

Full Length Research Paper

Taxonomic perspective of plant species yielding vegetable oils used in cosmetics and skin care products

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Accepted 17 November, 2004

A search conducted to determine the plants yielding vegetable oils resulted in 78 plant species with potential use in cosmetics and skin care products. The taxonomic position of these plant species is described with a description of vegetable oils from these plants and their use in cosmetics and skin care products. These species belonged to 74 genera and 45 plant families and yielded 79 vegetable oils. Family Rosaceae had highest number of vegetable oil yielding species (five species). Most of the species were distributed in two families (Anacardiaceae and Asteraceae) containing four species each, followed by seven families (Boraginaceae, Brassicaceae, Clausiaceae, Cucurbitaceae, Euphorbiaceae, Fabaceae and Lamaceae) containing three species each of oil yielding plants. Five families (Apiaceae, Dipterocarpaceae, Malvaceae, Rubiaceae and Sapotaceae) have two species each of vegetable oil yielding plants. Two monocotyledonous families Arecaceae and Poaceae contained three species each of oil yielding plants. Remaining 28 vegetable oil yielding species were distributed in 28 plant families, which included two species of gymnosperms distributed in family Cupressaceae and Pinaceae. These vegetable oils are natural and can be used as the base for mixing ones own aromatherapy massage or bath oil, or if preferred can be used as ready blended massage oils or bath oils. Apart from their medicinal value, vegetable oils have heat contents approximately 90% that of diesel fuel and are potential alternate fuel candidates. By combining the skills and efforts of biologists, food scientists, plant breeders and oil companies it may be possible to develop reasonably priced vegetable oils with enhanced levels of functional ingredients. With growing trend of using vegetable oils in food preparation and body and skin care, the health benefits in reducing heart disease and body and skin ailments could be substantial.

Key words: Taxonomy, vegetable oils, uses, cosmetics, skin care products.

INTRODUCTION

Many species of plants produce seeds containing fats which are used as a food reserve for the developing seedling and they are quite often present in sufficient quantities to make their extraction, in the form of oil, worthwhile. Vegetable oils are produced from nuts, seeds, grains and beans. They are sometimes referred

to as fixed oils because they are not as volatile (easily evaporated) as essential oils. Vegetable oils have a wide range of uses, and whilst many of these involve processes that are too technical for small scale ventures, there are still many ways in which we can employ them as a food or as a lubricant, a fuel for paraffin lamps and as a wood preservative (Goldberg and Williams, 1999; Gunstone, 2002). Some of them also have medicinal properties and make an excellent base in which to dilute essential oils for body and skin care products (Riechart, 2002).

Many components naturally present in vegetable oils have been shown to have beneficial properties. Once isolated and concentrated, a number of these compounds have proven effective in treating a wide range of conditions ranging from irritable bowel syndrome to chronic liver disease (De Deckere and Verschuren, 2000;

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Foster and Duke, 1990; Moerman, 1986, 1991, 1996; Okuyama, 1992; Riechart, 2002; Said, 1969; Shaheen et al., 2003). Similarly, many of the fatty acids and other compounds present in vegetable oils have long been known to benefit our health. There is clearly great potential for developing functional vegetable oils (De Deckere and Verschuren, 2000; Riechart, 2002; William and Ahmad, 1999).

Classification of medicinal plants is organized in different ways depending on the criteria used. In general, medicinal plants are arranged according to their active principles in their storage organs of plants, particularly roots, leaves, flowers, seeds and other parts of plant (Athar and Siddiqi, 2004; Foster and Duke, 1990; Moerman, 1986, 1991, 1996). These principles are valuable to mankind in the treatment of diseases (Duke, 1997; Shaheen et al., 2003). Reports on the classification of many plant species yielding vegetable oils used in cosmetics and body and skin care preparations are sporadic or lacking (Gunstone, 2002; Riechart 2002). Athar and Siddiqi (2004) described the taxonomy, distribution and flowering period of some of the medicinal flowers of Pakistan. This paper describes the taxonomy of plants yielding vegetable oils and summarizes main constituents of various vegetable oils and use of these oils for various skin problems.

