American Journal of Essential Oils and Natural Products

Available online at www.essencejournal.com

AJEONP American Journal of Essential Oils and Natural Products

AkiNik

ISSN: 2321-9114
AJEONP 2019; 7(1): 01-06

Received: 01-11-2018
Accepted: 04-12-2018

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Essential oils and the legislative landscape

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Abstract
Essential oils (EOs) are vital to the world-wide cosmetics, fragrance and perfume markets as well as being central to Complementary and Alternative Medicine (CAM) therapies. Many of the botanical sources for essential oils are not native to the U.S.A. and must be imported. Whereas a few EO companies maintain their own ecologically-beneficial farms overseas, most import their oils (and plants) from independent producers that may not practice environmentally-friendly farming principles. Accordingly, legislations such as the U.S. Lacey Act and the International CITES accord were instituted to conserve precious resources and maintain biodiversity. These legislations are briefly reviewed together with various contraventions as they relate to essential oils and other imported plant-based products. This article also discusses the importance of natural EOs and the differences in composition and properties between them and synthetic essential oils.

Keywords: Essential oils, CAM, CITES

1. Introduction
Essential oils from plants are complex volatile mixtures present at low concentrations and are commonly found in aromatic plants. Essential oils extracted from fresh leaves and flowers can be used as aroma additives in food, pharmaceuticals and cosmetics [1-4]. The term essential oil dates back to the sixteenth century and derives from the drug Quinta essentia, named by Paracelsus von Hohenheim of Switzerland [5].

Essential oils or "essences" owe their name to their flammability. Numerous authors have attempted to provide a definition of essential oils. The French Agency for Normalization: Agence Française de Normalisation (AFNOR) gives the following definition (NF T 75-006): *The essential oil is the product obtained from a vegetable raw material, either by steam distillation or by mechanical processes from the epicarp of Citrus, or "dry"" distillation. The essential oil is then separated from the aqueous phase by physical means* [6]. Essential oils are produced by various differentiated structures, especially the number and characteristics of which are highly variable. Essential oils are localized in the cytoplasm of certain plant cell secretions, which lies in one or more organs of the plant; namely, the secretory hairs or trichomes, epidermal cells, internal secretory cells, and the secretory pockets. These oils are complex mixtures that may contain over 300 different compounds. The attraction of medicinal and aromatic plants is continuously growing due to increasing consumer demand and interest in these plants for culinary, medicinal, and other anthropogenic applications. As consumers are becoming more and more informed about issues of food, health, and nutrition, they are also becoming aware of the benefits and potential applications of medicinal and aromatic plants and their metabolites. These plants produce a large variety of secondary metabolites; among them, essential oils. Despite their rich and complex composition, the use of essential oils tends to be largely limited to the cosmetics and perfumery domains. Essential oils could be exploited as effective alternatives or complements to synthetic medicinal compounds of the chemical and pharmaceutical industries, without inducing the same secondary effects.

An estimated 3000 essential oils are known, of which 300 are commercially important in the cosmetics, fragrance, perfume and aromatherapy markets as well as in the food industry and for the manufacture of many consumer products. They are complex mixtures of many chemical compounds with the principal ingredients being terpenes and their oxygenated compounds. Essential oils also contain numerous other chemical compounds in greater or lesser amounts, depending upon the individual oil. All these constituents contribute to the aroma of the essential oil as well as to their beneficial effects on the body and the mind [7-9].

2. Sourcing of Essential Oils

Many Companies market essential oils in the U.S.A., see Table 1. Even a brief review of the essential oils available from one of the industry leaders, Young Living, see Table 2, indicates the incredible diversity of botanicals from which essential oils are extracted. Given the world-wide consumption of essential oils for personal, medicinal and industrial (cosmetic, consumer product and food) use, then it is understandable that the essential oil industry is enormous. Farming of essential oil botanicals, however, requires a great deal of time and effort to ensure high crop yields, and because the yield of essential oils from each individual plant is relatively low, high acreage is required for growing each botanical species. The high acreage requirement is clear from the fact that10 kg of rose petals must be distilled to produce just 5 ml of rose oil. Since a single rose petal probably weighs less than 0.5 g, then about 20,000 petals are needed to produce just 5 ml of rose oil.

