to that substance.
- **sensitive areas of the body** - mucous membranes (lips, around the nose and eyes and around uro-genital areas) are particularly sensitive areas of the body; and the use of certain ingredients in these areas is contra-indicated or restricted by quantity. Formulators of toothpastes, for example, need to carefully consider the ingredients they use because of the area of application.
- **products for children and babies** - formulations to be used on children and babies, because of their large surface area to body weight ratio, must also be carefully considered, and made more mild where possible to avoid local irritations.
- **clear directions for use** - directions for use, which ultimately helps control the use of the product by the consumer, must be clear, concise and provide for the safe and effective use of each cosmetic product. While the cosmetic formulator is responsible for ensuring the ingredients they choose are suitable for the application in which they are to be used, others in the company can be involved in the safety assessment process by ensuring clear directions for use, flow restrictions or other measures if there are potentially irritating ingredients.

3.2 Common irritant ingredients

Irritant reactions can include symptoms of redness, swelling and itching. These will occur on each exposure to the irritant ingredient (or product) and will subside over time by discontinuing use of that product and by using a suitable moisturising agent. They do not involve the immune response and do not progressively worsen in severity like allergic reactions can.

While the following list of ingredients is provided as an example of common irritant ingredients, it does not mean that the use of these ingredients will in all cases cause irritation. This list is provided so you are aware of the types of ingredients that should be carefully considered, and limited in use, when preparing a cosmetic formula. The use of anti-irritant ingredients and formulation principles (provided in the following section) will also help reduce any potential irritancy these ingredients may otherwise cause. Careful and compliant use of these ingredients should yield finished products that are perfectly safe for normal use.

Personal care ingredients most likely to cause an irritant reaction are:

- **preservatives** - certain preservatives may be chosen over others because of their low-irritancy profile or safety data, but all preservatives should be used in the minimum concentration necessary to achieve effective preservation of the product. Adding extra preservative, beyond what is needed, should be avoided, to reduce the irritancy profile of the finished product. Careful selection should be made when deciding on preservatives for baby products and those used around the mucous membranes and eyes. An ineffectively preserved product can be potentially more hazardous to health than an irritant preservative, so using just the right amount of preservative is imperative. As there is such a wide range of preservatives to choose from when formulating cosmetic and personal care products, it is best to ask the raw material supplier for safety profiles of the preservative in question to evaluate its suitability if making a product for use around mucous membranes or on babies. When comparing and selecting preservatives, be sure to assess the safety data specific to the proposed usage concentration.
- **fragrances and essential oils** – products used on the face should contain less fragrance and essential oils than those used on the body; or alternatively no fragrance at all. Fragrances and essential oils should be carefully selected to ensure they have low irritancy profiles while also considering the skin coverage and type of person the product will be used on. For example, baby lotions which get applied over most of the baby's body should contain far less fragrance/essential oils than a product applied to the legs of a normal adult. Recommended usage rates for fragrances and essential oils is in the chapter on ingredient selection.
- **colours** – iron oxides are generally too large to penetrate the skin; however dyes with lower molecular weights (such as FD&C and D&C colourants) can penetrate the upper layers of the epidermis and cause irritation and allergens in susceptible people. When developing and marketing low irritant products, the use of FD&C and D&C colours should be avoided. In some colour cosmetics, however, their use cannot be avoided; so they are best incorporated into products with a low irritancy base.
- **UV filters** – chemical (organic) sunscreens (butyl methoxydibenzoylmethane, benzophenone-3 and octyl methoxycinnamate to name a few) act by absorbing UV light and have been associated with skin irritation. Physical (inorganic) sunscreens (such as zinc oxide and titanium dioxide) reflect UV light and have a much lower incidence of irritation. In order to get high SPF and broad spectrum ratings, a combination of sunscreen agents (both organic and inorganic) can be used which will reduce the

likelihood of potential irritancy in the finished product. Sunscreen products usually also contain relatively high contents of fragrance to mask their base odour, so this could be a contributing factor to the irritancy profile. The base used to carry the UV filter, for example be it a gel or cream, should also contain low irritant ingredients to reduce the irritancy profile of sunscreen agents and products.

- **surfactants** – cationic (e.g. cetrimonium chloride) and anionic surfactants (e.g. sodium lauryl sulfate) are by far the most irritating of all surfactant products. They are often combined in formulations with amphoteric (e.g. cocamidopropyl betaine) and non-ionic surfactants (e.g. decyl glucoside or cocamide MEA), which help to reduce the overall irritancy profile of the finished product.
- **tanning, whitening and skin peeling agents** – tanning and whitening products alter the skin cell's natural colouring process, and by absorption and activation of the chemical substituent, can create drying and irritancy. Skin peeling agents, such as alpha hydroxy acids, act to remove the surface layers of skin cells revealing fresher skin beneath. At the same time, however, some dehydration can occur, and irritation results. The acidic pH of many of these products can also further dehydrate the skin and increase irritation.

3.3 Anti-irritant formulation principles

Anti-irritants act to calm and soothe the skin, and often assist in resolving redness and irritation. Cosmetic products are not able to make the claims of calming or soothing, however the addition of anti-irritant ingredients can greatly reduce the overall irritancy profile of a product and render it safer and more pleasant to use. Specific steps that can be taken, alone or in combination, to increase the mildness of products include:

- **skin friendly pH** - the pH of the product should be around the pH of the skin (5.5). Highly acidic (alpha-hydroxy acid products; pH of around 3.5) and highly alkaline (traditional soaps; pH of around 9.5) should not be marketed to people with sensitive skin needs.
- **high lipid content** – by capturing moisture levels within the skin, conditioning the surface of the skin and providing a barrier to moisture loss, products with a high lipid base content can help reduce irritation reactions. Barrier creams, which have a high lipid content, can be applied to skin before exposure to harsh chemicals, providing moisture protection and decreased chemical penetration.
- **re-hydrate the skin** – humectants can hold water within the skin and also attract moisture from the surrounding atmosphere; helping it to stay plump, moist, and resist dehydration.
- **combinations of surfactant ingredients** – not only does combining anionic (e.g. sodium lauryl sulphate, ammonium lauryl sulphate), amphoteric (e.g. cocamidopropyl betaine) and non-ionic surfactants (e.g. cocamide MEA, decyl glucoside) boost the foaming and cleaning capacity of a surfactant product, but the addition of amphoterics and non-ionics can also greatly reduce the irritancy profile of the anionic component.
- **include anti-irritant ingredients** – natural based ingredients, such as algae, allantoin, aloe vera, alpha-bisabolol and chamomile can act to soothe the skin and reduce irritation when used in sufficient quantities. Care must be taken not to make therapeutic soothing claims when marketing a cosmetic product including these ingredients.

3.4 Allergens in cosmetics

Due to the complex nature of cosmetics, which may quite reasonably contain between 6-20 different ingredients in any one product (and sometimes more); it can be very hard to determine the specific allergy causing component. True allergy detection is conducted by trained dermatologists using skin patch tests.

Although many and varied, the most common allergens are:

- **fragrances** – common allergens include cinnamal, isoeugenol, limonene and oak moss
- **preservatives** – include formaldehyde releasers, methylisothiazolinone and methylchloroisothiazolinone
- **hair dyes** – oxidative hair dyes such as resorcinol are known allergens
- **highly ‘active’ ingredients** – those ingredients inducing the activity of the product, such as oxidising agents in oxidative hair colourants; resins and acrylates in false nail products; and some chemical (organic) UV absorbers.

3.5 Hypoallergenic products

Marketed to be the safest possible for all skin types, hypoallergenic products are formulated to reduce allergenic potential by avoiding ALL known allergens. Ways to achieve a hypoallergenic product include:

- **avoid using fragrances and essential oils** – many products labeled ‘hypoallergenic’ are fragrance free and free of essential oils.
- **carefully selecting preservatives** – while avoiding the use of preservatives cannot be achieved in a majority of cases, the use of preservatives with low allergenic profiles and in the lowest possible concentrations would be the next best step.
- **avoid oxidative products**
- **limit the number of ingredients used** – allergens can exist to more than just the common preservatives and fragrances; and many seemingly gentle ingredients can still cause allergic reactions in some consumers. By reducing the number of different ingredients used in a product, it reduces the likelihood of an unexpected allergic reaction, and make it easier to target the offending agent if a reaction does occur.

Conducting safety testing is best left to the professionals; suffice to say for the beginner, make sure you use potentially irritating and allergenic ingredients within limits, include anti-irritant formulating principles in your developments and provide clear directions on your packaging to ensure safe use.

To be marketed hypoallergenic, the product should be free of all known allergens. Be careful not to propose this claim for your product unless you have thoroughly investigated all ingredients, especially the preservatives, actives and fragrances/essential oils it contains.

Here is the technical guidance from the EU for ‘hypoallergenic claims’ to comply:

ANNEX IV

Hypoallergenic claim

The claim "hypoallergenic" can only be used in cases, where the cosmetic product has been designed to minimize its allergenic potential. The responsible person should have evidence to support the claim by verifying and confirming a very low allergenic potential of the product through scientifically robust and statistically reliable data (for example reviewing post-marketing surveillance data, etc.). This assessment should be updated continuously in light of new data.

If a cosmetic product claims to be hypoallergenic, the presence of known allergens or allergen precursors should be totally avoided, in particular of substances or mixtures:

- identified as sensitizers by the SCCS or former committees assessing the safety of cosmetic ingredients;
- identified as skin sensitizers by other official risk assessment committees;
- falling under the classification of skin sensitizers of category 1, sub-category 1A or sub-category 1B, on the basis of new criteria set by the CLP Regulation¹⁸;
- identified by the company on the basis of the assessment of consumer complaints;
- generally recognized as sensitizers in scientific literature; or
- for which relevant data on their sensitizing potential are missing.

The use of the claim "hypoallergenic" does not guarantee a complete absence of risk of an allergic reaction and the product should not give the impression that it does.

Regarding the use of human data in risk assessment of skin sensitisation, including ethical aspects, reference should be made to the SCCS “Memorandum on use of Human Data in risk assessment of skin sensitisation”, SCCS/1567/15, 15 December 2015.

The companies should consider whether consumers, in the respective country, understand the claim "hypoallergenic". If necessary, further information or clarification regarding its meaning should be made available.

