The Role of Fats and Oils in Cosmetics[1]

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ABSTRACT

The earliest emollients in the history of cosmetics were the naturally occurring animal fats and vegetable oils. These provided soothing and smoothing action on the skin and grooming effects on head and beard hair. For the most part, odor problems limited the interest in oils derived from fish. With the increasing sophistication of users and increasing understanding of the technology of these materials, the shortcomings of natural fats and oils were overcome in several ways: (a) increased stability through use of antioxidants; (b) reduced odor through improved processing; (c) improved stability and diversification through chemical modification; (d) increased diversity through preparation of derivatives; and (e) substitution of mineral oil. Today the most important single cosmetic use of an unmodified natural fat or oil is that of castor oil as the base for lipsticks. Other unmodified oils have largely minor specialty uses, particularly in higher-priced cosmetics. These include almond oil, apricot kernel oil, sesame oil, safflower oil, wheat germ oil, avocado oil, turtle oil and mink oil. Cocoa butter is used to some extent in suntan products. Reconstituted fractionated coconut oil is widely used. Polyglycerol esters of fatty acids are increasing in importance. Hydrogenation has produced stable oils useful in cosmetics. Alkyl esters and monoglycerol esters of fatty acids offer a wider range of properties than the original oils. Improvements in the naturally occurring fats and oils have made it possible for them to compete in some characteristics, and current interest in "natural" cosmetics may turn the attention of the cosmetic chemist back to improved versions of the classical raw materials.

INTRODUCTION

Dating back to antiquity, fats and oils have played an important role in the composition of cosmetics, providing emolliency, moisturizing, grooming, and acting as solvents and vehicles to carry other agents. The use of materials extracted from natural sources was standard practice from the time of the Egyptians (1). The fats and oils that have been used over the centuries and are considered "classical" by the cosmetic chemist include almond, castor, coconut, olive, peanut, persic (from apricot or peach kernels) and sesame oils, cocoa and palm butters, bear and goose greases, lard and mutton tallow. The list includes some from animal sources but none from marine sources. Problems of odor have put severe limitations on any interest in oils derived from fish.

The Egyptians were known to use castor oil and olive oil (2). The skin preparations of the ancients consisted largely of animal fats and vegetable oils, especially sesame, olive and almond oils (1). In 150 A.D., the Greek physician Galen devised the first cold cream, consisting of olive oil, beeswax and water (3). Later developments following his time substituted almond oil for the olive oil, and still later it was found that stability of the emulsion could be enhanced by adding borax. A composition remarkably similar to this is still to be found in the current National Formulary (4) under the name of Rose Water Ointment. It is based on almond oil, waxes, sodium borate, water and fragrance.

Unguents that were popular with the Romans included animal fats such as goose, swan and hen (2).

Castor oil was introduced to Spain in the 15th century from America (5). The use of cocoa butter was recorded in skin cleansers in Spain in the 17th century (5). Skin and hair preparations in the 17th and 18th centuries were frequently based on lard or mutton tallow, both in Europe (5) and in North America (2).

The earliest lipsticks were based on lard, tallow, olive oil or sesame oil.

Brilliantines and pomades for grooming the hair have been based on olive oil, peanut oil, almond oil, sesame oil and castor oil. The American frontiersman used bear or goose grease for grooming his hair, largely to help keep his long locks out of his eyes.

DISCUSSION

Modern Usage

In the last half century the use of materials from natural sources continued, but with a shift away from the fats of animal origin. The principal reason was the continuing effort to develop cosmetic products with less greasy perception by the user. The shift to vegetable oils maintained the advantages of emolliency, grooming, safety and soothing effects with a reduction in the heavy greasy feel.

As reproducibility was improved, as purity was increased, as rancidity was reduced and as stability was increased, many of these materials became established as standards under specifications such as those of the United States Pharmacopeia (USP) (6), the National Formulary (NF) (4) and the standards of the Cosmetic, Toiletry and Fragrance Association (CTFA) (7).

The principal fats and oils used during the past half century (most are still in use today) include: almond oil, NF XIII; avocado oil; castor oil, CTFA; coconut oil, CTFA; mink oil; olive oil, USP XVIII; peanut oil, USP XVIII; persic oil, USP XIV; rice bran oil; safflower oil; sesame oil, USP XVIII; soybean oil; theobroma oil, USP XVIII; turtle oil; and wheat germ oil. Theobroma oil is better known to the cosmetic chemist as cocoa butter.