Clearly, a great many essential oils are extracted from plants that are not indigenous to the United States and are farmed overseas. Some companies such as Young Living maintain large botanical farms in many different countries, but others source their plants from small, often independent and unregulated growers. Foreign sourcing of botanicals can present regulatory problems and U.S.-based essential oil companies must comply with two important pieces of legislation that are designed to protect endangered wildlife and their habitats, as well as flora and other species threatened with extinction. These two legislations are the United States Lacey Act (16 U.S.C. 3371 et seq.) and CITES, and compliance with them and foreign laws is mandatory for importers of flora and fauna.

3. The Lacey Act

The Lacey Act [10] enacted in 1900, is the oldest wildlife protection statute in the United States, but has been modified and extended several times in the past 100+ years. Originally proposed to protect and prohibit the interstate sale of poached game, the Lacey Act was amended in May 2008[11] to include plant species. The protections provided by the Lacey Act were extended by Congress to these products to address the environmental and economic impact of illegal logging around the world. Consequently, since May 2008, it has been illegal to import into the United States plants, plant products and wood that have been harvested and exported in violation of the laws of another country. The Lacey Act's illegal logging provisions protect vanishing foreign species and forest ecosystems. Not only that, the Act's provisions ensure that importers and America's forest products industry, together with the people and communities who depend on it, can compete fairly in the market place because they all must abide by the same set of rules.

So, under the Lacey Act, it is unlawful to import, export, transport, sell, receive, acquire or purchase in interstate trade or foreign commerce any plant in violation of the laws of the United States, State and Indian tribe laws, or any foreign laws that protect plants. Further, importers are required to submit a declaration at the time of importation for certain plants and plant products. There are serious penalties for companies and individuals violating the Lacey Act; these include civil fines and forfeiture of goods, but also potential criminal penalties attaching to individuals or companies that knowingly, or through lack of due care, violated the Lacey Act.

4. Cites

The Convention on International Trade in Endangered Species or CITES, also known as the Washington Convention, is a multilateral treaty aimed at protecting endangered plants and animals [12]. CITES went into force on 1 July 1975 and is directed at ensuring that international trade in wild animals and plants does not threaten the survival of at-risk species in the wild. It is one of the largest and oldest International conservation and sustainable use agreements in existence. Participation is voluntary, and countries that are bound by the Convention are known as Parties. CITES provides varying degrees of protection to more than 35,000 species of flora and fauna against over-exploitation through international trade. These species requiring protection and control of trading are listed in one of three Appendices, each providing a different level of regulation and all require CITES permits:

Appendix I: identifies and lists species threatened with extinction and have the greatest level of protection together with restrictions on commercial trade.

Appendix II: lists species that are not presently threatened with extinction but may become so without trade controls.

Appendix III: includes those species for which a signatory country has asked other countries for help in controlling international trade.

The permit system of CITES promotes International cooperation in conservation and trade monitoring. Permits are only issued if a signatory country's management and scientific authorities, e.g. the Fish and Wildlife Service in the U.S., determine that the trade is legal and will not threaten the species' survival in the wild. The system enables inspectors at both export and import ports to verify that CITES specimens are properly documented and facilitates collecting species-specific trade data. The latter are used to follow trends in trade and ensure that trade in wildlife and plants is sustainable.

Although CITES is legally binding on the Parties, it does not replace national laws. Thus, for example, the U.S. Lacey Act is the primary regulatory instrument for any plants or wildlife imported into, or exported from, the U.S.A. Instead, CITES provides a framework for participating countries to establish their own legislation to implement the Convention at the national level. However, many countries have no domestic legislation, or their imposable penalties are insufficient to deter or prevent trading in wildlife and plants. In fact, some 50% of Parties do not have Management and Scientific Authorities, domestic laws prohibiting trade in violation of CITES, lack penalties for illegal trading or even laws that enable the confiscation of specimens. As a result, species protection by CITES in many countries is far inferior to that provided by the Lacey Act in the U.S.