3.6 Comedogens in personal care

Comedogenicity is the ability of some ingredients to cause or exacerbate blackheads and acne lesions. Also commonly referred to as acnegenicity and pustulogenicity. The comedogenicity of a product is not an irritant or allergen reaction; but depends on the likelihood of a product or ingredient to cause or aggravate existing acne lesions or cause hyperkeratinous impactions to form in sebaceous follicles, causing blackheads or pustules to develop. Pustulogenicity results in inflamed pustules within a short time after using the offending product. Individual ingredients used in a product formulation may be non-comedogenic but when used in combination with each other and/or other components within the formulation, they may then become comedogenic. Similarly, a material which may be

comedogenic when applied neat on the skin may not cause comedogens when used in diluted amounts combined with other ingredients in a finished product formula. This applies to both synthetic and natural ingredients. Generalisations and patterns of comedogenicity cannot often be predicted and is a good example of why product evaluation is important before releasing a product into the marketplace.

Find out the truth!

A lot of misinformation exists about ‘comedogenic’ ingredients in personal care. A lot of consumers think silicones, for example, are comedogenic when they are not; and a lot of consumers believe natural ingredients are safer and better for the skin, when they can be comedogens and should never be assumed as ‘safe’. Their use should be evaluated just like every other cosmetic ingredient.

Watch this video summary on irritants, allergens and comedogens in personal care:

<https://youtu.be/YPwhFzxZHC8>

Chapter 6: Ingredient lists and claims

It is essential that you provide a correct ingredient list on your packaging and prepare only cosmetic products. The information provided here is intended for the cosmetic chemist beginner; if you are intending to sell your products beyond friends and family then it is recommended that you take more advanced studies to ensure full regulatory compliance.

1. Cosmetic products

The way different personal care products are viewed differs around the world. While it is easy to understand that a simple body lotion or body wash is considered a cosmetic product, it becomes harder to determine how a regulatory authority will view more advanced products or products with highly active ingredients or quasi-therapeutic properties. As the personal care industry evolves, there are more and more products that fall at the interface between cosmetic and therapeutic goods. For example, is an anti-dandruff shampoo cleansing the hair or changing a physiological function of the scalp? Is a foundation that contains SPF colouring the skin or protecting it from UV damage?

It is important that your formulation complies with what your local country determines as 'cosmetic'. Use the table provided below as a guide to help you understand how different products are viewed in various parts of the world, and whether you can develop a product as a cosmetic in that region.

Product	AUS	EU	USA	JAPAN
Sunscreen	Cosmetic – secondary function e.g moisturiser with SPF or foundation with SPF Therapeutic – primary function	Cosmetic	Drug	Cosmetic
Anti-bacterial	Cosmetic	Cosmetic	Drug	Quasi-drug
Anti-acne	Cosmetic	Cosmetic	Drug	Quasi-drug
Anti-perspirant	Cosmetic	Cosmetic	Drug	Quasi-drug
Hair dye	Cosmetic	Cosmetic	Cosmetic	Quasi-drug

Note: in the US, soap products are regulated by the Consumer Product Safety Commission (CPSC) and not the FDA; so are not considered cosmetics under the US definition. Soap products are considered to be those that are made using traditional saponification methods. If you are planning to create traditionally saponified 'soap' products in the US then you should refer to the CPSC.

2. Ingredient lists

The requirements for ingredients lists are amazingly similar around the world. This makes it relatively easy, once you know how, to ensure multi-country compliance if you carefully prepare your ingredient list.

Ingredients must be listed:

- using their International Nomenclature Cosmetic Ingredient (INCI) name – tips on how to search for the correct INCI name are provided in the next section
- on the container of the product, or where the product is not in a container, on the product itself. It must be available for a consumer to read at the point of sale, without having to open a box or purchase the product and open it first
- in descending order by volume or mass:
 - ingredients (except colour additives) present in concentrations of 1 per cent or more must be listed in descending order.
 - ingredients (except colour additives) present in concentrations of less than 1 per cent may be listed in any order.
 - colour additives may be listed in any order, regardless of their % input.
- if the container or product cannot meet these requirements because of its size, shape or nature, then the ingredients list must be provided in another way so as to inform a consumer of the ingredients in that product. For example, swing tags could be connected to a product; brochures could be provided with the product; the product could be attached to a display card; or an information card could be placed next to the product with the ingredients list.
- an ingredients list may include a reference to a colour additive that is not present so long as that additive is:
 - added for the purposes of colour matching to some batches and not others (for example, lipsticks or nail polishes)
 - used in one or more (but not all) of a range of cosmetic products (for example, eye shadows)
 - listed in the ingredients panel using the words ‘may contain (name of the additive)’ OR the symbol ‘+/- (name of the additive)’
- flavour/s must be shown using the word ‘flavour’, ‘flavours’, ‘aroma’, ‘aromas’ or the ingredients in the flavour/s.
- fragrance/s must be shown using the words ‘fragrance’, ‘fragrances’, ‘parfum’, ‘parfums’, or the ingredients in the fragrance/s.
- an incidental ingredient does not need to be included in the ingredients list in the AU or USA, but must be listed in ASEAN, South Africa, EU and UK.
 - an incidental ingredient is one that has no technical or functional effect in the product and is present at insignificant levels in the product.
 - if in doubt, check with your supplier whether an ingredient is an incidental ingredient. They should be able to provide you with information as to the correct INCI names of all ingredients used in the product; and approximate amounts, so you can prepare your own ingredients panel.
 - note: any ingredient, even if present in very minute amounts, that has a technical or functional effect in the product must be listed as an ingredient.
- the ingredients list must be prominently shown and clearly legible.

- there may also be a list of ingredients present in another language. Any information present in another language should not contradict that information that is present in English.
- for EU ingredient lists, allergens present in products must be listed when present at certain levels. These are covered in more detail in the section on fragrances and essential oils.
- for USA ingredient lists, water should be listed as Water; witch hazel extract should be listed as Witch Hazel Extract; and the names of sunscreen agents should be checked to ensure they are listed using their US approved names for drug products which differ to standard INCI names.
- for China, ingredient lists will need local translation and some changes may be required; it is best to refer to a regulatory agent in China with your intended list for checking before exporting to this region.

These labeling requirements do not apply to cosmetic products that are:

- **free samples** – for example, samples received in the mail or in magazines, hotelier in-room free products or samples given out in a shop or similar environment.
- **testers** – for example, testers supplied at a retail outlet for consumers to trial the product before purchasing a correctly labeled item.

When preparing your ingredients list, here are a couple of common mistakes you should be careful to avoid – and they have to do with composition (taught in the next section):

- make sure to find out the individual composition of ingredients where they are provided as blend. For example, cetearyl alcohol and ceteareth-20 is a common emulsifier blend that is available in varying proportions from different suppliers. This should not be listed in an ingredient list as cetearyl alcohol (and) ceteareth-20 but instead, the individual proportions of this blend should be calculated and listed in their corresponding positions in the ingredient list. For example, if the cetearyl alcohol was present at 65% and the ceteareth-20 was present at 35% of the blend; and this blended ingredient was present at 5% in a formulation, then the cetearyl alcohol should be positioned at 3.25% and the ceteareth-20 at 1.75% in the finished product ingredient list
- for ingredients provided as dilutions (eg cocamidopropyl betaine is often provided as a 30% dilution in water with some incidental preservatives), they should be listed based on their active content. For example, if there was 10% of a 30% cocamidopropyl betaine solution added in a formulation, then there is actually 3% of cocamidopropyl betaine and it should be listed accordingly in the ingredient list
- this information can often be found by checking the raw material SDS or contacting the supplier for composition information. They will not often give you the exact % input of each ingredient but would more commonly give you a % range – take the mid point of this range and ensure all ingredients make up 100% of the composition and use this to determine the correct position of each ingredient in your finished product ingredient list

2.1 Ingredient composition

Many ingredients contain more than one component. For example:

- blended emulsifying waxes like cetearyl alcohol and ceteareth-20
- herbal extracts with glycerin present,
- blended preservative materials, like combinations of phenoxyethanol with ethylhexylglycerin

We often need to determine the relative amount of components present, for 2 reasons:

- when preparing an ingredient list, we need to find out how much of each component is present, and then list SEPARATELY on the ingredient list, based on the exact amount of each component.
- when formulating with a material, you often need to calculate how much of an 'active' material is present. For example, when formulating with surfactant materials, which often come as diluted raw materials, you need to calculate how much actual surfactant is present compared to the water portion, to determine how much of the blended material to add in your formula.

Suppliers won't normally provide you with 'exact' amounts of each component, but are required to provide you with 'ranges' that will enable you to make correct compositional calculations for either of these purposes. Its essential that you can calculate composition correctly, so we're going to practice that now.

When using materials that are diluted or a 'blend' of different materials, you will need to be able to calculate the exact composition of each part of the blend, to list each material out correctly in an ingredient list. While the rules for preparing an ingredient list is the topic of another unit, being able to calculate the composition of blended or diluted materials is an important part of your learning for this unit. We'll take a look at some examples so this makes more sense.

Let's start with a material we have already looked at: Sodium laureth sulfate 70% active.

Step 1: Determine all component input %:

- let's say on the supplier website, they have listed it as sodium laureth sulfate (70%) or in their MSDS, they tell you it is aqua 30%, sodium laureth sulfate 70%.

Step 2: Determine the % present in the finished product:

- in our example, let's say there is 20% sodium laureth sulfate (70%) in the finished product. This means there would be:

20 x 70% sodium laureth sulfate = 14.0% sodium laureth sulfate present in the finished product

and

20 x 30% water = 6.0% water present as part of this material in the finished product

It may be easier for you to calculate it out like this:

Sodium laureth sulfate (70%) paste		
Component	% present in material	% present when used at 20% in a finished product
Sodium laureth sulfate	70.0	20 x 70% = 14.0%
Water	30.0	20 x 30% = 6.0%

Now, let's look at a dual-component blend. Refer to the following composition information to follow our calculations for a material called Arlacel 1689. This is a good example of how

ambiguous supplier information can sometimes be; and how you need to determine calculations of input from the information supplied.

In this example, you can see that the components of this material are listed with inputs at between 25-50%. Normally you would take the mid-point of this range, i.e. 37.5%; but if you did this for both materials you would only get a total of 75% for the blend, where in fact these are the only two components present and must therefore make up 100% of the material! In this circumstance (and you will see it happen quite often where composition information does not add up perfectly to 100%), you need to make an appropriate % input judgement for all materials, from within the ranges given, to ensure the full product composition always equals 100%. We'll show you a more complicated example of how we apply this in a final example; but for now, use 50% input of both materials to reach a total component input of 100%.