MATERIALS AND METHODS

This study is based on extensive on line and library search, study through MEDLINE of research papers, review articles and book reports to find out plants species yielding vegetable oils used in cosmetics and body and skin care products (Athar and Siddiqi, 2004; Boercher et al., 2000; De Deckere and Verschuren, 2000, Duke, 1997; Foster and Duke, 1990; Goldberg and Williams, 1999; Gunstone, 2002; Huang and Needham, 2001; Moerman, 1986, 1991, 1996; Riechart, 2002; Said, 1969; Shaheen et al., 2003; William and Ahmad, 1999). A list of plants yielding vegetable oils was prepared and their taxonomic position determined (Table 1). The nomenclature and classification followed Bailey and Bailey (1976) and author citations followed Brummitt and Powell (1992). The genera were arranged alphabetically within families. The scientific names of the plants and common names of vegetable oils are provided. The table also summarizes the ailments, main constituents of various vegetable oils and principal method of application. The table does not rank the order of the species importance as a medicinal source for various skin problems.

RESULTS AND DISCUSSION

The taxonomic position of 78 plant species and the potential use of vegetable oils from these plants in cosmetics and skin care are described in Table 1. These species belonged to 74 genera and 45 plant families and yielded 79 vegetable oils. It is interesting to mention that *Persia americana* Mill. yielded both the avocado butter and avocado oil. Family Rosaceae had highest number of vegetable oil yielding species (five species). Most of

the species were distributed in two families (Anacardiaceae and Asteraceae) containing four species each, followed by seven families (Boraginaceae, Brassicaceae, Clausiaceae, Cucurbitaceae, Euphorbiaceae, Fabaceae and Lamaceae) containing three species each of oil yielding plants. Five families (Apiaceae, Dipterocarpaceae, Malvaceae, Rubiaceae and Sapotaceae) have two species each of vegetable oil yielding plants. Two monocotyledonous families Arecaceae and Poaceae contained three species each of oil yielding plants. Remaining 28 vegetable oil yielding species were distributed in 28 plant families which included two species of gymnosperms distributed in family Cupressaceae and Pinaceae (Table 1). The list is quite long and yet not complete as more plants species could be explored and added to the list. Majority of the species are annuals, however, there are quite a few perennial species that could be utilized for oil production. Details of all the vegetable oils are not provided here except for some of the most common ones like soybean, linseed, walnut, sunflower and safflower (Table 2).

Due to their healing and nurturing properties, vegetable oils have been extracted from various plants for many years for use in cosmetics and body and skin care products. These plants are ever lasting, easily available and century old tested source for healing various skin ailments (Riechart, 2002). The vegetable oils and ground seeds need to be kept refrigerated because they oxidize easily and become rancid (Huang and Needham, 2001). For treating some conditions, such as rheumatoid arthritis or diabetic neuropathy, one may try oils high in gamma linolenic acid, such as primrose oil. This free oil is no longer to be thought of as a food, it is a medication used to treat symptoms of a disease with both positive and negative effects.

Oils are often divided into three categories according to their qualities, these categories are non-drying, semi-drying and drying (Gunstone, 2002). Non-drying oils are slow to oxidize and so remain liquid for a long time. This quality makes them particularly useful as lubricants and as a fuel for lamps. Drying oils, on the other hand, are quite quick to oxidize and become solid, thus they are often used in paints and varnishes, a good example being linseed oil. Semi-drying oils have qualities intermediate between the above two groups. Since plants synthesize these fats they are the original and obvious source of all essential fatty acids. If animals, such as fish, have significant amounts of essential fatty acids in their tissues, it is because they ate plants, like algae, which originally made the essential fatty acids. Natural oils contain combinations of varying amounts of both w-6 and w-3 fats, as well as several saturated and monounsaturated fats (Blackburn, 1992). Essential fatty acids are found in significant amounts in various plants some of them are presented in Table 2.

These vegetable oils are natural and can be used as the base for mixing ones own aromatherapy massage or

Table 1. Taxonomy of plant species yielding vegetable oils used in cosmetics and skin care products.