5. Lacey Act Violations

Because of the encompassing scope of the Lacey Act, some very large corporations, several smaller companies and some well-known figures have been indicted for contravening the statute. It should be mentioned that not all violations of the Lacey Act by companies and individuals occur knowingly but may be the result of lack of due care.

5.1 Lumber Liquidators

The Environmental Background to the conviction of Lumber Liquidators centers around the Russian Federation's Far Eastern Federal District (Far East Russia), a remote area of

Russia that sits between Siberia and the Pacific Ocean. Within Far East Russia is one of the last remaining old-growth temperate rainforests, consisting of mixed broadleaf and conifer species, such as Mongolian oak (*Quercus mongolica*) and Korean pine (*Pinus koreansis*). The temperate forests of Far East Russia are home to the last remaining Siberian tigers (*Panthera Tigris Altaica*) and Amur leopards (*Panthera Pardus Orientalis*). There are only an estimated 450 Siberian tigers and 57 Amur leopards remaining in the wild. The primary contributors to the cats' risk of extinction are illegal logging and detrimental logging practices because the cats are dependent on intact forests for hunting. In addition, acorns and pine nuts are the primary food source for the cats' prey species, such as red deer, roe deer, and wild boar. Extensive illegal logging in Far East Russia has been reported by the Russian government as well as non-governmental organizations. Much of this illegally-logged wood is transported across Russia's eastern border into China where it is processed into flooring and furniture and the U.S. is a significant market for Chinese-manufactured flooring and furniture. Lumber Liquidators were found guilty of importing 385.38 m^3 of Mongolian oak (*Quercus mongolica*) into the United States between February 1, 2013, and August 30, 2013. Lumber Liquidators had to pay $969,175 in forfeiture as well as a criminal fine of $7,800,000. In addition, they had to make two community service payments of $1,230,825. The latter payments were made to The National Fish and Wildlife Foundation, notably The Timber Identification Technology Fund **(**$500,000), The Amur Leopard Conservation Fund **(**$380,825) and to The Rhinoceros and Tiger Conservation Fund ($350,000).

5.2 Gibson guitar corporation

The forests of Madagascar are home to diverse and unique ecosystems and wildlife, but they are severely impacted by deforestation. Both legal and illegal loggings of many tree species have significantly reduced Madagascar's forest cover. In particular, Madagascar ebony is a slow-growing tree species and its availability is severely threatened through over-exploitation. Consequently, to limit overharvesting and conserve valuable tree species, harvesting of ebony in Madagascar and the export of unfinished ebony has been banned since 2006. In June 2008, a Gibson employee participated in a trip to Madagascar, sponsored by a non-profit organization. Trip participants were told that Madagascar had passed a law in 2006 that banned both the harvesting of ebony and the export of any ebony products that were not in finished form. In other words, exports of wood products of specific interest to Gibson Guitars, notably instrument parts such as fingerboard blanks, were unfinished and therefore prohibited from export under the 2006 law. Also, the trip participants visited the facility of a timber exporter in Madagascar where they were told that the wood at the facility was under seizure and could not be moved. After the Gibson employee returned from Madagascar, he informed his superiors and others at Gibson Guitars of the situation in Madagascar. Gibson management, however, did not investigate or act upon the information and the company continued to place orders with its supplier. The purchased ebony "fingerboard blanks" was obtained from an exporter in Madagascar after the 2006 ban and, further, the exporter had no authorization to export the ebony.

Gibson received four shipments of Madagascar ebony fingerboard blanks from its supplier between October 2008 and September 2009, thereby contravening local laws as well as the Lacey Act. This ultimately led to Gibson Guitar Corp. entering into a criminal enforcement agreement with the U.S. Justice Department's Environment and Natural Resources Division, the Middle District of Tennessee and the U.S. Department of the Interior's U.S. Fish & Wildlife Service in August 2012. This agreement resolved a criminal investigation into allegations that the company violated the Lacey Act by illegally purchasing and importing ebony wood from Madagascar and rosewood and ebony from India. As part of the agreement, Gibson Guitars ceased acquisitions of wood species from Madagascar and recognized its duty under the Lacey Act to guard against acquiring wood of illegal origin by verifying the circumstances of its harvest and export. The Company also paid a penalty of $300,000 as well as a community service payment of $50,000 to the National Fish and Wildlife Foundation. The latter payment was to be used to promote the conservation, identification and propagation of protected tree species and the forests where those species are found with respect to wood used in the musical instrument industry. Gibson also was required to implement a compliance program designed to strengthen its compliance controls and procedures. The agreement included the provision that the Company would abandon its claims to the wood seized during the criminal investigation, including shipments of Madagascar ebony with an invoice value of $261,844.