Percentage Composition Statement for Arlacel 1689 (CBR0302)

Component (INCI Name)	Content (FDA Code)
Sorbitan Oleate	B
Polyglyceryl – 3 Polyricinoleate	B

Where FDA Codes:

A	> 50 %
B	25-50 %
C	10-25 %
D	5-10 %
E	1-5 %
F	0.1-1 %
G	< 0.1 %

Step 1: Determine all component input %:

- 50% sorbitan oleate and 50% polyglyceryl-3 polyricinoleate.

Step 2: Determine the % present in the finished product:

- for our example, let's say there is 5% Arlacel 1689 used in the finished product formulation.

5 x 50% sorbitan oleate = 2.5% sorbitan oleate present in the finished product
and

5 x 50% polyglyceryl-3 polyricinoleate = 2.5% polyglyceryl-3 polyricinoleate present as part of this material in the finished product

It may be easier for you to calculate this out like this:

Arlacel 1689		
Component	% present in material	% present when used at 5% in a finished product
Sorbitan Oleate	50.0	5 x 50% = 2.5%
Polyglyceryl-3 Polyricinoleate	50.0	5 x 50% = 2.5%

2.2 INCI names and CAS numbers

So how can you know the correct name for your ingredient? You can conduct a CosIng search to find it's 'INCI' name, and make sure you use that. 'INCI' stands for International Nomenclature of Cosmetic Ingredients and is the name that should be used to identify the chemical on the product label (in most countries). All too often we see incorrect spelling of ingredients because they aren't cross referenced with the CosIng database properly – so now you know where to check!

Chemicals may be referred to by their:

- **INCI name** - this is the only name that should be listed on the product label in most countries. In our search example, this was cetearyl alcohol.
- **a 'common' name** - which can be quite deceiving or in some cases, incorrect.
- **chemical nomenclature** – this can be confusing for those who don't have a strong chemistry background, and in any case, is not suitable for a product label.
- **trade name** – the name a supplier uses to describe a specific grade of the material they are selling.
- **botanical or latin name** – if a plant substance e.g. plant oils, extracts or essential oils

OR

- **their CAS number** – this is the best way to search for a material as it is very specific and unique

One of the most important elements of these search results is the **Chemical Abstracts Service number (CAS number)**. This is a numerical identifier for the chemical substance, and it can be used to search a variety of regulatory databases and also be used to cross check documentation of substances where other names may be used or differ to the INCI name. The CAS number is a very reliable way to search for and/or identify a chemical substance, regardless of whether someone is calling it by its chemical, INCI, common or molecular name. Sometimes you may see:

- more than one CAS number – a chemical can have more than one CAS number but a CAS number never relates to more than one chemical. In our search example, cetearyl alcohol has the CAS numbers 67762-27-0 AND 8005-44-5. Using either CAS number to refer to, or search for, cetearyl alcohol is correct. But, if you use either of these numbers, you'll never get a different chemical. You'll only ever get cetearyl alcohol as a search result using either of these numbers.
- EC number – this refers to a chemicals European Inventory of Existing Commercial Chemical Substances (EINECS) number. This is a historical number used on

chemicals between 1 January 1971 – 18 September 1981. We don't need to use these numbers so you can largely ignore this entry, and focus on the CAS number/s instead.

I'll show you a simple search so you can see how to find the correct CAS numbers for materials. We'll use the example of a simple search for a substance known as cetearyl alcohol, commonly used in various cosmetic formulas.

A link for the CosIng database is provided here:

<http://ec.europa.eu/consumers/cosmetics/cosing/> The link to this site is updated on a regular basis; so the link provided in these notes may not work from time to time. You can also find this site by entering 'cosing europa' into an internet search bar.

It looks like this:

The screenshot shows the CosIng database homepage. At the top is a blue header with the text "Internal Market, Industry, Entrepreneurship and SMEs". Below this is a navigation bar with tabs: "Single Market and Standards", "Industry", "Entrepreneurship and SMEs", "Access to finance for SMEs", and "Sectors". The "Sectors" tab is selected. On the left is a sidebar with a "CosIng" section containing links for "Search", "Reference data", and "User manual". The "Search" link is highlighted. Below this is a "Cosmetics - links" section with "News" and "Events". The main content area is titled "CosIng" and contains text explaining the database's purpose, listing relevant regulations and decisions, and providing a search link. The search link is "Search in the CosIng database".

Click on Search in the CosIng Database to start your search. This will take you to a page that looks like this:

The screenshot shows the "Simple Search" page of the CosIng database. The page has a sidebar on the left with a "CosIng" section containing links for "Search", "Reference data", and "User manual". The "Search" link is highlighted. Below this is a "Cosmetics - links" section with "News", "Events", "Contracts and grants", and "Public consultations". The main content area is titled "Simple Search" and contains text explaining the search criteria. It includes a search form with fields for "Name" (with a help icon), "CAS/EC #", "Scope" (a dropdown menu set to "All"), and "Status" (a dropdown menu set to "Active"). There is a "Search" button. Below the search form is a link to "Advanced search".

When you are on the CosIng site:

1. enter the INCI name or CAS number of your chemical in the empty search bar that is provided toward the bottom of the page and hit enter or the search bar

2. wait for the screen to refresh with a list of choices and select the most appropriate entry for your chemical/substance - this will take you to a page providing details of that chemical

#	INCI Name/Substance Name	CAS No.	EC No.	Restriction/Annex/Ref #
1.	CETEARYL ALCOHOL	67762-27-0 / 8005-44-5	267-008-6 / -	
2.	CETEARYL OLIVATE			
3.	CETEARYL PALMATE			

3. Cross check the CAS number with the MSDS provided by the supplier for that material to make sure they are definitely the same material. If the CAS number is a match, you will have found your INCI!

Sometimes you'll see more than one CAS number – why? Sometimes:

- chemicals exist as 'isomers'. Isomers are the same chemical, but in a different form, similar to how you have a left and right hand – they're both hands, but they're structurally a bit different (try putting your left hand on top of your right hand and you'll see the thumb make them structurally different, but mirror images). Isomers get allocated different CAS numbers.
- an application for a CAS number may be done simultaneously, meaning 2 different applications get allocated 2 different numbers for the same chemical.
- a chemical is composed of certain elements in varying proportions and different CAS numbers may get allocated to the varying proportions, even though one INCI name is sufficient to accurately describe the substance.

You don't really need to know WHY a substance has more than one CAS number, but you may need to use all the CAS numbers for a chemical when you conduct regulatory searches, for example. Luckily, CosIng provides all of this detail for you.

What did our search for Cetearyl Alcohol show us?

In the search result for cetearyl alcohol from CosIng, we not only found out the roles it could play, we also found out:

- the **INCI name**, and correct spelling, is cetearyl alcohol. This can be listed on a label as Cetearyl Alcohol or cetearyl alcohol or CETEARYL ALCOHOL; what is most important is that the spelling is right!
- **chemical nomenclature** - in our search example, this was 'alcohols, C16-18'. In other words, the INCI name applies to a broad category of fatty alcohols that fit this chemical nomenclature. This should NOT be used on the product label or when ordering the material.
- **CAS number** – this material has 2 CAS numbers listed: 67762-27-0 and 8005-44-5.

What about the **trade name**?

Look in Appendix B now, and you'll find a manufacturing procedure for Lanette O. At the end of the document you see the material referred to as 'Lanette O' with (cetearyl alcohol) in brackets. Lanette O is the **trade name** of this supplier's cetearyl alcohol. This means if I wanted to order this material from this supplier, I would place an order for Lanette O – it is THEIR specific grade of cetearyl alcohol, and may differ from another suppliers version of cetearyl alcohol. They may also offer more than one grade of cetearyl alcohol, so using a trade name on my formula helps make sure that this specific material gets ordered and used in my product. If a different grade of cetearyl alcohol were used, it could have a different result in my finished product.

This is a really important point to remember,
and is why, when formulas get written up professionally,
they are written up using trade names.

We're providing you with a lot of formulas using common names to make it less daunting for you to get formulating – but, different suppliers (even small suppliers) may call different materials similar names, for example, the emulsifying wax from one supplier may be very different to what another small supplier also calls emulsifying wax. You'll need to start checking documentation as you start sourcing more materials, and learn more professionally if you intend to expand the different materials you want to use.

If you are studying a formulation program with us, you will learn a lot more on this in coming units as well as get access to the suppliers and trade names of a few thousand different materials to make your job of formulating easier, and more professional.

2.3 INCI names for botanical materials

If you are trying to find the INCI name for a botanical substance (vegetable oil, essential oil and/or plant extract), you will need to know the Latin name before searching CosIng, as well as the plant part and form.

- to find the Latin name, perform an internet search by typing in the plant name and 'Latin name'; for example, 'mango Latin name'; you should see that *Mangifera Indica* comes back on multiple sites.
- once you have the Latin name, you will need to refer to a CofA, or may need to go back to the supplier, to find out the plant preparation. For example: is it the fruit, the pulp, the extract or the butter? In this example, let's say it is the butter.
- once you have this information, perform a search on CosIng using the Latin name, but only a small part of it. For example, we would perform the search in this example with the search term, 'Mangifera'. Try this search and you will see multiple results come back. Scroll through the results until you find one that best describes the substance, and click on that entry to read the description. If this matches the plant and its preparation, as advised on a CofA, SDS or technical data sheet (from the supplier) then use this name. In this example, the best INCI match is *Mangifera Indica* Seed Butter.
- if you want to add the common name, you would do this after the Latin name but before the plant part, for example, *Mangifera Indica* (Mango) Seed Butter.

Example ingredient list

Below is an example of how you would create an ingredient list using a formulation; take particular note of how the 'blended' ingredients have been split up based on their actual individual input %.