Species	Vegetable Oil	Cosmetic and skin care uses
GYMNOSPERMS		
Cupressaceae		
<i>Juniperus communis</i> L.	Juniper Berry Oil	Juniper berry oil has a warm, woody, peppery, pine smell that is uplifting and strengthening. Used by Native Americans to purify the air, it is highly anti-septic. Juniper berry oil can be used as an astringent for the skin and hair and in anti-cellulite massage blends.
Pinaceae		
<i>Pinus pinea</i> L.	Pine Nut Oil	A Mediterranean delicacy, the edible seeds are known as 'pignons' or 'pinocchi' and they yield a novel moisturizing oil.
ANGIOSPERMS		
MONOCOTYLEDONS		
Arecaceae (Palmae)		
<i>Cocos nucifera</i> L.	Coconut Oil	A traditional and trusted moisturizing and protective oil from the tropics. One of the most respected oils found in the British Pharmacopoeia.
<i>Orbignya oleifera</i> Burret= <i>Attalea speciosa</i> Mart.ex Spreng.	Babassu Oil	Originating from the Brazilian rainforest, this oil is reported to be non-comedogenic. It leaves the skin with a soft, lustrous smoothness.
<i>Elaeis guineensis</i> Jacq.	Palm Oil	Palm is considered the tallow of vegetable soaps, it lends hardness and smooth creamy bubbles to soap. Palm oil is also used in the manufacture of soaps, detergents and other surfactants. It's hard to find a soap recipe that doesn't include palm oil.
Poaceae (Graminae)		
<i>Oryza sativa</i> L.	Rice Bran Oil	A moisturizing oil, rich in gamma oryzanol.
<i>Triticum vulgare</i> Vill. = <i>Triticum aestivum</i> L. subsp. <i>aestivum</i>	Wheatgerm Oil	Contains one of the highest levels of natural vitamin E and is a valuable additive to any skin care product where care and protection of the skin is important.
<i>Zea mays</i> L.	Corn Oil	Corn oil is mostly used in frying and cooking the food. It is emollient and skin lubricant.
DICOTYLEDONS		
Actinidiaceae		
<i>Actinidia chinensis</i> Planch.	Kiwi Seed Oil	An oil rich in vitamin E, the Kiwi or Chinese gooseberry, grown in New Zealand, is a significant source of skin nutrition and protection.
Anacardiaceae		
<i>Anacardium occidentale</i> L.	Cashew Nut Oil	An lubricious oil rich in proteins, that can be used wherever a skin nourishing effect is needed.
<i>Mangifera indica</i> L.	Mango Seed Oil	This oil from Asia is a greatly respected emollient that is often used as a cocoa butter replacement.
<i>Pistacia vera</i> L.	Pistachio Nut Oil	An oil that is substantive and protective to the harshest of external conditions. Compares favorably with peanut oil.
<i>Sclerocarya birrea</i> (A. Rich) J.O. Hochst.	Marula Oil	An oil from the fruit of a tree much revered by the indigenous people of Southern Africa, who extract the oil themselves for cracked, dry or damaged skin. It is a prized cosmetic oil for both skin and hair, being similar to olive oil in composition.
Apiaceae (Umbelliferae)		
<i>Coriandrum sativum</i> L.	Coriander Oil	As the coriander oil stimulates circulation, it is helpful in cellulite, effective in relieving facial neuralgia and helps to fight fungal infections. Also useful for arthritis, broken capillaries, dandruff, eczema, muscular aches and pains, rheumatism, spasms, stiffness and sweaty feet
<i>Daucus carota</i> L.	Carrot Oil	A source of beta-carotene and provitamin A natural color and skin nutrient. Often used in sun care products.

Table 1. Contd.