5.3 Young Living

The Lacey Act contravention with Young Living is rather different from the Lumber Liquidators and Gibson Guitar cases. In the case of Young Living, senior management of the Company became aware that several employees and contractors had harvested, transported, and distilled rosewood in Peru and imported some of the resulting oil into the United States. Because Young Living realized that they might have contravened the Lacey Act, they contacted the Department of Justice (DoJ) and admitted what had transpired. According to the plea agreement with the DoJ, the Company admitted that from June 2010 to October 2014 they had performed the unauthorized harvesting and transport of timber, including rosewood, thereby contravening Peruvian law. It was also reported that the Company exported spikenard oil harvested in Nepal to the United Kingdom, without a CITES (Convention on International Trade in Endangered Species) permit. The latter contravention is a somewhat confused situation because the spikenard oil was previously imported into the U.S.A. from a UK company that had obtained a CITES export permit. The product, however, was found to be unsatisfactory and it was shipped back to the United Kingdom. Although an application was filed for a CITES permit for this shipment, this was done after the fact and the required copy of the permit authorizing its original export from the United Kingdom was not provided. Since then, Young Living has achieved a gold star status with respect to compliance with the Lacey Act. It is also astonishing that the Company had reported its own contravention of the Lacey Act, paid the fine and have since been meticulous in complying with the Act.

5.4 Essential oil companies

It is not known whether all vendors and importers of essential oils similarly comply with the Lacey Act. Such compliance is of great importance in conserving endangered plant species and ensuring the health of the world's biodiversity and ecosystems. Compliance with the Lacey Act and the need for conservative and chemical-free farming presents a major, if

not insurmountable, challenge for essential oil companies that obtain their supplies of botanicals and essential oils from varying numbers of small-scale growers overseas. Compliance with the Lacey Act and CITES is probably impossible under these sourcing conditions. It because of this sort of situation that Young Living, for example, maintains its own farms both in the U.S. and abroad to ensure adherence to organic farming principles and compliance with all national and international environmental rules and regulations. In addition, by owning and operating its own farms in the United States and abroad, Young Living can ensure that their growing and harvesting of botanical essential oil sources have a positive environmental impact. Young Living can also guarantee that there are fair labor conditions and a safe and healthy working environment free from exploitive practices, harassment and discrimination for all their workers and staff.

Although there do not appear have been contraventions of either the Lacey Act or CITES, a recent newspaper article [13] accused doTERRA and its local partner, Asli Maydi Export Ltd., of operating in a manner that caused a negative environmental impact. In particular, the newspaper article alleged that both companies encouraged over-tapping of frankincense trees, compromising environmental sustainability. It was stated that over-demand and overharvesting of wild frankincense trees caused harm to the trees, endangered forests and had a devastating environmental impact.

6. Synthetic *vs.* natural essential oils

A growing controversy with essential oils is the marketing of low-cost oils that are often misleading labeled as being either pure, natural or containing 100% of the nominal contents. In many cases, the greater part of the volume of liquid in these bottles of low-cost oils are diluents or carrier oils, typically coconut oil or grape seed oil and they may even contain solvent residues. Clearly, such products are not pure, are not 100% of the designated oil and, in many cases, may not be natural. The latter are synthetic oils produced chemically using fermentation and chemical synthesis techniques as well as by electrochemical methods. The commercial case for synthetic essential oils is based on relative costs. The yields of essential oils from plants are low because their average essential oil content is only 1-3 wt. % so that, in most cases, a ton or more of flowers may be required to produce 0.5 kg (1 lb.) of essential oil. Producing this volume of botanicals is clearly an expensive proposition not only in terms of harvesting the plants but also for the vast acreage required to grow the requisite crops.

