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Innovative Organic Lipids in Filtering the Chemistry in Cosmeceuticals

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Introduction

Organic food is defined as a product of a farming system which is produced by avoiding the use of man-made chemical fertilizers, pesticides, growth regulators and livestock feed. The system should basically rely on crop rotation, animal and plant manure, some hand weeding and biological pest control. Organic fertilizers release the nutrients with time and are less likely to be washed out compared to synthetic fertilizers. Most organic fertilizers are by-products of the food industry and are devoid of synthetics.

Medicines and food have a common origin. This ancient Japanese proverb is, in one form or another core to the medical folklore of almost all cultures around the globe. Modern science, however, is only now beginning to provide solid scientific evidence for this very concept. There is ample body of evidence that certain vitamins and particularly their antioxidant activities can help prevent or delay the onset of diseases such as heart disease and cancer. However, a host of nonnutritive components of plant foods, especially polyphenols and phytoestrogens have come to be recognized as "chemopreventers" (i.e., naturally appearing chemical components with the strong capacity to prevent certain diseases).

We all should strive for enhancing individual beauty without threatening the beauty of our planet. In recent years natural products have grown from a niche segment to one of the fastest growing categories in personal care. In fact natural personal care (NPC) has outperformed other natural product segments such as functional foods and supplements. Growth of NPC will continue following the growth of the nutraceutical market as the consumer drive continues towards natural products offering more value for money.

Although all attempts are being made to replace petroleum-based products with natural ones, the substitution is far from complete, owing to the lack of in-depth knowledge of the raw materials as well as product formulations and stability. Application of natural oils and fats was severely restricted due to oxidative degradation of lipids resulting in malodours, colour changes, viscosity increases, and changes in specific gravity, solubility and appearance. We recently described the technology of development of a unique means of stabilization of exotic butters and natural oils, thus avoiding any cumbersome application of antioxidants and avoiding heating, homogenisation, extra labour, and handling of additional powders. (Cosmetic Science and Technology 2005)

While using natural oils and butters, one can use either the properties of triacylglycerol constituents or nontriacylglycerol components (chemopreventers) or both as per the specific requirements of the product formulation in question. This paper deals with the art of engineering organic lipid products employing both the above characteristics.

Nontriacylglycerol constituents

The triacylglycerol constituents of fats and oils generally co-exist with non-triacylglycerol components, and these are represented mainly by unsaponifiable matter. Table 1 summarises the content of unsaponifiable matter in selected oils. Among other oils, shea butter, oat oil, neem oil, and avocado oil contain high amounts of unsaponifiables which are non-fatty compounds. Shea olein fraction may contain up to 12% unsaponifiable matter.

Oil	Unsaponifiables
Soybean	1.5
Canola/rapeseed	2.0
Sesame	2.0
Avocado	4.5
Neem	5.0
Oat	6.0
Shea	6.0
Wheat germ	3.0
Rice bran	3.5
Evening primrose	1.5
Borage	1.2
Black currant	1.2
Palm	1.2
Sal	1.5
Sunflower	1.0
Grapeseed	1.0
Almond	0.5
Hazelnut	0.5
Castor	0.5
Coconut	0.2

Table 1: Content of unsaponifiable matter in selected oils (%)

The unsaponifiable matter of fats and oils generally contains a variety of active ingredients that could stabilise them against deteriorative processes, although some might also pose specific problems. The nontriacylglycerol constituents belong primarily to the tocopherol/tocotrienol/phenolics and flavonoids, sterols, phospholipids, carotenoids, and triterpenyl alcohols as well as phytic acid family of compounds. Each oil may contain several classes of the above substances, and may have a pronounced effect on the stability of products and their nutritional properties. Table 2 below summarises the chemical classes of unsaponifiables in selected oils.