Asteraceae (Compositae)		
<i>Artemisia sphaerocephala</i> Krasch.	Artemisia Oil	This oil comes from a family that includes Mugwort, Chinese Wormwood, Davana and Absinthe. The Artemisia family shares the common feature of being beneficial to the skin, especially to keep it clear of infection and improve wound healing.
<i>Calendula officinalis</i> L.	Marigold Oil	An oil that would be in any herbalist's arsenal for the care of bruised or damaged skin. Especially good for chapped or roughened skin. Also traditionally used for the care of varicose veins.
<i>Carthamus tinctorius</i> L.	Safflower Oil	Safflower oil is mentioned in ancient Egyptian texts and was used to heal old wounds. It has an exceptionally high linoleic acid content and is an excellent choice for the replenishment of moisture in skin crèmes and lotions.
<i>Helianthus annuus</i> L.	Sunflower Oil	A simple yet cost-effective emollient oil, well tried and tested for generations in a wide variety of emulsions formulated for face and body products.
Berseraceae		
<i>Canarium</i> spp.	Ngali Oil	A precious oil is extracted from this exotic tree (which also provides a valuable resin) for use as a local remedy for dry skin.
Betulaceae		
<i>Corylus americana</i> Marshall	Hazelnut Oil	Hazelnut oil contains phospholipids which give greater and longer-lasting moisturizing potential to cosmetic emulsions.
Bombaceae		
<i>Adansonia digitata</i> L.	Baobab Oil	An African tree steeped in mystery, legend and religious significance. The fruit provides an exquisite oil that is a rich and substantive moisturizer.
Boraginaceae		
<i>Borago officinalis</i> L.	Borage (Starflower) Oil	Another rich plant source of GLA. Excellent moisturizer in skin care. A prized oil for its abundant food, health, cosmetic and medicinal benefits.
<i>Lithospermum erythrorhizon</i> Siebold & Zucc.	Shikonin Seed Oil	Known by the Chinese name Zi Cao or in English as Gromwell, this material shows clinical anti-inflammatory activity and is used in traditional Chinese medicine for the treatment of burns, sores, eczema and scalds. It has also been shown to increase the growth of epithelial cells.
<i>Trichodesma zeylanicum</i> (Burm. f.) R. Br.	Wild Borage Oil	This oil is not totally unrelated to our borage (<i>Borago officinalis</i> L.) since it is from the same family. It originates from Tanzania, where it is used for its emollient and soothing properties. It may also be found in Pakistan, where it is used for similar purposes.
Brassicaceae (Cruciferae)		
<i>Brassica compestris</i> L.	Canola (rapeseed)	Canola (rapeseed) is mostly used in frying and cooking the food. It is emollient and skin lubricant.
<i>Camelina sativa</i> (L.) Crantz	Gold of Pleasure Oil	Probably introduced by the Romans, this oil has an amazing lubricity which makes it ideal for those products where spread ability is required.
<i>Sisymbrium irio</i> L.	Sisymbrium Irio Oil	This seed oil was much loved by the Romans and is still used today by the beautiful women of Asia for improvement of the complexion. It can be used with great benefit in skin care preparations.
Buxaceae		
<i>Simmondsia chinensis</i> (Link) C.K. Schneid.	Australian Golden Jajoba Oil	Australian golden jojoba oil is extracted from jojoba plants grown in the vast desert areas in Australia. It is a stable oil with very long shelf life. Similar to the skin's own sebum, unrefined jojoba oil has superior moisturizing properties. Suitable for soap making and for creams, lotions, hair care products and body oils. Perfect as a perfume base and for essential oil dilution.

Table 1. Contd.