To 100	Purified water
3.0	Glycerin
3.0	Mango butter
1.5	Shea butter
1.6	Beeswax
6.4	Cosmowax D (65% cetearyl alcohol, 35% ceteareth-20)
1.8	Stearic acid
7.4	Coconut oil
2.5	Grapeseed oil
0.3	Kakadu plum extract (90% glycerin, 10% kakadu plum extract)
0.2	Xanthan gum
0.5	Vitamin E
0.4	Fragrance
0.2	Germall plus (diazolidinyl urea, iodopropynyl butylcarbamate)

Ingredients: Aqua (water), *Cocos nucifera* (coconut) oil, cetearyl alcohol, glycerin, *Mangifera indica* (mango) seed oil, *Vitis vinifera* (grape) seed oil, ceteareth-20, stearic acid, *Cera alba* (beeswax), *Butyrospermum parkii* (shea) butter, tocopherol (vitamin E), *Terminalia ferdinandiana* (Kakadu plum) fruit extract, xanthan gum, parfum (fragrance), diazolidinyl urea, iodopropynyl butylcarbamate.

Watch how it's done!

Here is an overview video on how to get your ingredient list right:

<https://youtu.be/2EHtaFQVe58>

3. Claims

The personal care industry is one of the most competitive industries around – there are several large, very successful brands and literally hundreds of smaller brands trying to grow and enter this larger market every year. To attract a consumer to a product, and especially to try and get a consumer to change their purchasing patterns, any cosmetic product needs to have a good ‘story’ and be priced right to attract their particular target market. To keep that consumer, the product needs to deliver on its promises and actually do what it claims to do within a relatively short time frame. If the story used to promote a product is not effective, the first purchase won’t happen. If the product doesn’t perform the way a consumer expects it to, it won’t get purchased again. When formulating products, therefore, you need to make sure you are using ingredients that will give the concept developer (and/or their marketing department) a good point of difference and marketing story AND ensure the product will perform the way it has promised to suit that target market. This brings us to two crucial elements you need to ensure the specialty ingredients you select can achieve: marketing claims and performance results.

Marketing claims specific to specialty ingredients:

- these go beyond the standard ‘natural’ or ‘exotic’ type claims attached to ingredients in standard personal care products, for example, beyond claims such as ‘contains moisturising shea butter’ or ‘exotic argan oil’.
- claims need to be much more direct for specialty products to support the higher price these products sell for in the market place; such as ‘reduces the appearance of wrinkles by up to 20% within 28 days’
- any marketing claims associated with a cosmetic ingredient or product:
 - must comply with cosmetic regulations:
 - claims must be restricted to appearance or odour based changes to the skin or hair; claims cannot be made about the physiological changes occurring within the skin to achieve those changes. For example:
 - whitening agents work to inhibit one or more of the pathways to melanin production, but you can’t mention anything about inhibiting melanin production, as that is a physiological change – your claims would instead be restricted to the visible/appearance based changes the use of the ingredient creates, such as ‘visibly lightens the skin by up to x% in x days’.
 - antioxidants work by neutralizing free radicals, but since neutralizing a free radical is a physiological function, this can’t be claimed. Therefore, antioxidants are restricted to input claims, such as, ‘contains antioxidants’ or ‘contains the antioxidant vitamin E’.
 - should be specific, with expected results over a stated timeframe, based on the evidence:

- if you are using the performance results of a raw material to support your marketing claims, then you need to make sure your claims are ingredient specific rather than for the product as a whole.
 - for example, ‘contains an active ingredient clinically proven to...’
 - some raw material suppliers will require you to use the trade name of their active ingredient to use the results they have obtained, such as, ‘contains [Tradename®], clinically proven to...’
 - you couldn’t make claims such as ‘this product is clinically proven to...’ unless you have actually tested the exact finished product formulation and obtained those results.
 - state the visible results expected and the time frame over which these changes will take to occur.
 - there is no point using a specialty ingredient to make standard type claims for a cosmetic product – specialty ingredients and products cost more to produce and sell at higher prices in the market place, so make sure you are selecting ingredients which will enable bold, compliant claims to be made.
 - standard type claims are, for example, ‘contains anti-aging actives.’
 - bold, compliant claims include appearance based changes with a statistically significant, numerical result with a stated number of days, for example, ‘clinically proven to reduce the appearance of wrinkles by x% within x days’.
 - stating a statistically significant result ensures consumers are informed properly; claims must not be misleading or deceptive or likely to mislead or deceive.
- must have evidence to support the claim:
 - the ingredient to achieve the results must be used in the finished product the same way as the test results were obtained.
 - for example, if the ingredient was used at 2% in a cream applied twice daily to obtain the results, you would need to use it at 2% in a cream also with directions to apply twice daily.
 - you could not use the evidence from a twice a day leave on product for a once a day wash off or once a week leave on product, for example.
 - all evidence must be on humans, preferably placebo controlled and be statistically significant in a group of at least 20 suitable individuals (in vivo).
 - evidence that is in vitro can help with your selection in terms of performance results but does not support marketing claims in actual humans- results obtained in vitro cannot be used to support ‘clinically proven’ type claims.
 - ex vivo results may be used if the results are:
 - based on the application of a test substance at the amount that would be used on humans in the way it would be used on humans, for example, used in a cream at 2% applied twice daily at a suitable quantity to sample size comparable to actual use on the face/body as appropriate AND
 - statistically significant over a suitable number of test samples and visible results are obtained.
 - for example, many ex vivo tests look at collagen and elastin synthesis – claims about stimulating collagen and elastin synthesis can’t be made as these are physiological changes to the underlying structures of the skin.
 - if the ex vivo tests show a statistically significant change to the visible effects the ingredient has on the skin, claims could be made, for

example, ‘improves the appearance of elasticity/suppleness by x% within x days’.

Performance results specific to specialty ingredients:

- performance results are based on the physiological function of the ingredient; that is, how it actually performs its functions within the skin.
- performance results should be considered on a scientific basis, and how that ingredient is being used in your formulation. Will you achieve the required penetration in your formulation to obtain the same activity?
- this includes consideration of the results of in vitro, ex vivo and small subject number in vivo tests, even though marketing claims can only usually be made on well designed, minimum 20 person, placebo controlled in vivo trials.
- performance results allow you to compare and select ingredients based on their actual physiological function and activity, but may not be suitable to use to support claims.

3.1 Misleading and deceptive conduct and free from claims

While the exact wording used by regulators to prohibit misleading and deceptive conduct differs around the world, the overarching principles, and message, does not. It is not legal to mislead or deceive your consumer into purchasing a product either through direct or implied claims or omissions of truth. Before we look at specific examples, here are some common mistruths companies fall into believing:

- just because another company breaks the rules, does not mean it is okay for your organization to repeat their mistake. If you see another company breaking the rules you should report them, otherwise you are not operating in a level playing field and they should be held accountable for non-compliance, otherwise it makes it harder for your company to market based on truth.
- regulators will hold your organization accountable for any misconduct regardless of what other companies are saying or doing – even if another company is breaking the law, your company will still be held accountable for their actions.
- linking your site to another site is not a way to make claims about ingredients or products that are not compliant. Regulators consider that any link you make from your website or product information is also advertising your product, whether it leads to a sale or not. This means that any information or claims from any sources that are linked from your website or product information must also comply with cosmetic regulations, or be removed from your links.
- it is not appropriate to imply harm from a cosmetic ingredient that is permitted in cosmetics in any amount. An example of where this has not been done appropriately is with the use of parabens – the use of parabens is strictly controlled by input and the amount that is permitted in cosmetics has been proven to be safe as used, so it is misleading to suggest that their use makes a product unsafe. There are strict regulations about the inputs of any ingredients of concern and Chemists and companies are responsible to ensure they stay within those limits – therefore cosmetics are considered safe when used as directed and when containing permitted chemicals within the limits specified. It is therefore misleading to suggest that a permitted ingredient (when used in permitted amounts) can cause any harm to a consumer.
- it is the message as interpreted by the ‘average’ or ‘typical’ consumer that matters, not what you intend that message to be. If a regulatory or consumer protection agency finds your claims to be misleading to the average/intended consumer, they will also find your

claims non-compliant. So remember, it's not how you intend the message to be conveyed that matters, but how the average/intended consumer would interpret the message that would be considered by the regulators. That message must comply with regulations and not be misleading.

- if you are ever in doubt about the evidence you hold to support your claims, the message of the claim or links from your site/product, then it may not be compliant. Hold the evidence to support all claims and check the overall message to ensure full compliance, and only link to websites or sources that you have thoroughly checked for compliance.

Now, let's look at specific regulations. We will use the EU model of regulations as they have been very clear on acceptability of claims, especially 'free from' claims. ASEAN and African models follow this EU model, and while Regulatory agencies in other regions have their own specific laws, the EU model sets great examples that could be used to define cosmetic marketing interpretations in other regions as well.

Under EU Cosmetic Regulation 1223/2009 Article 20, the acceptability of a claim made on a cosmetic product is determined by its compliance with six common criteria: legal compliance, truthfulness, evidential support, honesty, fairness and informed decision-making. The table below is taken directly from Annex III on the Working Document for Cosmetic Claims - take time to read through these examples now and the specific examples they make explaining what is not an appropriate claim. This list and these examples are not exhaustive – by not being mentioned on this list does not make it an okay claim – these are examples with specific situations only and the requirements to ensure legal compliance, truthfulness, evidential support, honesty, fairness and informed decision making still apply even if a certain example is not listed here.

Criterion	Description	Examples of claims (only illustrative and not exhaustive) and remarks
Legal compliance	"Free from" claims or claims with similar meaning should not be made concerning (an) ingredient(s) which is prohibited for use in cosmetics by Regulation (EC) No 1223/2009.	The claim <i>'free from Corticosteroids'</i> is not allowed, as Corticosteroids are banned by EU cosmetics legislation.
Truthfulness	In case claims in relation to the absence of ingredients are made in relation to functional groups of ingredients that are defined in Regulation (EC) No 1223/2009, such as preservatives and colorants, the product should not contain any ingredient that belongs to the group as defined in this Regulation. If it is claimed on the product that it does not contain a specific ingredient(s), the ingredient should not be present or released.	The claim <i>'free from Formaldehyde'</i> is not allowed, if the product contains a formaldehyde releasing ingredient (e.g. Diazolidinyl Urea).