Oil	Unsaponifiable constituents
Rapeseed/canola	Sterols, tocopherols
Soybean	Tocopherols, sterols, triterpene alcohols
Palm	Tocotrienols, carotenoids, sterols, ubiquinones
Sesame	Tocopherols, sesamolin, sesamin, sesamol, sterols
Rice bran	Tocopherols, orzanol, phytic acid, sterols
Olive	Hydroxytyrosol, elauropein, phenolic acids, tocopherols,
Oat	Tocopherols, sterols, sterol esters, polar lipids, ferulates, caffeates
Avocado	Tocopherols, sterols, triterpene alcohols
Shea butter	Cinnamic acid esters, sterols and triterpene alcohols
Wheat germ oil	Tocopherols, ferulic acid esters with triterpenic alcohols, polar lipids

Table 2: Important chemical constituents of unsaponifiable matter

Effect of processing on minor constituents

Each processing step in the degumming, refining, bleaching, and deodorisation of edible oils is designed to perform a specific function for removing certain minor components from the sample. However, removal of compounds perceived as having deleterious effects should be kept at an optimum level so that their potential beneficial health effects are not totally negated by their removal from oils or effects thereof.

Ferrari et al. have reported changes in the minor constituents of vegetable oils during industrial processing as depicted in Table 3. It was clearly demonstrated that there was a marked decrease in the content of tocopherols during the deodorisation process. However, the content of sterols was less affected by heating. The compound plastochromanol-8 was a minor constituent, and its content did not change to any large extent.

Constituent	Crude	Degummed	Neutralized	Bleached	Winterized	Deodorized
Corn oil						
Tocopherols	194.6	–	203.8	201.9	193.5	76.7
Tocotrienols	7.9	–	10.2	10.0	9.8	6.1
Total sterols	1113.9	–	859.2	848.8	818.3	715.3
Rapeseed/canola oil						
Tocopherols	136.0	114.7	128.7	117.8	–	87.3
Total sterols	820.6	772.0	797.8	650.4	–	393.0
Soybean oil						
Tocopherols	222.3	291.9	267.7	284.0	–	195.2
Total sterols	359.5	321.5	313.9	288.8	–	295.4

Table 3: Changes in the content and composition of minor components of vegetable oils during industrial processing (mg/100 g)

Another oil component that might be fully depleted during processing is its carotenoid constituents. Bleaching of carotenoids in palm oil is an intentional industrial process employed to obtain a colourless product. However, production of red palm oil as a speciality product is now being practised.

Cold-pressed oils have the advantage over solvent-extracted oils as the cold-pressed oils retain much more of their valuable ingredients; thus pressed oils are more stable than extracted oils. However, this stability is only possible for oils where pressing is done at low temperatures of less than 50ºC so that the natural components do not degrade. In addition, cold extraction demands high-quality seeds that have not deteriorated oxidatively and whose oils contain low levels of free fatty acids.

Organic Lipids for Cosmeceuticals

The oil from the mechanical press contains moisture, waxes and other solid waste such as small fractions of the grain shells which remain suspended in the oil. These are removed by filtration through cotton cloth and subsequent decanting into vats which eliminates the waxes. A second step filtration is done using blotting paper to remove traces of moisture and wax.

The oil thus obtained has a high peroxide value and free fatty acid content. Instead of conventional neutralisation with alkali, the oil is deodorised using steam under high vacuum (around 2-5 mmbar) at temperatures varying between 150 – 210 degrees C. Under such conditions, both the free fatty acid content and the peroxide value drop considerably to required percentages. Thus the oil gets refined without the involvement with any kind of chemicals.

In some cases the oil is bleached using naturally active bleaching and clarifying adsorbents which do not contain mineral acid or other chemical compounds. Fractionated products like oleins and stearins are used for various product formulations. Such physical fractionations are done by cooling the parent oils at a suitable temperature without any solvents such as acetone, hexane etc. The oleins and stearins thus obtained retain their organic label and can be used for designing organic formulations.

Employing the natural power of fractionation we have engineered a range of raw materials with very high concentration of bio-actives and retained these in further processing, thus the resultant oil is the most clean and bioactives rich organic ingredient to be used in formulations.

At our company we have very recently developed a range of rejuvenated organic ingredients with moderately high Sun Protection Factor (SPF) value, based on vegetable lipids. They do not cause true allergy (contact dermatitis) as many synthetic compounds, nor the more common photosensitive irritation. The Rejuvenated Biolipid Series has an exceptional natural sun protection factor, contains natural antioxidants rendering the lipids more stable than conventional recipe engineered lipids, is antimicrobial and has healing properties.