A prime factor in selecting among oils for use on the skin is the feel on the skin. This is a subjective matter, but a great deal of information related to this can be derived from studying the rheology of the material. Simple measurements of viscosity at one rate of shear are often inadequate for the purpose. In addition, other factors may play a substantial role. Relative occlusivity on the skin is important in achieving moisturizing. Compatibility with, and solubilization of, other materials can broaden applicability. Ability to form stable emulsions can be very significant. Odor and stability to light and oxygen are critical to modern cosmetic formulation. Light color can be an asset for some uses.

Some of these materials have found specialized applications that have continued until recent times. Castor oil was widely used in hairgrooms until very recently. It is still used extensively today in the base for lipsticks. It is unique for this use not only because of its viscosity and feel, but because of its high solvent power for the bromo acids which are sometimes used as lipstick stains. The unique structure

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of ricinoleic acid is apparently significant in imparting these properties.

Cocoa butter has been used in lipsticks in the past but it has the defect that it tends to bloom on the lips. Cocoa butter is still widely used today as a base for many suntan preparations, because of its texture and low melting point.

Almond oil and persic oil derived from either apricot or peach kernels continue to be used in skin preparations because they are classic for this use and serve the purpose well. However they tend to be in scarce supply.

Wheat germ oil (8) has been used because of its polyunsaturated nature in light of the evidence that dry skin is sometimes associated with certain dietary deficiencies of polyunsaturates. However topical application of polyunsaturated oils has not been shown to be more effective in moisturizing dry skin than other oils.

Oils from exotic sources, such as mink oil (9), turtle oil (8) and avocado oil (10) appear to have little scientific support for uniqueness, but are undoubtedly suited to the purpose of providing emolliency in a safe fashion.

Today, as an offshoot of the consumer interest in health foods and foods grown without the use of chemical fertilizers and pesticides, there has been considerable pressure to produce so-called "natural" cosmetics.

Paths to Improvement

It is quite possible that this will revive interest in the fats and oils of natural origin. This would represent a reversal in a trend which started ca. 25 years ago when the increasing sophistication of the cosmetic industry created pressure for raw materials of good reproducibility from batch to batch, low odor and high stability. The shift that started at that time was to overcome the shortcomings of natural fats and oils. The following approaches to achieve improvement will be discussed: (a) increased stability through use of antioxidants; (b) reduced odor through improved processing; (c) improved stability and diversification through chemical modification; (d) increased diversity through preparation of derivatives; and (e) substitution of mineral oil or petrolatum.

Antioxidants

Although many of the oils contain natural antioxidants, especially tocopherols, they are sometimes insufficiently stable to oxidation to meet the requirements of cosmetics (11). Therefore supplementation of the natural antioxidants by agents such as propyl gallate, butylated hydroxy toluene and other commonly used antioxidants has been helpful (12). The development of rancidity in a cosmetic product would be disastrous, so the cosmetic chemist must study carefully the potential influence of any natural oils on the stability of the product.

Deodorization

Because fragrance is one of the key attributes of most cosmetic products, the raw materials must be low in odor to avoid conflict with the fragrance. Deodorization of oils, for example by steam stripping (13), has been an important factor in making them more useful for cosmetics.

Chemical Modification

The third item in the list is improved stability and diversification through chemical modification. Aside from improvement in stability, such modifications can also create a whole new range of materials having properties desired for cosmetic use. For example, an important development has been the availability of reconstituted vegetable oils in which the fatty acids have been fractionated to yield triglycerides of desired molecular size range (14,15). In this way, lower viscosity and increased stability can be achieved. Alternatively, hydrogenation of unsaturated oils can yield hardened materials of heavier texture and greater stability (16). Such materials can fill needs in the same areas where cocoa butter and castor oil have been used so successfully in cosmetics.

Although not strictly a chemical modification, the cosmetic chemist has had made available to him recently a safflower oil abnormally high in oleic content. This has been achieved by genetic breeding of the plant rather than by chemical manipulation of the product.

Derivatives

The next path to improvement is to make derivatives of the fats and oils. They are mentioned here briefly only for purposes of indicating the variety of properties that can be introduced by chemical reaction and to indicate something about the types of properties that are desired in cosmetic raw materials.

Among the earliest of the derivatives utilized for cosmetic purposes were the monoglycerides, such as glyceryl monostearate (GMS), which have been widely used for their hydrophillic properties and as aids in emulsification and stabilization of emulsions. GMS is still widely used today in cosmetic emulsions. One of the reasons for interest in this type of material is the introduction of surface activity into the molecule.

A much more recent development to provide surface activity in derivatives of fats and oils is the availability of the polyglycerol esters such as decaglycerol decastearate, hexaglycerol distearate, etc. These polymerized esters offer a wide range of surface activity and solubility (17).