Evidential support	The absence of (a) specific ingredient(s) should be demonstrated by adequate and verifiable evidence.	See Annex II on "Best practices applying to experimental studies".
Honesty	"Free from" claims or claims with similar meaning should not be allowed when they refer to an ingredient which is typically not used in the particular kind of cosmetic product. "Free from" claims or claims with similar meaning should not be allowed when they imply guaranteed properties of the product, based on the absence of (an) ingredient(s), which cannot be given. "Free from" claims or claims with similar meaning addressing functional groups of ingredients should not be allowed if the product contains ingredients with multiple functions and among these is the function that the product is claimed to be free from. Exceptions might be possible (e.g. based on challenge test results of the formula without the particular ingredient(s)).	Fine fragrances usually contain such a high amount of alcohol that the additional use of preservatives is not necessary. In this case, it would be dishonest to highlight in advertising the fact that a certain fine fragrance does not contain any preservative. The claim <i>'free from allergenic/sensitizing substances'</i> is not allowed. A complete absence of the risk of an allergic reaction cannot be guaranteed and the product should not give the impression that it does. The claim <i>'free from preservatives'</i> should not be used when a product contains (an) ingredient(s) showing a protective effect against microorganisms, which are not included in Annex V of Regulation 1223/2009, e. g. alcohol. If the responsible person has evidence that the particular ingredient or the combination of such ingredients does not contribute to the product protection, it might be appropriate to use the claim (e.g. challenge test results of the formula without the particular ingredient).

		The claim <i>'free from perfume'</i> should not be used when a product contains an ingredient which exerts a perfuming function in the product, regardless of its other possible functions in the product.
Fairness	"Free from" claims or claims with similar meaning should not be allowed when they imply a denigrating message, notably when they are mainly based on a presumed negative perception on the safety of the ingredient (or group of ingredients).	Certain parabens are safe when used in accordance to Regulation (EC) No 1223/2009. Considering the fact that all cosmetic products must be safe, the claim <i>'free from parabens'</i> should not be accepted, because it is denigrating the entire group of parabens. Phenoxyethanol and triclosan are safe when used according to the Cosmetics Regulation. Hence the claim free from these substances should not be accepted because it is denigrating authorised substances.
Informed decision-making	"Free from" claims or claims with similar meaning should be permitted when they allow an informed choice to a specific target group or groups of end users.	The following claims should be permitted if they also comply with the other common criteria: <i>'free from alcohol'</i>, e.g. in a mouthwash intended as a family product; <i>'free from animal-derived ingredients'</i>, e.g. in products intended for vegans; or <i>'free from acetone'</i>, e.g. in nail polish, for users wishing to avoid its particular smell.

Final examples of breaches that would be considered misleading and deceptive conduct include:

- packaging a product into a container with a false bottom to make it look like a bigger container than it actually is.
- promoting a product as being clinically proven, scientifically tested, dermatologist approved etc., where your company does not have evidence in humans or on human skin to sustain such claims.
- claiming an organic content by %, when that % content is not true.
- misrepresenting statistical claims about the acceptability, use or performance characteristics of a product. If you want to make statistical claims about a product you must state how those statistics apply. For example, if you were to say, '9 out of 10 women preferred our product over leading Brand X', you would also need to state how you arrived at those figures; for example: 'as tested in 100 women.' Next time you see a statistical claim, check on the promotion for a small disclaimer stating the tests conditions under which that statistic was obtained. Providing this disclaimer allows the consumer to make an educated decision as to how likely they are to feel the same way about the product too.
- presenting a product as having benefits pertaining to a particular ingredient based on research that used a greater concentration than that which is used in your final product. For example, if you want to use graphs in your promotional material showing results when a certain active was used on human skin tissue at 2%, but you only use this active ingredient in your product at 1%, you cannot use those graphs or make claims about the results of the study because your product does not contain the same amount of active that was used to obtain results in the clinical setting.
- implying a competitors' brand is harmful or ineffectual because they use, or don't use, certain ingredients. For example, you cannot claim that competitor products, or the chemicals they contain, are harmful or induce certain health effects in individuals. All cosmetic chemicals permitted in cosmetic products are considered safe when used within stated limits, so it is misleading to suggest otherwise. Misinformation in breach of these acts abounds in the personal care industry – don't let your company spread the misinformation! The most common examples of such breaches are:
 - companies who promote that parabens are linked to breast cancer. The truth is, the use of parabens in under arm deodorants was at one point questioned as to whether it may be associated with an increase in breast cancer. It has since been proven that using parabens does not have any association with an increased risk of breast cancer, and that they are considered safe to use as part of normal personal care regimes within the regulatory limits specified. If your company chooses not to use parabens that is their choice; but any statements about why they choose not to use parabens should not suggest they are unsafe.
 - companies who promote that using sodium laureth sulfate or sodium lauryl sulfate (SLS) can cause a myriad of health problems including cancer, corneal damage and skin conditions such as eczema or dermatitis. The truth is, in animal studies where concentrated solutions of SLS were scratched into the eyes or skin of rabbits and not washed off, irritation and damage did occur. There have been in depth studies to prove the safety of SLS for use in personal care products at the concentration and wash off methods of use involved. If your company chooses not to use SLS that is their choice; but any statements about why they choose not to use SLS must imply it is not safe to use.
 - companies who promote that propylene glycol is toxic because it is used in anti-freeze. In fact, it is actually the chemical ethylene glycol that is highly

toxic and used in anti-freeze. Some anti-freeze products do contain propylene glycol as a humectant agent, but their use in anti-freeze makes them no more harmful than the water that is also used in anti-freeze. Promoting propylene glycol as harmful for the skin simply because it is used in anti-freeze is misleading and it is considered safe to use in personal care products.

If a Regulator finds your company making non-compliant claims they will require that you remove the offending promotional material from the market place immediately. If this promotional activity extends to your labels, you will need to remove your product from the market place immediately and return it only when new labels have been applied that are compliant. Repeat offences (or first time offences, if the breach is serious enough) will incur substantial penalties and fines.

Having to remove a product from the market place and replace its label; or having to withdraw a promotional activity because of its claims is obviously a very costly and undesirable situation for a company to be faced with. It is for this reason you should ensure your product and promotions fully comply with the definitions of a cosmetic product, you hold appropriate evidence to determine appropriate claims and support them BEFORE the claim is made and be careful not to mislead or deceive in your marketing whether intentional or not – remember your average consumer and how they will perceive the message!

Make sure you get it right!

Make sure you now watch the following videos to see more examples of what is, and is not acceptable according to the regulators.

Free from claims – how to get it right: <https://youtu.be/yeh3XmwpYxQ>

How to select the best active: shows how Chemists use supplier information to select amongst actives and then formulate products to ensure compatibility and performance of the active: https://youtu.be/Oh9JIBEI_Dc

Cosmetic Claims video: an overview on guidance of various types of claims: <https://youtu.be/tKtP8B1quSE>

Cosmetic Absorption by the Skin: an explanation of how much of your cosmetics actually get absorbed by the skin: <https://youtu.be/LKiZtYffteE>

Do Cosmetics Work: a true account of whether different types of cosmetic products actually work: <https://youtu.be/z4-HM-S2qYU>

Chapter 7: Practical Formulation Guides

Now it's time to prepare some samples, if you haven't started already. You'll need the following basic equipment:

- Scales that measure to 1.2kg in 0.01g increments. You might purchase cheap scales to begin with; you could source:
 - 1 scale that measures to 2kg in 0.1g increments PLUS
 - 1 scale that measures to 500g in 0.01g increments
 - Just remember if you want to formulate more professionally later you will need to invest in proper scientific scales from a lab supplier or similar
- Stainless steel whisks at a minimum – stick blenders are not ideal, they introduce too much air into your formula and impact product quality.
- Heat/chemical resistant spatulas – available from most department stores
- Electric hot plates – don't use induction or gas; the heat distribution is too intense at the source; you'll find you burn product at the base
- Stainless steel spoons – you can get these from most department stores
- Disposable pipettes – cheap plastic pipettes for measuring liquids; available from e-bay or lab suppliers at usually a very reasonable price
- pH strips or meter – you can start with strips that measure from pH 3 – 8 ideally in 0.5 increments. If you want to formulate more professionally later you will need to invest in a proper pH meter.

Watch how it's done!

Here is a great video to introduce you to basic and more advanced lab equipment – it will help get you started and help you see what you might want to invest in later:

<https://youtu.be/Yj7Q0WTr2X8>

With all of your samples, you must make sure you have clean, stainless steel equipment. While the notes here take you through the basic equipment you will need, a simple yet effective cleaning method is as follows:

- clean your equipment using hot soapy water
- rinse the equipment using cold purified water
 - you could add a bleach step at this point – prepare your bleach to a 200ppm solution and wash the equipment in this before again rinsing in cold purified water
 - preparing your bleach solution may take some careful calculations as bulk solutions can come in varying hypochlorite concentrations – you may need to speak to a cleaning chemicals supplier about their hypochlorites and ask them to help you calculate dilution rates to ensure your end solution is correct
 - the bleach and rinse step is not compulsory
- allow to air dry in a very clean place and pack away when dry
- spray with a 70% ethanol solution (if you are able to get pure ethanol) before use and wipe over with a clean cloth

- if you can't get access to ethanol for this step then please make sure you wash and rinse your equipment thoroughly and allow to air dry in a very clean place and store carefully

Contamination from poorly cleaned equipment is one of the most common reasons for finished product contamination, so make sure you clean and store your equipment well to avoid this potential microbial risk factor.

1. Preparing an emulsion

In the following pages, you will see various formulas and methods of manufacture for different emulsions. An example of one is provided below for you to read through in preparation – and is repeated in the later notes. In practice, most skin creams will follow the same basic procedure; however there may be variances depending on the raw materials used, equipment available and size of batches.

When preparing samples, you should prepare 200g at a time; except balms which can be prepared in 100g quantities. This will provide you enough to ensure the sample will mix together well and be of the required quality.

For this sample, you will need the following equipment:

2 x 1L stainless steel bowls

Whisk (or other stirrer)

Heat source

Scales: 1100g with 0.1g resolution

Stainless steel spoons – use these to measure out dry and waxy materials, glycerin and tocopherol (vitamin E)

Teat pipettes – use these to measure out liquid materials

pH strips or pH meter

To adjust the pH of your finished product:

1. Dip the pH strip into the product and determine its reading.
2. If the pH is above 6.0, add citric acid (50% solution; only a drop or two at a time) and stir through until the mixture is homogenous (evenly mixed). Alternatively, if the pH is too low (below 5.0), add the sodium hydroxide (30% solution; a couple of drops at a time) and stir through until the mixture is homogenous (evenly mixed).
3. Dip another pH strip into the product and determine its reading.
4. Repeat step 2 until the pH is within the required formulation range (stated in the method).

Watch how it's done!