The four rejuvenated bio organic products for cosmetic formulations are:

- Rejuvenated Biolipid SPF: Sun-protective creams, anti-wrinkle creams, body lotions, bath foams, baby care products and massage creams. This product provides high natural SPF (Sun Protection Factor), anti-microbial properties, antioxidant properties and healing effect.
- Rejuvenated Biolipid 100: Emollient for skin-care applications, a rejuvenated replacement of conventional shea butter in anti-wrinkle creams, body lotions, bath foams, baby care, sun-care products and massage creams.
- Rejuvenated Biolipid Danomega-3: Effective in adding nourishment to the skin especially in creams, lotions, anti-wrinkle creams, baby care products and massage creams and specifically anti-inflammatory cosmetic products.
- Rejuvenated Biolip Lipids: Specifically for lipstick production.

Organic Haircare with Amla

Amla is known for its medicinal and therapeutic potential from ancient times in India. Sushrutu, the father of ancient "Ayurveda" medicine, mentioned its therapeutic potential during 1500 BC – 1300 BC. Amla promotes healthier hair. It maintains youthful hair colour and retards premature greying, and supports the strength of the hair follicles, so there is less thinning with age. Its hair promoting properties are attributed to its high content of tannins (20%). When blended with rosemary it stimulates hair growth.

We have successfully combined these above strong properties to design organic exotic butters such as mango and shea as ingredients for the hair care industry.

Conclusion

Products based on natural ingredients have always been popular with consumers, whether functional, isolated chemical or biologically-targeted ones, they are of significant value in beauty care. This paper successfully demonstrates the art of production of all natural active ingredients for skin care and hair care formulations using organic lipids. These all natural ingredients will provide new impetus in designing safe, innovative, high performance, elegant feeling and, above all, completely natural series of cosmeceuticals. The beauty of these products is that they provide all properties such as antioxidant, antimicrobial, healing and natural SPF in one envelope.

Author's Biography

Awards: AOCS's Fellow Award (2005), AOCS's Stephen S. Chang Award (2002), AOCS's Herbert J. Dutton Award (1996).

Author of more than 110 original scientific publications, 3 invited review papers, 8 book chapters in the areas of biochemistry, human nutrition, enzymology, modern analytical techniques for the separation of lipids and proteins.

Specialization

Vijai K.S. Shukla's research interests have ranged from physical phenomena to mechanism of autoxidation, isolation of lipids, spectral phenomena related to lipids, modern analytical methodology and involvement of essential fatty acids in health and diseases such as multiple sclerosis and Batten's syndrome.

Shukla has shown essential fatty acid deficiency in multiple sclerosis and Batten's disease. These were related with glutathione peroxidase activity and antioxidants requirements in these diseases. Shukla has also analyzed arctic diet in Greenland Eskimos and compared with Danes elucidating some of the mechanism of coronary heart diseases in these population groups. In his research work Shukla employs modern analytical methodology in order to resolve various scientific problems.

Accomplishments in Industrial Applications

Shukla has been working in the area of confectionery product development for the last sixteen years. He has a special expertise in cocoa butter, milk fat, cocoa butter equivalents and cocoa butter substitutes based on modern concepts of recipe engineering.

Shukla has always applied scientific principles to upgrade or modify existing production to achieve super quality products. Some of his major achievements are as follows:

During 1996 Dr Shukla has established a brand new refinery in Holland and has successfully demonstrated that total oxidation in bulk oils can be completely arrested and speciality fats delivered to the customers will be of extremely fresh quality. These deliveries were in the scale of 500-1000 MT per shipment. A proper research approach clearly shows that it is possible to provide an uplift to large scale production through extreme caretaking the help of nitrogen as intert gas and stainless steel in the production system. A number of international press articles presented these developments.

For the last decade Dr Shukla's research has focussed on the quality of encapsulated fish and vegetable oils. He has successfully demonstrated that it is possible to produce an ultrarefined fish oil with extreme low peroxide value and anisidine value. This oil is already in commercial production.

Having produced the above mentioned oils it is of utmost importance to keep these oxidation values extremely low therefore he has designed several natural antioxidant systems for general nutrition as well as cosmetic oils. This natural antioxidant system is 50 to 60 times more powerful than existing available antioxidants.

He has recently developed a novel designer oil called Nutridan containing very high amounts of essential polyunsaturated fatty acids. The oils used are of vegetable origin and extracted by physical means and are thus totally solvent free. Nutridan provides not only balanced essential fatty acids, but also a high dosage of natural antioxidants which are extremely beneficial for better health. Nutridan helps to lower the ratio of omega 6/omega 3 fatty acids in human nutrition.