Cannabinaceae		
<i>Cannabis sativa</i> L.	Hemp Oil	A virtually cannabinoid-free oil that rivals linseed for its richness and high arachidonic acid content. A perfect choice for skin protection.
Clusiaceae (Guttiferae)		
<i>Calophyllum inophyllum</i> L.	Tamanu oil, Foraha oil	The oil is obtained from dried nuts of the Tamanu tree found in the Pacific and Asian tropical regions. Tamanu oil has hydrating and soothing effect on the skin, relieves irritations such as sun burn, inflammation and general rashes, and helps regenerate skin cells. Tamanu oil is useful for the treatment of rheumatism, eczema and inflammatory skin and helps heal cuts and wounds while acting as a germicide to prevent infection.
<i>Garcinia indica</i> (Thouars) Choisy	Kokum Butter	Kokum butter is produced in India from the fruit kernels and contains oleic acid, stearic acid and palmitic acid. It has application in skin and hair products, acne products and skin tonics.
<i>Pentadesma butyracea</i> Sabine	Pentadesma Butter	An oil from fruit kernels has physical, chemical and cosmetic properties close to shea butter. An unexpected high proportion of stigmasterol is reported in the oil.
Cucurbitaceae		
<i>Cucurbita pepo</i> L.	Pumpkin Seed Oil	The oil from pumpkin seeds has been used across the world as a treatment for sores, ulcers and other skin problems. Its high sterol and vitamins E content makes it ideal for the this purpose
<i>Citrullus lanatus</i> (Thumb.) Matsum & Nakai	Watermelon Seed Oil	Known since the time of ancient Egyptians, the seed oil has been used for the care of the skin, to maintain its beauty and aid in its repair.
<i>Telfairia pedata</i> (Sm. ex Sims) Hook.	Oyster Nut oil	A novel oil that offers skin conditioning and protection against the loss of precious skin hydration.
Dipterocarpaceae		
<i>Shorea robusta</i> C.F. Gaertn.	Sal Butter	Sal butter is produced in India from the kernels of sal tree. The butter has a composition close to that of mango butter and physical properties close to cacao butter.
<i>Shorea stenoptera</i> Burck	Illipe Butter	An exotic material from the rainforests of Borneo. This rich butter is packed with natural fatty acids, triglycerides and phytosterols to protect and moisturize the skin by complementing its natural lipid layer. A wonderful alternative to cocoa butter which closely resembles it chemically.
Elaeagnaceae		
<i>Hippophae rhamnoides</i> L.	Seabuckthorn Oil	Obtained from the maceration and extraction of the fruit into olive or sunflower oil, this is an old and traditional remedy handed down by generations of battling Mongols for the treatment of bruised and battered skin. Ideal for inclusion in "sports" ranges.
Euphorbiaceae		
<i>Aleurites moluccanus</i> (L.) Willd.	Kukui Nut Oil	To the Hawaiians this tree is a symbol and a legend. The oil is a panacea for delicate, sensitive or dry skin and is pure and gentle enough to use on a baby's delicate skin.
<i>Ricinus communis</i> L.	Castor Oil	A very glossy oil on the skin. Used in lipsticks, lip balms and lip salves. Also used in transparent soaps and hair grooming products.
<i>Ricinodendron rautanenii</i> Schinz = <i>Schinziophyton rautanenii</i> (Schinz.) Radcl.-Sm.	Manketti Nut Oil	The Manketti Nut or Mongogo Nut is a source of a precious edible oil from Namibia that is rich in phytosterols and natural proteins. It is highly prized emollient that will pamper the skin to leave it lusciously protected.
Fabaceae (Leguminosae)		
<i>Arachis hypogaea</i> L.	Peanut Oil	A traditional oil for use in sunscreen preparations and after-sun oils. It is substantive and protective to the harshest of the external conditions.

Table 1. Contd.