Here is a great video on how to test and adjust pH: <https://youtu.be/kwvLAK3KauM>

Dry skin cream

PHASE	ADDED %w/w	RAW MATERIALS	FUNCTION
A	74.2	Purified water	Solvent
B	5.0	Glycerin	Humectant
B	0.3	Xanthan gum	Viscosity modifier
C	5.0	Macadamia oil	Emollient
C	4.0	Caprylic/capric triglyceride	Emollient
C	4.0	Cetearyl alcohol, ceteareth-20	Emulsifier
C	2.5	Stearic acid	Emulsifier
C	2.0	Sunflower oil	Emollient
C	1.5	Beeswax	Consistency factor/emollient
D	1.0	Euxyl PE9010	Preservative
D	0.5	Tocopherol	Antioxidant
E	q.s	pH adjuster	pH adjustment/chelating agent

METHOD:

1. Combine phase B ingredients and mix until they form a slurry. Add to water slowly under constant stirring and allow to hydrate and thicken. Try to limit the amount of air introduced into the formula throughout your stirring.
2. Heat to 70°C. (If you do not have access to a thermometer, heat the water and glycerin to almost boiling but do not let too much water evaporate).
3. Heat phase C to 65 - 70°C. (If you do not have access to a thermometer, heat the oil phase until all solids have melted but before it begins to boil).
4. Add phase C to phase A/B and stir. Try to limit the amount of air introduced into the formula throughout your stirring.
5. Allow to cool below 35°C and add ingredients from phase D.
6. Adjust pH to 5.0 – 6.0

Extracts, proteins, vitamins, fragrances or essential oils would be added with phase D. If planning to add these ingredients, adjust your water input before preparing your sample to make the formula equal 100%. For example, if you wanted to add 0.3% essential oils, you would add this with the tocopherol and reduce the water input at the beginning by 0.3%.

Watch how it's done!

How to make creams/lotions: <https://youtu.be/WR08f77Iht8>

2. Preparing a surfactant

In the following pages, you will see various formulas and methods of manufacture for different surfactant based products. An example of one is provided here for you to read through in preparation – and is repeated in the later notes. In practice, most surfactant formulas will follow the same basic procedure; however there may be variances depending on the raw materials used, equipment available and size of batches.

When preparing samples, you should prepare 200g at a time. This will provide you enough to ensure the sample will mix together well and be of the required quality.

For this sample, you will need the following equipment:

2 x 1L stainless steel bowls

Whisk (or other stirrer)

Heat source

Scales: 1100g with 0.1g resolution

Stainless steel spoons – use these to measure out dry and waxy materials, glycerin and tocopherol (vitamin E)

Teat pipettes – use these to measure out liquid materials

pH strips or pH meter

To adjust the pH of your finished product:

1. Dip the pH strip into the product and determine its reading.
2. If the pH is above 6.0, add citric acid (50% solution; only a drop or two at a time) and stir through until the mixture is homogenous (evenly mixed). Alternatively, if the pH is too low (below 5.0), add the sodium hydroxide (30% solution; a couple of drops at a time) and stir through until the mixture is homogenous (evenly mixed).
3. Dip another pH strip into the product and determine its reading.
4. Repeat step 2 until the pH is within the required formulation range (stated in the method).

Simple body wash

PHASE	ADDED %w/w	RAW MATERIALS	FUNCTION
A	41.6	Purified water	Solvent
A	35.0	Cocamidopropyl betaine (30%)	Surfactant/cleansing agent/mildness additive
A	15.0	Sodium lauroyl sarcosinate	Surfactant/cleansing agent
A	3.0	Decyl glucoside (53.5%)	Surfactant/cleansing agent/mildness additive
A	0.1	Disodium EDTA	Chelating agent
B	4.0	Glycerin	Humectant
B	0.3	Xanthan gum	Thickener
C	1.0	Spectrastat	Preservative
D	q.s	pH adjuster	pH adjustment

METHOD

1. Combine phase A ingredients, stirring gently to mix thoroughly but without adding too much air into the product.
2. Precombine phase B ingredients to form a slurry. Slowly add phase B to phase A and stir slowly for 15 minutes or until hydrated.
3. Add ingredients in phase C to phase A/B, stirring slowly until homogenous.
4. Adjust pH to 5.0 – 5.5.

Extracts, proteins, vitamins, fragrances or essential oils would be added with phase C. If planning to add these ingredients, adjust your water input before preparing your sample to make the formula equal 100%. For example, if you wanted to add 0.3% essential oils, you would add this at phase C and reduce the water input at the beginning by 0.3%.

Watch how it's done!

How to make easy natural surfactants: https://youtu.be/mp_9vhLfjIY

1. Foaming face cleanser

PHASE	ADDED %w/w	RAW MATERIALS	FUNCTION
A	51.9	Purified water	Solvent
A	29.0	Cocoamidopropyl betaine	Surfactant/cleansing agent/mildness additive
A	12.0	Sodium lauroyl sarcosinate	Surfactant/cleansing agent
A	0.1	Disodium edta	Chelating agent
B	5.0	Glycerin	Humectant
B	0.6	Xanthan gum	Thickener
C	1.0	Spectrastat	Preservative
C	0.3	Essential oil blend (your choice)	Fragrance/skin conditioning agent
C	0.1	Vitamin E	Antioxidant/skin conditioning agent
D	q.s	pH adjuster	pH adjustment

METHOD

1. Combine phase A ingredients.
2. Precombine phase B ingredients to form a slurry. Slowly add phase B to phase A and stir for approximately 15 minutes or until thoroughly hydrated.
3. Add ingredients in phase C to phase A/B, one after the other, stirring slowly between each addition until homogenous.
4. Adjust pH to 5.0 – 5.5.

Extracts, proteins and vitamins would be added with phase C. If planning to add these ingredients, adjust your water input before preparing your sample to make the formula equal 100%. For example, if you wanted to add 0.3% extracts, you would add this at phase C and reduce the water input at the beginning by 0.3%.

2. Crème face cleanser

PHASE	ADDED %w/w	RAW MATERIALS	FUNCTION
A	82.6	Purified water	Solvent
B	4.0	Glycerin	Humectant
B	0.6	Xanthan gum	Viscosity modifier
C	6.0	Cetearyl alcohol, ceteareth-20	Emulsifier
C	5.0	Macadamia oil	Emollient
D	1.0	Euxyl PE9010	Preservative
D	0.5	Tocopherol	Antioxidant
D	0.3	Essential oils (your choice)	Fragrance/skin conditioning agent
E	q.s	pH adjuster	pH adjustment/chelating agent

METHOD:

1. Combine phase B ingredients and mix until they form a slurry. Add to water slowly under constant stirring and allow to hydrate and thicken. Try to limit the amount of air introduced into the formula throughout your stirring.
2. Heat to 70°C.
3. Heat phase C to 65 - 70°C.
4. Add phase C to phase A/B and stir. Try to limit the amount of air introduced into the formula throughout your stirring.
5. Allow to cool below 35°C and add ingredients from phase D.
6. Adjust pH to 5.0 – 6.0

Extracts, proteins and vitamins would be added with phase D. If planning to add these ingredients, adjust your water input before preparing your sample to make the formula equal 100%. For example, if you wanted to add 0.3% plant extracts, you would add this with the tocopherol and reduce the water input at the beginning by 0.3%.

3. Simple body wash

PHASE	ADDED %w/w	RAW MATERIALS	FUNCTION
A	41.6	Purified water	Solvent
A	35.0	Cocamidopropyl betaine (30%)	Surfactant/cleansing agent/mildness additive
A	15.0	Sodium lauroyl sarcosinate	Surfactant/cleansing agent
A	3.0	Decyl glucoside (53.5%)	Surfactant/cleansing agent/mildness additive
A	0.1	Disodium EDTA	Chelating agent
B	4.0	Glycerin	Humectant
B	0.3	Xanthan gum	Thickener
C	1.0	Spectrastat	Preservative
D	q.s	pH adjuster	pH adjustment

METHOD

1. Combine phase A ingredients, stirring gently to mix thoroughly but without adding too much air into the product.
2. Precombine phase B ingredients to form a slurry. Slowly add phase B to phase A and stir slowly for 15 minutes or until hydrated.
3. Add ingredients in phase C to phase A/B, stirring slowly until homogenous.
4. Adjust pH to 5.0 – 5.5.

Extracts, proteins, vitamins, fragrances or essential oils would be added with phase C. If planning to add these ingredients, adjust your water input before preparing your sample to make the formula equal 100%. For example, if you wanted to add 0.3% essential oils, you would add this at phase C and reduce the water input at the beginning by 0.3%.

4. Toner/mist

PHASE	ADDED %w/w	RAW MATERIALS	FUNCTION
A	90.4	Purified water	Solvent
A	4.0	Glycerin	Humectant
A	1.0	Spectrastat	Preservative
B	4.0	Polysorbate 20	Solubiliser
B	0.3	Geranium essential oil	Fragrance/skin conditioning agent
B	0.2	Lavender essential oil	Fragrance/skin conditioning agent
B	0.1	Vitamin E	Skin conditioning agent
C	q.s	pH adjuster	pH adjustment

METHOD

1. Combine ingredients in phase A.
2. Combine ingredients in phase B.
3. Slowly add phase B to phase A under constant slow stirring.
4. Adjust pH to 5.0 – 6.0.

Extracts and proteins would be added with phase A if water soluble; or premixed with phase B if oil soluble. If planning to add these ingredients, adjust your water input before preparing your sample to make the formula equal 100%. For example, if you wanted to add 0.3% extracts, you would add this at phase A and reduce the water input at the beginning by 0.3%.