Another very important group of derivatives are the alkyl monoesters, such as isopropyl myristate. Some of these have become of interest because of their low viscosity and consequent nongreasy feel on the skin. Another important feature is their solubility and compatibility. Other examples in this group are isopropyl palmitate and butyl stearate.

Another important group of materials is the polyhydric alcohol esters of fatty acids, such as propylene glycol stearate, sorbitan oleate, polyethylene glycol stearate and so on. These are valuable materials in providing variations in viscosity, emolliency and surface activity.

Important surface active agents are derived by ethoxylation of fatty acids. Other derivatives that are used in cosmetics include acetylated monoglycerides (18) and epoxidized soybean oil (19).

Obviously, almost an infinite variety of derivatives can be made. Many of them have been evaluated and found interesting for cosmetic use, principally those mentioned above. In addition, there are almost endless variations yet to be prepared and evaluated. The requirements of low odor, high stability, reproducibility, solubility, compatibility and emolliency tend to favor the derivatives.

Mineral Oil and Petrolatum

The last item on the list notes that it is possible to substitute mineral oil for oils in cosmetics. Similarly, petrolatum can be substituted for fats. In recent years this has become increasingly true, as mineral oils and petrolatums of high purity and wide range of viscosity or consistency have been made available as cosmetic raw materials, and have cut heavily into the use of triglycerides. The low cost of these materials has made them attractive, especially because they are highly stable to light, heat and oxygen. They can provide excellent emolliency and occlusivity on the skin.

Preliminary experiments in our laboratories suggest that mineral oil is more occlusive on the skin than some vegetable oils, but there may be some, such as castor oil, that are in the range of mineral oil. The more occlusive an oil, the less of it is needed to achieve equivalent moisturizing of the skin, thus emphasizing the importance of

evaluating this property.

In competing with mineral oil or petrolatum, vegetable oils and animal fats are fighting an uphill battle with respect to odor, stability and cost.

REFERENCES

1. Poucher, W.A., "Perfumes, Cosmetics and Soaps," Seventh Edition, Vol. 2, Chapman and Hall Ltd., London, 1959, p. 3.
2. McDonough, E.G., "Truth About Cosmetics," The Drug and Cosmetic Industry, New York, 1937, p. 12.
3. Sarton, G., "Introduction to the History of Science." Vol. I, Williams and Wilkins, Baltimore, 1927.
4. National Formulary, 13th Edition, American Pharmaceutical Association, Mack, Easton, Pa., 1971.
5. Wall, F.E., "Origin and Development of Cosmetic Science and Technology," in "Cosmetics Science and Technology," Edited by E. Sagarin, Interscience, New York, 1957, p. 30.
6. Pharmacopeia of the United States of America, 18th Edition, U.S. Pharmacopeial Convention, Mack, Easton, Pa., 1971.
7. "CTFA Standards," Edited by N.F. Estrin, The Cosmetic, Toiletry and Fragrance Association, Inc., Washington, D.C., 1971.
8. De Navarre, M.G., "The Chemistry and Manufacture of Cosmetics," Second Edition, Vol. II, Van Nostrand, Princeton, N.J., 1962, p. 329.
9. Von Baumann, E., U.S. Patent 2,954,325 (1960).
10. Douglas, J.S., "The Avocado Pear and Avocado Oil," in Soap, Perfumery and Cosmetics XLIV(7):446 (1971).
11. Privett, O.S., "Oxidative Deterioration and Its Prevention in Miscellaneous Products," in Lundberg, W.O., "Autoxidation and Antioxidants," Vol. II, Wiley-Interscience, New York, 1962, p. 1005.
12. De Navarre, M.G., "The Chemistry and Manufacture of Cosmetics," Second Edition, Vol. I, Van Nostrand, New York, 1962, p. 299.
13. Norris, F.A., "Fats and Fatty Oils," in "Encyclopedia of Chemical Technology," Second Edition, Vol. 8, Wiley-Interscience, New York, 1965, p. 805.
14. "The Neobee Oils-Cosmetic and Pharmaceutical Applications," Drew Chemical Corp., Boonton, N.J., 1969.
15. "Norda Schimmel Briefs," Edited by R.C. Heald, No. 408, April 1969.
16. Jellinek, J.S., "Formulation and Function of Cosmetics," Wiley-Interscience, New York, 1970, p. 115.
17. "Cosmetic and Pharmaceutical Esters, Surfactants and Emollients," Drew Chemical Corp., Boonton, N.J , 1969.
18. De Navarre, M.G., "The Chemistry and Manufacture of Cosmetics," Second Edition, Vol. II, Van Nostrand, Princeton, N.J., 1962, p. 1.
19. "New Ingredients in Dispersible Bath Oils," in Norda Schimmel Briefs, Edited by R.C. Heald, No. 425, November 1970.

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