<i>Glycine max</i> (L.) Merr.	Soybean Oil	This plant has been known and used by the Chinese for more than 4,000 years, though today most of the oil comes from the USA. This oil is cost-effective base on which to prepare hair and body products where good honest moisturisation is required at a budget price.
<i>Medicago sativa</i> L.	Alfalfa Oil	Reported to reduce the erythema caused by sunburn. Rich in carotenes and lutein.
Flacourtiaceae		
<i>Taraktogenos kurzil</i> King = <i>Hydnocarpus kurzii</i> (King) Warb.	Chaulmoogra Oil	An oil native to Burma and China, it is an Indian remedy for problem skins, particularly for dry, desquamative skin conditions and sores.
Grossulariaceae		
<i>Ribes nigrum</i> L.	Blackcurrant Seed Oil	A rich source of GLA and a superb moisturizer which can be used in place of evening primrose or borage seed oils.
Hypericaceae		
<i>Hypericum perforatum</i> L.	St. John's Wort Oil	An orange-red oil that takes its color from the hypericin it contains. This oil is part of most herbalists' repertoire for damaged skin, bruises and other skin problems. Especially useful for sensitive skin products.
Juglandaceae		
<i>Juglans regia</i> L.	Walnut Oil	Probably a native of Persia, this nut provides an emollient oil which has been used for its efficacy on dry and damaged skin. In mythology, white man ate the acorns the Gods ate the Walnuts.
Lamiaceae (Labiatae)		
<i>Hyptis suaveolens</i> (L.) Poit	Hyptis Oil	A high concentration of omega-6 lipids makes hyptis oil an ideal choice in products for dry, flaky skin.
<i>Perilla frutescns</i> (L.) Britton.	Perilla Oil	Known by the Chinese name of Zi Su or in English as the beefsteak plant or Perilla, this material shows anti-septic activity and has been shown to be effective against Propionibacterium acne responsible for acne.
<i>Salvia hispanica</i> L.	Chia Oil	A rich luxuriant oil with a wonderful ancient Aztec storyline. It contains an abundance of linolenic acid which helps to explain its substantive feel on the skin.
Lauraceae		
<i>Persea americana</i> Mill.	Avocado Butter	Reported to contain a complex blend of vitamins A and E and other active materials which increases skin elasticity and encourages healthy skin.
<i>Persea americana</i> Mill.	Avocado Oil	A light, fast penetrating oil that was reported to be absorbed faster by the skin than corn, soybean, almond and olive oils.
Lecythidaceae		
<i>Bertholletia excelsa</i> Bonpl.	Brazil Nut Oil	An oil rich in proteins and vitamins E and A, this precious gift from the South American rainforest comes from the fruit (nut) of a tree that can grow for a thousand years. Brazil nuts, or paranuts, produce an oil that is rich emollient and a moisturizer not too dissimilar to sesame oil.
Limnanthaceae		
<i>Limnanthes alba</i> Hartw. ex Benth.	Meadowfoam Seed Oil	An oil that is stable, non-greasy and rapidly absorbed. This oil is ideal for those products where a soft, smooth, silky feel is required whether it be on skin or hair.
Linaceae		
<i>Linum usitatissimum</i> L.	Linseed Oil	An ancient cultigen widely grown in Asia and North America as a fiber plant and as a seed crop for linseed oil. Oil is used in soaps, inks, and in the production of linoleum. Note that the first three letters of linoleum are <i>lin...</i> for linseed.

Table 1. Contd.

Malvaceae		
<i>Gossypium hirsutum</i> L.	Cotton seed Oil	Cottonseed oil is mostly used in frying and cooking the food. It enhances the fresh natural flavor of the food. It is also emollient and skin lubricant. Another benefit of the cottonseed oil is the high level of anti-oxidants (vitamin E).
<i>Hibiscus cannabinus</i> L.	Kenaf Oil	It is cultivated secondarily for the seeds which contain about 20% oil, used for: salad, cooking, and lubricant oils. Kenaf oil is also used in the manufacture of soap, linoleum, paints and varnishes and for illumination.
Meliaceae		
<i>Melia azadirachta</i> L. = <i>Azadirachta indica</i> A.Juss.	Neem Oil	A very aromatic oil, neem is one of Indo-Pakistan's most respected treatment for problem skin.
Oleaceae		
<i>Olea europaea</i> L.	Olive Oil	An oil that is mentioned in the Bible and was known to the ancient Greek and Phoenicians, who introduced it into Spain. This oil is legendary for its safe, gentle care and treatment of the skin.
Onagraceae		
<i>Oenothera biennis</i> L.	Evening Primrose Oil	A favorite source of GLA, this modern seed oil is a well known and much loved moisturizer and skin nutrient.
Orchidaceae		
<i>Vanilla planifolia</i> Jacks.	Orchid Oil	A light delicate oil that is perfect for providing a light miniaturization to those products where the after-skin feel should be a whisper
Papaveraceae		
<i>Papaver orientale</i> L.	Poppy Seed Oil	Containing virtually no opiates, this must be the sister to hemp oil and could be used in any products where an interesting moisturizer is required with an emotive story line in the pack copy.
Passifloraceae		
<i>Passiflora edulis</i> Sims.	Passionflower Oil	A light, gentle oil with connotations of being soothing and relaxing. It leaves a natural soft feel to the skin without being over-occlusive.
Pedaliaceae		
<i>Sesamum indicum</i> L.	Sesame Oil	Also known as gingili oil, this oil has been known since earliest antiquity, from ancient Egypt to the Indo-Pakistan sub-continent, as a soothing, gentle emollient. It is an extremely good substitute to oil and has excellent longevity in massage preparation.
Proteaceae		
<i>Macadamia ternifolia</i> F. Muell.	Macadamia Nut Oil	An oil from the "king of Nuts", this Hawaiian emollient is reported to have properties akin to those of sebum.
Rosaceae		
<i>Prunus amygdalus dulcis</i> L.= <i>Prunus dulcis</i> (Mill.) D.A. Webb	Sweet Almond Oil	Much loved for generations, listed in the British Pharmacopoeia and an excellent choice for even the most simple of the moisturizers or massage oils. Almond oil should be in every formulators' palette.
<i>Prunus armeniaca</i> L.	Apricot Kernel Oil	A skin conditioning agent that is emollient, non-greasy and ideal for dry, tired and mature skins.
<i>Prunus avium</i> (L.) L.	Cherry Pit Oil	An oil with an interesting profile of fatty acids. It moisturizes and protects the skin to leave it soft and smooth.
<i>Prunus persica</i> (L.) Batsch	Peach Kernel Oil	A skin conditioning agent that is emollient, non-greasy and ideal for dry, tired and mature skins. Can be used as an equivalent to apricot kernel oil.
<i>Rosa canina</i> L.	Rose Hips Oil	The rose of Mosqueta oil, which was once described as the 'Fountain of Youth'. This oil is remarkable for its benefits to damaged and distressed skin