5. Oily skin moisturiser (face)

PHASE	ADDED %w/w	RAW MATERIALS	FUNCTION
A	78.8	Purified water	Solvent
B	4.0	Glycerin	Humectant
B	0.3	Xanthan gum	Viscosity modifier
C	6.0	Isopropyl myristate	Emollient
C	5.5	Cetearyl alcohol, ceteareth-20	Emulsifier
C	2.0	Caprylic/capric triglyceride	Emollient
C	1.5	Stearic acid	Emulsifier
D	1.0	Euxyl PE9010	Preservative
D	0.5	Tocopherol	Antioxidant
D	0.4	Essential oils (your choice)	Fragrance/skin conditioning agent
E	q.s	pH adjuster	pH adjustment/chelating agent

METHOD:

1. Combine phase B ingredients and mix until they form a slurry. Add to water slowly under constant stirring and allow to hydrate and thicken. Try to limit the amount of air introduced into the formula throughout your stirring.
2. Heat to 70°C.
3. Heat phase C to 65 - 70°C.
4. Add phase C to phase A/B and stir. Try to limit the amount of air introduced into the formula throughout your stirring.
5. Allow to cool below 35°C and add ingredients from phase D.
6. Adjust pH to 5.0 – 6.0

Extracts, proteins and vitamins would be added with phase D. If planning to add these ingredients, adjust your water input before preparing your sample to make the formula equal 100%. For example, if you wanted to add 0.3% plant extracts, you would add this with the tocopherol and reduce the water input at the beginning by 0.3%.

6. Normal skin moisturiser (face)

PHASE	ADDED %w/w	RAW MATERIALS	FUNCTION
A	75.8	Purified water	Solvent
B	4.0	Glycerin	Humectant
B	0.3	Xanthan gum	Viscosity modifier
C	5.5	Cetearyl alcohol, cetareth-20	Emulsifier
C	5.0	Shea butter	Emollient
C	4.0	Caprylic/capric triglyceride	Emollient
C	2.0	Sunflower oil	Emollient
C	1.5	Stearic acid	Emulsifier
D	1.0	Euxyl PE9010	Preservative
D	0.5	Tocopherol	Antioxidant
D	0.4	Essential oils (your choice)	Fragrance/skin conditioning agent
E	q.s	pH adjuster	pH adjustment/chelating agent

METHOD:

1. Combine phase B ingredients and mix until they form a slurry. Add to water slowly under constant stirring and allow to hydrate and thicken. Try to limit the amount of air introduced into the formula throughout your stirring.
2. Heat to 70°C.
3. Heat phase C to 65 - 70°C.
4. Add phase C to phase A/B and stir. Try to limit the amount of air introduced into the formula throughout your stirring.
5. Allow to cool below 35°C and add ingredients from phase D.
6. Adjust pH to 5.0 – 6.0

Extracts, proteins and vitamins would be added with phase D. If planning to add these ingredients, adjust your water input before preparing your sample to make the formula equal 100%. For example, if you wanted to add 0.3% plant extracts, you would add this with the tocopherol and reduce the water input at the beginning by 0.3%.

Try changing the oils used for various depths of moisturizing factor, to make the formula more specific to certain skin types and to alter the viscosity of the finished product.

7. Dry skin moisturiser (face)

PHASE	ADDED %w/w	RAW MATERIALS	FUNCTION
A	74.2	Purified water	Solvent
B	5.0	Glycerin	Humectant
B	0.3	Xanthan gum	Viscosity modifier
C	5.0	Macadamia oil	Emollient
C	4.0	Caprylic/capric triglyceride	Emollient
C	4.0	Cetearyl alcohol, cetareth-20	Emulsifier
C	2.5	Stearic acid	Emulsifier
C	2.0	Shea butter	Emollient
C	1.5	Beeswax	Consistency factor/emollient
D	1.0	Euxyl PE9010	Preservative
D	0.5	Tocopherol	Antioxidant
E	q.s	pH adjuster	pH adjustment/chelating agent

METHOD:

1. Combine phase B ingredients and mix until they form a slurry. Add to water slowly under constant stirring and allow to hydrate and thicken. Try to limit the amount of air introduced into the formula throughout your stirring.
2. Heat to 70°C.
3. Heat phase C to 65 - 70°C.
4. Add phase C to phase A/B and stir. Try to limit the amount of air introduced into the formula throughout your stirring.
5. Allow to cool below 35°C and add ingredients from phase D.
6. Adjust pH to 5.0 – 6.0

Extracts, proteins and vitamins would be added with phase D. If planning to add these ingredients, adjust your water input before preparing your sample to make the formula equal 100%. For example, if you wanted to add 0.3% plant extracts, you would add this with the tocopherol and reduce the water input at the beginning by 0.3%.

Try changing the oils used for various depths of moisturizing factor, to make the formula more specific to certain skin types and to alter the viscosity of the finished product.

8. Hand Lotion

PHASE	ADDED %w/w	RAW MATERIALS	FUNCTION
A	75.7	Purified water	Solvent
B	5.0	Glycerin	Humectant
B	0.3	Xanthan gum	Viscosity modifier
C	5.5	Cetearyl alcohol, ceteareth-20	Emulsifier
C	5.0	Macadamia oil	Emollient
C	3.5	Caprylic/capric triglyceride	Emollient
C	2.0	Shea butter	Emollient
C	1.5	Stearic acid	Emulsifier
D	1.0	Euxyl PE9010	Preservative
D	0.5	Tocopherol	Antioxidant
E	q.s	pH adjuster	pH adjustment/chelating agent

METHOD:

1. Combine phase B ingredients and mix until they form a slurry. Add to water slowly under constant stirring and allow to hydrate and thicken. Try to limit the amount of air introduced into the formula throughout your stirring.
2. Heat to 70°C.
3. Heat phase C to 65 - 70°C.
4. Add phase C to phase A/B and stir. Try to limit the amount of air introduced into the formula throughout your stirring.
5. Allow to cool below 35°C and add ingredients from phase D.
6. Adjust pH to 5.0 – 6.0

Extracts, proteins and vitamins would be added with phase D. If planning to add these ingredients, adjust your water input before preparing your sample to make the formula equal 100%. For example, if you wanted to add 0.3% plant extracts, you would add this with the tocopherol and reduce the water input at the beginning by 0.3%.

Try changing the oils used for various depths of moisturizing factor, to make the formula more specific to certain skin types and to alter the viscosity of the finished product.

9. Body lotion

PHASE	ADDED %w/w	RAW MATERIALS	FUNCTION
A	69.7	Purified water	Solvent
B	5.0	Glycerin	Humectant
B	0.3	Xanthan gum	Viscosity modifier
C	6.0	Cetearyl alcohol, ceteareth-20	Emulsifier
C	6.0	Macadamia oil	Emollient
C	4.0	Isopropyl myristate	Emollient
C	3.0	Sunflower oil	Emollient
C	2.0	Caprylic/capric triglyceride	Emollient
C	1.5	Stearic acid	Emulsifier
D	1.0	Euxyl PE9010	Preservative
D	1.0	Essential oils (your choice)	Fragrance/skin conditioning agent
D	0.5	Tocopherol	Antioxidant
E	q.s	pH adjuster	pH adjustment/chelating agent

METHOD:

1. Combine phase B ingredients and mix until they form a slurry. Add to water slowly under constant stirring and allow to hydrate and thicken. Try to limit the amount of air introduced into the formula throughout your stirring.
2. Heat to 70°C.
3. Heat phase C to 65 - 70°C.
4. Add phase C to phase A/B and stir. Try to limit the amount of air introduced into the formula throughout your stirring.
5. Allow to cool below 35°C and add ingredients from phase D.
6. Adjust pH to 5.0 – 6.0

Extracts, proteins and vitamins would be added with phase D. If planning to add these ingredients, adjust your water input before preparing your sample to make the formula equal 100%. For example, if you wanted to add 0.3% plant extracts, you would add this with the tocopherol and reduce the water input at the beginning by 0.3%.

Try changing the oils used for various depths of moisturizing factor, to make the formula more specific to certain skin types and to alter the viscosity of the finished product.

10. Body butter

PHASE	ADDED %w/w	RAW MATERIALS	FUNCTION
A	61.1	Purified water	Solvent
B	5.0	Glycerin	Humectant
B	0.4	Xanthan gum	Viscosity modifier
C	6.5	Cetearyl alcohol, ceteareth-20	Emulsifier
C	6.0	Macadamia oil	Emollient
C	6.0	Shea butter	Emollient
C	6.0	Sunflower oil	Emollient
C	3.0	Beeswax	Consistency factor/emollient
C	2.5	Stearic acid	Emulsifier
D	1.5	Essential oils (your choice)	Fragrance/skin conditioning agent
D	1.0	Tocopherol	Antioxidant
D	1.0	Euxyl PE9010	Preservative
E	q.s	pH adjuster	pH adjustment/chelating agent

METHOD:

1. Combine phase B ingredients and mix until they form a slurry. Add to water slowly under constant stirring and allow to hydrate and thicken. Try to limit the amount of air introduced into the formula throughout your stirring.
2. Heat to 70°C.
3. Heat phase C to 65 - 70°C.
4. Add phase C to phase A/B and stir. Try to limit the amount of air introduced into the formula throughout your stirring.
5. Allow to cool below 35°C and add ingredients from phase D.
6. Adjust pH to 5.0 – 6.0

Extracts, proteins and vitamins would be added with phase D. If planning to add these ingredients, adjust your water input before preparing your sample to make the formula equal 100%. For example, if you wanted to add 0.3% plant extracts, you would add this with the tocopherol and reduce the water input at the beginning by 0.3%.

Try changing the oils used for various depths of moisturizing factor, to make the formula more specific to certain skin types and to alter the viscosity of the finished product.

11. Citrus lip balm

PHASE	ADDED %w/w	RAW MATERIALS	FUNCTION
A	72.0	Sunflower oil	Emollient
A	16.0	Beeswax	Consistency factor/emollient
A	5.0	Macadamia oil	Humectant
A	2.0	Shea butter	Emollient
B	3.0	Orange essential oil	Fragrance/skin conditioning agent
B	2.0	Tocopherol	Antioxidant

METHOD:

1. Combine ingredients in phase A and heat to 75°C, stirring gently until thoroughly melted.
2. Allow to cool to 55-60°C.
3. Combine ingredients in phase B and add to phase A. Stir until homogenous and pour off while still hot.
4. Do not cap until product is set and cool.

Water soluble ingredients will not suit this type of formula. You should only use oil soluble ingredients otherwise a precipitate or separation could occur.

Try changing the oils used for various depths of moisturizing factor, to make the formula more specific to certain skin types and to alter the viscosity of the finished product.

12. Peppermint lip balm

PHASE	ADDED %w/w	RAW MATERIALS	FUNCTION
A	74.5	Sunflower oil	Emollient
A	14.0	Beeswax	Consistency factor/emollient
A	5.0	Macadamia oil	Humectant
A	4.0	Shea butter	Emollient
B	0.5	Peppermint essential oil	Fragrance/skin conditioning agent
B	2.0	Tocopherol	Antioxidant

METHOD:

1. Combine ingredients in phase A and heat to 75°C, stirring gently until thoroughly melted.
2. Allow to cool to 55-60°C.
3. Combine ingredients in phase B and add to phase A. Stir until homogenous and pour off while still hot.
4. Do not cap until product is set and cool.

