BEESWAX: BACK TO BASICS

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INTRODUCTION

Personal care is an exciting, evolving field. Our progress is dependent on new regulations, environmental awareness, consumer perceptions and scientific advancement. At Koster Keunen we strive to educate, and in this article we will go back to basics to provide an overview and better understanding of one of the staples of the beauty industry and the oldest wax known to man: Beeswax.

The definition of wax is still fairly vague. Physically, a wax is a kneadable solid to a hard brittle material at room temperature, with a melt point above 40 °C and a relatively low viscosity above its melt point.[1] Because of this broad definition, waxes are generally classified according to their origin, allowing the chemical composition to be narrowed down within each category. Natural waxes, such as beeswax, are complex mixtures of organic compounds, mainly esters of long chain alcohols and acids. [2]

Beeswax is produced by honey bees of the genus Apis. Once secreted, it is then modified by the bee into the wax which will be used to build the honey comb, with the main purposes of honey and pollen storage and brood protection. [3]

Beeswax is one of the oldest cosmetic ingredients in the world. It was first put to use by the ancient people of China and Egypt. Egyptians used it in cosmetics and in hair preparations to hold curls and braids in place. Other documented historical uses include preservation of papyrus scrolls and, later, candle making, specifically for religious ceremonies. [4]

Today, beeswax is widely used in cosmetics, especially in color cosmetics and lip balms. In 2017, 7% of new product launches in the eye color, lip color and lip care categories contained beeswax or a beeswax derivative. This means more beauty products are currently being launched with beeswax than with other industry staples such as paraffin, dimethicone, or polyethylene (2%, 5%, and 4.5% of new product launches respectively). [5]

A UNIQUE CHEMISTRY

From a chemical point of view, beeswax is a fascinating ingredient with a highly complex composition. The major components, obtained via capillary gas chromatography, are listed in Table 1[6,7]

Beeswax is secreted on the thorax and abdomen of the Apis honey bee to form cuticular wax (produced by the epidermal cells) and scale wax (produced by abdominal glands) and is initially richer in hydrocarbons. The biosynthesis of hydrocarbons is suggested to come from fatty acetates being elongated and then decarboxylated. Simultaneously, beeswax esters result from enzymatic esterifications of C20 – C32 alcohols with palmitate-Co A (providing the C16 and C18 components).

The minor components of beeswax, called propolis or "bee glue", are not secreted by the bee but are collected by it from surrounding trees, shrubs, and flowers. Propolis consists of a highly complex mixture of mostly resins, oils, pollen, and flavonoids, which give beeswax some of its pliability and yellow color.

Newly secreted cuticular and scale wax, along with propolis are all manipulated and chewed by the bee, where they are chemically modified by salivary enzymes, rendering the mix ready for use as comb wax, which now has a different chemical composition richer in monoesters.[8] In the case of propolis, the biologically inactive components can become biologically active, which has been of great interest to the scientific community. The physical and chemical properties of beeswax are listed in listed in Table 2. [9,10]

Chemical Composition of Beeswax	
Monoesters	45 to 55%*
Hydrocarbons	15 to 18%
Free Fatty Acids	10 to 15%
Di and Complex Esters	8 to 12%
Hydroxy Monoesters	4 to 6%
Free Fatty Alcohols	1 to 2%
Minor Components	2 to 5%

Table 1 : Chemical composition of beeswax

Physical and Chemical Properties of Beeswax	
Melting Point	62 – 65 °C*
Cloud Point	< 65 °C
Flash Point	242 – 250 °C
Specific Gravity	0.95 - 0.96
Iodine Value	8 – 11
Saponification Value	89 – 103
Acid Value	17 – 24
Ester Value	72 – 79
Unsaponifiables	45 – 55 %

Table 2: Physical and chemical properties of beeswax

Beeswax is a remarkable cosmetic ingredient. It thickens and structures oils by forming stable gel networks where gel viscosity and hardness are proportional to the percent of beeswax. The gel also depends on the oil/wax compatibility, as is shown in Figure 1. [11] In realistic terms, by manipulating very few variables, cosmetic products will range from waxy hard sticks to soft sticky balms. The uniqueness of beeswax lies in its dual functionality as a structuring agent (due to the monoesters, hydrocarbons and fatty acids) and a plasticizer (due to the di- and complex esters), which is important for stick integrity, smooth textures, and even color deposition. The plasticizing properties in beeswax will also help prevent crystallization, "sweating", and bloom. This double functionality also simplifies the formulation process.