Table 1. Contd.

Rubiaceae		
<i>Coffea arabica</i> L.	Coffee Oil	An unusual and exciting proposition for an emollient. This oil has connotations of being reviving and stimulating.
<i>Gardenia taitensis</i> DC.	Manoi	The tropical paradise of Tahiti captured in one gloriously fragranced oil which overpowers the senses with its rich floral bouquet. The pure delight of gardenia flowers infused in skin-loving coconut oil from <i>Cocos nucifera</i> .
Sapotaceae		
<i>Argania spinosa</i> (L.) Skeels.	Argane Oil	Rich in natural sterols, this oil from Morocco is used by the local women to keep their skin soft, smooth and protected.
<i>Butyrospermum parkii</i> Kotschy = <i>Vitellaria paradoxa</i> C.F. Gaertn.	Shea Butter	This rich buttery oil from central Africa is used for the protection and care of skin cracked and dehydrated by the elements. Beurre de karate is an elegant addition to products crafted for the smoothing and replenishment of dry skins.
Sterculiaceae		
<i>Theobroma cacao</i> L.	Cocoa Butter	A traditional African remedy for dry skin, suitable for the most delicate of skin types.
Theaceae		
<i>Camellia sinensis</i> (L.) Kuntze	Camellia Oil	A traditional oil used in the Far East and particularly in Japan for the protection and moisturization of the skin and hair.
Vitaceae		
<i>Vitis vinifera</i> L.	Grape Seed Oil	A slightly green, low odor oil which is ideal as a carrier for essential oils in massage oils and other delicate color/fragrance products.

bath oil, or if preferred can be used as ready blended massage oils or bath oils (Table 1). Carrier or base oils can be used on ones personal choice for massage, many having particularly good properties and can be rich in vitamins and minerals. Mostly they are used as the base to essential oils before applying to the skin. The vegetable oils used in massage can be hand blended to give the best quality natural oils. Grapeseed oil can be used as the carrier in most instances as it is suitable for all types of skin (Table 1). It is also an emollient, contains a high level of linoleic acid and some vitamin E. Being light the oil absorbs readily, has little smell and is less likely to cause staining of the clothes. However, it is best if possible to ensure any massage oil is evenly applied and rubbed well in leaving 15 - 20 minutes to allow the oils to absorb fully.

Vegetable oils have heat contents approximately 90% that of diesel fuel and are potential alternate fuel candidates (Schwab et al., 1986). Biodiesel is a fuel derived from plant oil or animal fat. It can be used in pure form but it is often blended with regular diesel. The most common form is B20 - a blend of 20% biodiesel and 80% petroleum diesel. Veggie car owners agree that biodiesel is another renewable fuel source, but it is not as cost effective or eco-friendly as vegetable oils are in limited supplies. Environmentalists with diesel cars have used vegetable oil for years as an alternative fuel to cut back on sooty emissions, but as gas prices soar above, "veggie cars" are a great way to save cash. Although the

Table 2. Distribution of essential fatty acids found in significant amounts in various plants.