Consider, for example, the sesquiterpene nootkatone, a compound found in grapefruit and certain cedar trees; nootkatone is not an essential oil itself but it is a significant component of many essential oils. About 400,000 kg of grapefruits are needed to produce 1 kg of nootkatone at a cost of about $4000. However, if nootkatone is produced by oxidizing valencene, the cost drops to about $2000[14]. Now there is increasing interest in producing essential oils through fermentation and even electrochemical processing to reduce costs.

Synthetic essential oils contain the same principal ingredient as their wholly-natural counterparts, but they do not contain the many different minor components of natural essential oils [15]. The difference between all-natural and synthetic wintergreen essential oils is clearly shown by the GC-MS chromatograms for the two oils, both of which have methyl salicylate as the major component, Figures 1 and 2. The chromatogram for the synthetic oil indicates the presence of methyl salicylate as the primary ingredient together with a small amount of ethyl salicylate (the smaller band to the far right of the major lines). In contrast, the chromatogram of the 100% natural wintergreen oil has the characteristic lines for methyl salicylate together with many bands for the other naturally-occurring components present in the oil. The natural oil, however, contains minimal amounts of ethyl salicylate, as shown by the missing line for the compound which would have shown up at a higher m/z ratio than methyl salicylate.

The minor components in all-natural essential oils are major contributors to the aroma and properties of essential oils in the same way that the conjoiners in fine wines and whiskies contribute so much to their taste and bouquet. Although it has been argued that there is little difference between all-natural and synthetic essential oils, proponents and practitioners of aromatherapy, massage therapy and topical use of essential oils profoundly disagree with this statement. In fact, allergic reactions and other adverse effects are known to occur with the synthetic counterparts of essential oils.

Thus, it is highly unlikely that "pure" essential oils costing only a few dollars, and which are found in many supermarkets, drug stores and online are pure or wholly natural products. In those cases where lower cost essential oils *are* natural products, it may also be questionable whether the source plants were organically grown or derived from a single plant source, and indeed that the bottle contents are 100% pure.

At this time, there does not appear to be any legislative barriers to the sale of synthetic essential oils or even diluted natural oils. Not only that, whereas synthetic essential oils are not subject to the Lacey Act, compliance with the Act may not always be the case with all imported oils. This unsatisfactory situation regarding the need for organic farming of essential oil plants both in the U.S. and overseas, greater compliance with the Lacey Act and the marketing of synthetic or diluted oils as natural products can and should change. Such changes would help maintain the world's ecological health as well as the health of essential oil users.

7. The future

Although some essential oil suppliers claim to be CITES-compliant, such compliance imposes far fewer export/import restrictions than the Lacey Act. This is particularly true when botanicals and their extracted oils come from countries with inadequate or unenforced domestic preservation laws. For this reason, it is believed that compliance with the Lacey Act should be mandatory for all imports of essential oils and their botanical sources into the United States.

There are some ISO (International Organization for Standardization) and ASTM International (American Society for Testing of Materials) voluntary consensus technical standards for essential oils. In fact, the ISO has adopted the AFNOR (Association Française de Normalisation) standards for essential oils. At present, it appears that no company certifies its essential oils although ethical corporations such as Young Living do use these guidelines and other standards including their own internal standards for testing of their products. This Company policy ensures that the oils they create preserve the properties and integrity of the essential oil through testing, supporting their effects on the body and emotional wellbeing. Interestingly, Young Living routinely sends samples of its oils to France for testing against AFNOR/*ISO* standards.

Given the size, importance and economics of the essential oil

industry, increased regulation of the sourcing of essential oil botanicals and tighter controls over the labelling and marketing of essential oils may be long overdue. Strict compliance with the Lacey Act and CITES as well as ISO/ASTM certification of all essential oil products to ensure consumer protection should be a requirement for any essential oil product. Marketing of adulterated and synthetic essential oils should be restricted and, ideally, the container labeling should clearly indicate that the packaged products are based on synthetic essential oils.

Table 1: Suppliers of essential oils in the U.S.