Beeswax also has widespread use as a thickener in emulsion formulas (both oil-in-water and water-in-oil), especially where a thick consistency is desired, such as butters or creams. Because of its free fatty acids, beeswax has the ability to form in situ soaps when heated with a base, therefore doubling as an emulsifier as well as a thickener. This is the basis of traditional cold creams, which have been in use since 400 AD. Sample formulations are provided in Tables 3 and 4.

*Variation within the range depends on many factors, including geographical region, climate, and bee subspecies.

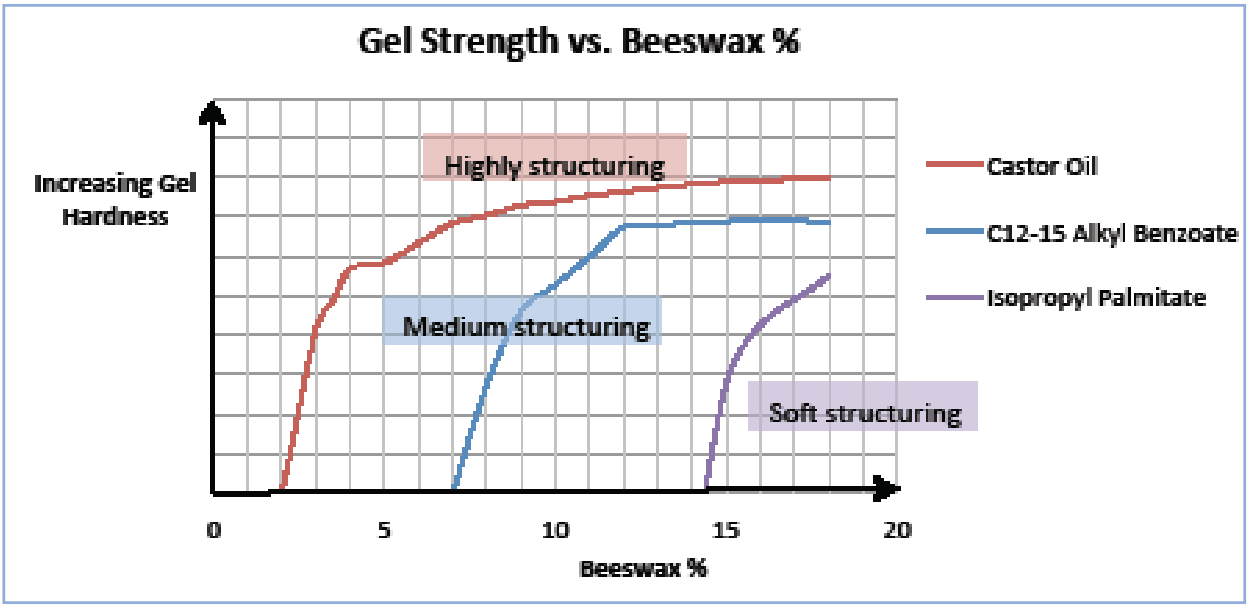

Figure 1. Gel strength and hardness as a function of % beeswax and oil medium.

Phase	**INCI**	**%**
A	**White Beeswax #421P** by Koster Keunen	**9.5**
	Ozokerite 175 by Koster Keunen	**8.0**
	Enhans SB-63 by Koster Keunen	**5.0**
	Cocoa Butter by Koster Keunen	**4.0**
	Kester Wax K-82P by Koster Keunen	**2.0**
	Ricinus Communis (Castor) Seed Oil	13.5
	Octyldodecanol	12.0
	Octinoxate	6.0
	Butyl Acrylate/Hydroxypropyl Dimethicone Acrylate Copolymer	3.0
B	**Color Concentrate:** Available upon request	37.0
Procedure: Available on request.		

Table 3: Sample lipstick formulation

Formula 2: All Natural Cold Cream		
Phase	**INCI**	**%**
A	**White Beeswax #421P** by Koster Keunen	**10.0**
	Kester Wax K-24 by Koster Keunen	**20.0**
	Behenic Acid by Koster Keunen	**1.5**
	Prunus Amygdalus (Sweet Almond) Oil	16.3
	Polyglyceryl-3 Stearate	1.0
	Tocopheryl Acetate	0.5
B	Water	44.8
	Glycerol	5.0
	Xanthan Gum	0.3
	Phenoxyethanol, Benzoic Acid, Dehydroacetic Acid	0.5
	Potassium Hydroxide	0.1
Procedure: Available on request.		