Essential Fatty Acids	Plant Species
Linoleic	Safflower, sunflower, hempseed, soybean, walnut, pumpkin, sesame, linseed.
α -Linolenic	Linseed, hempseed, canola (rapeseed), soybean, walnut, purslane, perilla.
γ -Linolenic	Borage, black currant seed, primrose.

Environmental Protection Agency has approved vegetable-based biodiesel, which is also gaining in popularity, it has not approved any recycled oil for sale. Environmental Protection Agency has concern that there could be metals, other chemicals that, when burned, could create something was not intended to burn. Another major obstacle deterring their use in the direct-injection diesel engine is their inherent high viscosities which are nearly 10 times that of diesel fuel. Solution to the viscosity problem has been approached by microemulsification, pyrolysis, and transesterification. Microemulsification with short chain alcohols such as methanol and ethanol yields fuels that are clear, thermodynamically stable liquid systems with viscosities near the ASTM specified range for number 2 diesel fuel. These micellar systems may be formulated ionically or nonionically. The alcohols are attractive from an econ-

omic as well as a renewable resource viewpoint. Methanol has an economic advantage over ethanol, and it can be derived from a large variety of base stocks. These include biomass, municipal waste, natural gas being flared at refineries and from coal. Pyrolysis of vegetable oils is another approach to lowering their viscosity. Soybean and safflower oils were thermally decomposed in both air and nitrogen to obtain fuels for the diesel engine. Using standard ASTM distillation conditions, yields of pyrolysis products were about 75%. GS-MS analysis of the distillates showed the presence of alkanes, alkenes, aromatics, and carboxylic acids with carbon numbers ranging from 4 to more than 20. Fuel properties of the thermal decomposition products were substantially improved as evaluated by lower viscosities and higher cetane numbers compared to the unpyrolyzed vegetable oils. Simple esters from transesterification of vegetable oils perform well in engine tests, and thus show good promise as an alternative or emergency fuel for diesel engines.

Since many compounds in oil seeds already have proven nutritional benefits, there are great possibilities for using them to develop new functional vegetable oils (Goldberg and Williams, 1999; Huang and Needham, 2001). Vegetable oils containing enhanced levels of beneficial active ingredients could have a substantial impact on human health considering the amount consumed in most industrialized countries. In fact, in Japan this is already happening and oils are now available with improved levels of vitamin E and phytosterols. One way to develop functional oils is to fortify ordinary vegetable oils with additional amounts of specific functional ingredients. This concept is similar to the fortification of white flour, which was successfully introduced many decades ago. This route allows the addition of precise amounts of particular beneficial components while at the same time maintaining the original sensory qualities of the food that consumers already know and enjoy. Another way to increase the beneficial qualities of vegetable oils would be to develop a gentler production process so that more of the functional ingredients naturally in the oil seeds remain in the oil. Oils produced this way are likely to be cloudier, may have an unusual color, or could have a stronger more characteristic taste and additional chemical properties.

By combining the skills and efforts of biologists, food scientists, plant breeders and oil companies it may be possible to develop reasonably priced vegetable oils with enhanced levels of functional ingredients. With growing trend of using vegetable oil in food preparation and body and skin care, the health benefits in reducing heart disease and body and skin ailment could be substantial (Borchers et al., 2000, De Deckere and Verschuren, 2000; Goldberg and Williams, 1999). Perhaps in the future we will take the new nutritionally improved vegetable oils for granted - just as we do our daily bread and olive oil today.

ACKNOWLEDGMENTS

Special gratitude is expressed to Dr. Joseph H. Kirkbide, USDA, Agricultural Research Service, Beltsville, MD, for his help in checking the nomenclature and taxonomy of the plants and Dr. M. Akmal Siddiqi, Marshfield Medical Research Foundation, Marshfield, WI, USA for valuable suggestions and helpful criticism on the manuscript. Authors are also grateful to Dr. Zahoor Ahmad, Pakistan Agricultural Research Council, Islamabad, and Prof. Dr. M. Iqbal Choudhary, H. E. J. Research Institute of Chemistry, University of Karachi, Karachi, Pakistan for providing many original reprints that helped in the preparation of this paper. The web site (http://www.connock.co.uk/vegetable_oils.htm) is credited for most of the information used in this paper.

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