Water soluble ingredients will not suit this type of formula. You should only use oil soluble ingredients otherwise a precipitate or separation could occur.

Try changing the oils used for various depths of moisturizing factor, to make the formula more specific to certain skin types and to alter the viscosity of the finished product.

13. Body scrub

PHASE	ADDED %w/w	RAW MATERIALS	FUNCTION
A	75.9	Purified water	Solvent
B	4.0	Glycerin	Humectant
B	0.6	Xanthan gum	Viscosity modifier
C	6.0	Cetearyl alcohol, ceteareth-20	Emulsifier
C	5.0	Macadamia oil	Emollient
C	2.5	Stearic acid	Emulsifier
D	3.0	Walnut shell (ground)	Abrasive
D	1.5	Essential oils (your choice)	Fragrance/skin conditioning agent
D	1.0	Euxyl PE9010	Preservative
D	0.5	Tocopherol	Antioxidant
E	q.s	pH adjuster	pH adjustment/chelating agent

METHOD:

1. Combine phase B ingredients and mix until they form a slurry. Add to water slowly under constant stirring and allow to hydrate and thicken. Try to limit the amount of air introduced into the formula throughout your stirring.
2. Heat to 70°C.
3. Heat phase C to 65 - 70°C.
4. Add phase C to phase A/B and stir. Try to limit the amount of air introduced into the formula throughout your stirring.
5. Allow to cool below 35°C and add ingredients from phase D.
6. Adjust pH to 5.0 – 6.0

Extracts, proteins and vitamins would be added with phase D. If planning to add these ingredients, adjust your water input before preparing your sample to make the formula equal 100%. For example, if you wanted to add 0.3% plant extracts, you would add this with the tocopherol and reduce the water input at the beginning by 0.3%.

Be careful when handling and storing natural abrasives; as they are more prone to microbial contamination.

14. Facial exfoliant

PHASE	ADDED %w/w	RAW MATERIALS	FUNCTION
A	76.8	Purified water	Solvent
B	4.0	Glycerin	Humectant
B	0.3	Xanthan gum	Viscosity modifier
C	6.0	Caprylic/capric triglyceride	Emollient
C	6.0	Cetearyl alcohol, cetareth-20	Emulsifier
C	1.5	Stearic acid	Emulsifier
D	1.0	Spectrastat	Preservative
D	1.0	Euxyl PE9010	Preservative
D	1.5	Walnut shell (ground)	Abrasive
D	0.5	Tocopherol	Antioxidant
D	0.4	Essential oils (your choice)	Fragrance/skin conditioning agent
E	q.s	pH adjuster	pH adjustment/chelating agent

METHOD:

1. Combine phase B ingredients and mix until they form a slurry. Add to water slowly under constant stirring and allow to hydrate and thicken. Try to limit the amount of air introduced into the formula throughout your stirring.
2. Heat to 70°C.
3. Heat phase C to 65 - 70°C.
4. Add phase C to phase A/B and stir. Try to limit the amount of air introduced into the formula throughout your stirring.
5. Allow to cool below 35°C and add ingredients from phase D.
6. Adjust pH to 5.0 – 6.0

Extracts, proteins and vitamins would be added with phase D. If planning to add these ingredients, adjust your water input before preparing your sample to make the formula equal 100%. For example, if you wanted to add 0.3% plant extracts, you would add this with the tocopherol and reduce the water input at the beginning by 0.3%.

Be careful when handling and storing natural abrasives; as they are more prone to microbial contamination.

15. Dry hair shampoo

PHASE	ADDED %w/w	RAW MATERIALS	FUNCTION
A	48.9	Purified water	Solvent
A	4.0	Glycerin	Humectant
B	25.0	Cocamidopropyl betaine (30%)	Surfactant/cleansing agent/mildness additive
B	10.0	Sodium lauroyl sarcosinate	Surfactant/cleansing agent
C	10.0	Polyquaternium-7 (9%)	Conditioning additive
C	1.0	Spectrastat	Preservative
C	0.8	Essential oil blend (your choice)	Fragrance/conditioning additive
C	0.2	Vitamin B5	Conditioning additive
C	0.1	Disodium EDTA	Chelating agent
D	q.s	pH adjuster	pH adjustment

METHOD

1. Combine ingredients in phase A.
2. Add ingredients in phase B to phase A, one after the other, stirring slowly between each addition until homogenous.
3. Add ingredients in phase C, one after the other, stirring slowly between each addition until homogenous. Be careful not to create too much foam while stirring.
4. Adjust pH to 5.0 – 5.5.

Extracts, proteins and vitamins would be added with phase C. If planning to add these ingredients, adjust your water input before preparing your sample to make the formula equal 100%. For example, if you wanted to add 0.3% extracts, you would add this at phase C and reduce the water input at the beginning by 0.3%.

16. Oily hair shampoo

PHASE	ADDED %w/w	RAW MATERIALS	FUNCTION
A	44.9	Purified water	Solvent
A	4.0	Glycerin	Humectant
B	29.0	Cocamidopropyl betaine (30%)	Surfactant/cleansing agent/mildness additive
B	12.0	Sodium lauroyl sarcosinate	Surfactant/cleansing agent
B	3.0	Decyl glucoside (53.5%)	Surfactant/cleansing agent/mildness additive
C	5.0	Polyquaternium- 7 (9%)	Conditioning additive
C	1.0	Spectrastat	Preservative
C	0.8	Essential oil blend (your choice)	Fragrance/conditioning additive
C	0.2	Vitamin B5	Conditioning additive
C	0.1	Disodium EDTA	Chelating agent
D	q.s	pH adjuster	pH adjustment

METHOD

1. Combine ingredients in phase A.
2. Add ingredients in phase B to phase A, one after the other, stirring slowly between each addition until homogenous.
3. Add ingredients in phase C, one after the other, stirring slowly between each addition until homogenous. Be careful not to create too much foam while stirring.
4. Adjust pH to 5.0 – 5.5.

Extracts, proteins and vitamins would be added with phase C. If planning to add these ingredients, adjust your water input before preparing your sample to make the formula equal 100%. For example, if you wanted to add 0.3% extracts, you would add this at phase C and reduce the water input at the beginning by 0.3%.

17. Dry hair conditioner

PHASE	ADDED %w/w	RAW MATERIALS	FUNCTION
A	72.4	Purified water	Solvent
B	4.0	Cetearyl alcohol, cetareth-20	Emulsifier
B	6.0	Behentrimonium chloride	Conditioning agent
B	0.5	Shea butter	Emollient
C	10.0	Polyquaternium-7 (9%)	Conditioning agent
D	4.0	Glycerin	Humectant
D	1.0	Guar hydroxypropyltrimonium chloride	Viscosity modifier
E	1.0	Spectrastat	Preservative
E	0.8	Essential oils (your choice)	Fragrance/conditioning agent
E	0.2	Vitamin B5	Conditioning agent
E	0.1	Tocopherol	Antioxidant
F	q.s	pH adjuster	pH adjustment/chelating agent

METHOD:

1. Heat water to 70°C.
2. Heat phase B to 65 - 70°C and stir. When this starts to thicken, add to water and stir until thoroughly melted and mixed homogenously.
3. Allow to cool below 35°C and add phase C.
4. Precombine phase D ingredients to form a slurry. Slowly add this to emulsified phase A/B/C under constant stirring and stir for 15 minutes or until fully hydrated. Try to limit the amount of air introduced into the formula throughout your stirring. Once hydrated, allow a further 15 minutes before continuing.
5. Add ingredients from phase D, one after the other and mix slowly until homogenous.
6. Adjust pH to 4.0 – 4.5.

Extracts and proteins would be added with phase E. If planning to add these ingredients, adjust your water input before preparing your sample to make the formula equal 100%. For example, if you wanted to add 0.3% extracts, you would add this with the tocopherol and reduce the water input at the beginning by 0.3%.

18. Oily hair conditioner

PHASE	ADDED %w/w	RAW MATERIALS	FUNCTION
A	80.2	Purified water	Solvent
B	4.0	Behentrimonium chloride (25%)	Conditioning agent
B	4.0	Cetearyl alcohol, ceteareth-20	Emulsifier
B	0.1	Caprylic/capric triglyceride	Emollient
C	5.0	Polyquaternium-7 (9%)	Conditioning agent
D	4.0	Glycerin	Humectant
D	0.6	Guar hydroxypropyltrimonium chloride	Viscosity modifier
E	1.0	Spectrastat	Preservative
E	0.8	Essential oils (your choice)	Fragrance/conditioning agent
E	0.2	Vitamin B5	Conditioning agent
E	0.1	Tocopherol	Antioxidant
F	q.s	pH adjuster	pH adjustment/chelating agent

METHOD:

1. Heat water to 70°C.
2. Heat phase B to 65 - 70°C and stir. When this starts to thicken, add to water and stir until thoroughly melted and mixed homogenously.
3. Allow to cool below 35°C and add phase C.
4. Precombine phase D ingredients to form a slurry. Slowly add this to emulsified phase A/B/C under constant stirring and stir for 15 minutes or until fully hydrated. Try to limit the amount of air introduced into the formula throughout your stirring. Once hydrated, allow a further 15 minutes before continuing.
5. Add ingredients from phase D, one after the other and mix slowly until homogenous.
6. Adjust pH to 4.0 – 4.5.

Extracts and proteins would be added with phase E. If planning to add these ingredients, adjust your water input before preparing your sample to make the formula equal 100%. For example, if you wanted to add 0.3% extracts, you would add this with the tocopherol and reduce the water input at the beginning by 0.3%.

Product Name:

METHOD	1.
	2.
	3.
	4.
	5.
	6.
	7.
	8.
	Final pH required:

Final pH compatible with:	✓	Processing method (shear & temp) compatible with:	✓
• Preservative/s		• Preservative/s	
• Gum/Thickener		• Gum/Thickener	
• Emulsifiers/Surfactant		• Emulsifiers/Surfactant	
• Actives present		• Actives present	

Appendix B: Manufacturing flow chart for Lanette O®

carechemicals

LANETTE® O

Manufacturing procedure

July 2010