Table 4: Sample cold cream formulation

The complex composition of beeswax and its unique chemistry allow for the preparation of many derivatives, usually via esterification of the free fatty acids with suitable alcohols. Derivatives increase the functionality and application range of beeswax.

For example, our Peg-8 Beeswax and Cera Bellina both have a higher polarity than beeswax, making them compatible with a wider range of cosmetic ingredients, including sunscreens, or even water. Other examples of beeswax functionalization are our Behenyl Beeswax – where the removal of free fatty acids minimizes unwanted side reactions like in situ soap and salt formation - and our Enhans SB-63 – where the addition of new functional groups imparts new properties to the wax, like increased slip or higher pigment deposition.

A FASCINATING STORY

Beeswax is unique from a marketing perspective as well. It offers countless benefits, such as skin protection, natural origin, anti-microbial properties, and UV absorption.[13]

Beeswax is globally approved, biodegradable, non-toxic[14], non-irritant, and non-comedogenic[15]. It can be certified natural and/or organic by NPA, COSMOS, USDA, Ecocert and other certifying bodies. It is offered in different grades, such as NF (USP), and can be purchased with different certifications allowing for attractive packaging callouts, including "organic", "kosher", "halal", "non-GMO", "sustainable", "ethically sourced", "made in the USA", and many more.

Honey bees are fascinating social insects. Success of the colony depends on following a firm hierarchy, proper division of labor, and the ability to change behavior based on a series of chemical and tactile interactions.[16] Working as a team, Apis mellifera bees produce beeswax and honey, but also pollinate our crops. In the United States more than one-third of all crop production – ranging from nuts to berries to flowering vegetables - requires insect pollination.[17] Consumers unknowingly rely on commercial beekeepers to provide pollination services to farms, and beekeepers, in a reciprocal partnership, provide optimum conditions for bees to thrive.

Ironically, consumers swayed by the increasingly visible animal rights and vegan movements, as well as the shortcomings in animal welfare laws in the United States[18,19] are also putting beekeeping and beeswax harvesting under scrutiny. The facts are as follows: bees are not used as cosmetic raw materials, they are not exterminated for their beeswax, and they are not used as substrates for cosmetic testing.

Koster Keunen's position on beeswax is that it is a "cruelty-free" product. Worldwide, bees are not harmed in the farming process, in fact bees must be kept in optimal conditions in order to thrive and be productive. It is not in beekeepers' best interest to harm their bees, as bee product trade and pollination are part of their livelihood. In developing areas of the world, entire villages depend on the income from honey and beeswax trade.

Another area of controversy is the beeswax sourcing and its impact on communities. The beeswax that Koster Keunen purchases is sourced from all around the world, with an increased focus on specific locations in an effort to improve living standards. Our responsible sourcing promotes pure beeswax, economic development, and beekeeper safety. We work directly with beekeepers and their families, and our beeswax purchases provide a tangible impact on local communities (Koster, J., personal communication, December 2017).

ALTERNATIVES

Because beeswax is an animal by-product, it cannot obtain the currently popular certification of "vegan", nor can a cosmetic product that contains it. At Koster Keunen, we understand the market and offer a wide array of alternatives for our customers who need multiple options.

There are many synthetic replacements; blends of commercially available waxes engineered to closely match the properties of natural beeswax. As added benefits, these alternatives are cost effective and carry the vague INCI nomenclature of Synthetic Beeswax. In formulas with small percentages of beeswax they can be a "drop-in", but formulas with high amounts may require some rework.

We encourage formulators and product developers with natural and vegan needs to reach out to us. Finding a one-to-one natural replacement for beeswax can be difficult due to the uniqueness of beeswax chemistry and the high dependency on the end product application. Koster Keunen has the technology to assist in the process. For example, in mascaras, Rice Bran Wax can work well as an alternate, while for candles, we might recommend Soy Wax. For lipsticks where brittle formulas are problematic or for low viscosity gels with a tendency to crystallize, a plasticizer such as Kester Wax K-60P can be blended with another natural wax in order to mimic the performance of beeswax.

CONCLUSIONS

Beeswax is a well-established, indispensable raw material in the cosmetic industry. At Koster Keunen, our goal is to protect this resource and continue to understand beeswax, its chemistry and its possibilities. Formulators and cosmetic chemists will find it to be an effective thickener, film former, plasticizer and even emulsifier. Marketers can tell compelling stories; every stage of the beeswax journey is exciting, and it all begins with a young honey bee emerging from her hexagon.

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