Aromaland	ArtNaturals	Citrus and Allied Essences	Do TERRA
Eden's Garden	Essential Oil Company	Fleurchem Inc.	Gurunanda
Lebermuth Company	Liberty Natural Products	Miracle Essential Oils	New Directions Aromatics
NHR Organic Oils	Now Solutions	Organic Infusions	Plant Therapy Essential Oils
Rocky Mountain Oils	Wellington Fragrance Company	Young Living	

Table 2: Commercially available essential oils

Angelica	Goldenrod	Ocotea
Basil	Grapefruit	Orange
Bergamot	Helichrysum	Oregano
Black Pepper	Hinoki	Palmarosa
Blue Cypress	Hyssop	Palo Santo
Cardamom	Idaho Balsam Fir	Patchouli
Carrot Seed	Idaho Blue Spruce	Peppermint
Cedarwood	Jade Lemon	Petitgrain
Celery Seed	Jasmine	Pine
Cinnamon Bark	Juniper	Ravintsara
Cistus	*Laurus nobilis*	Roman Chamomile
Citronella	Lavender	Rose
Clary Sage	Ledum	Rosemary
Clove	Lemon	Royal Hawaiian Sandalwood
Copaiba	Lemon Myrtle	Sacred Frankincense
Coriander	Lemongrass	Sacred Sandalwood
Cypress	Lime	Sage
Dill	Manuka	Spearmint
Dorado Azul	Marjoram	Tangerine
Elemi	Mastrante	Tarragon
Eucalyptus Blue	*Melaleuca quinquenervia*	Tea Tree
Eucalyptus globulus	Melissa	Thyme
Eucalyptus radiata	Mountain Savory	Tsuga
Fennel	Myrrh	Valerian
Frankincense	Myrtle	Vetiver
Geranium	Neroli	Wintergreen
German Chamomile	Northern Lights Black Spruce	Xiang Mao
Ginger	Nutmeg	YlangYlang

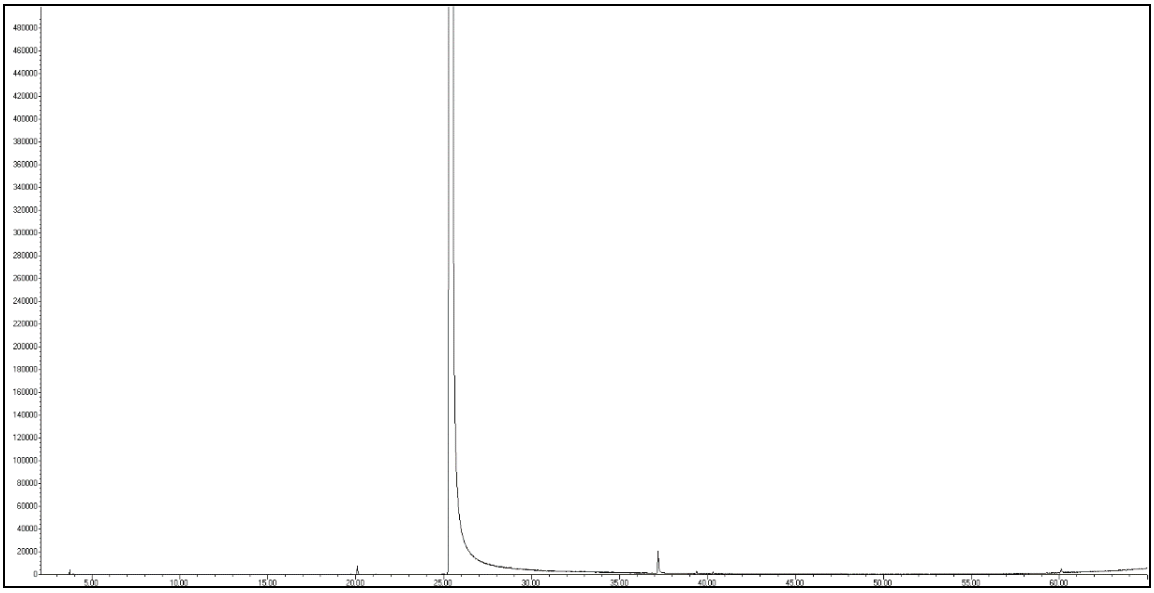

Fig 1: Synthetic Wintergreen Oil

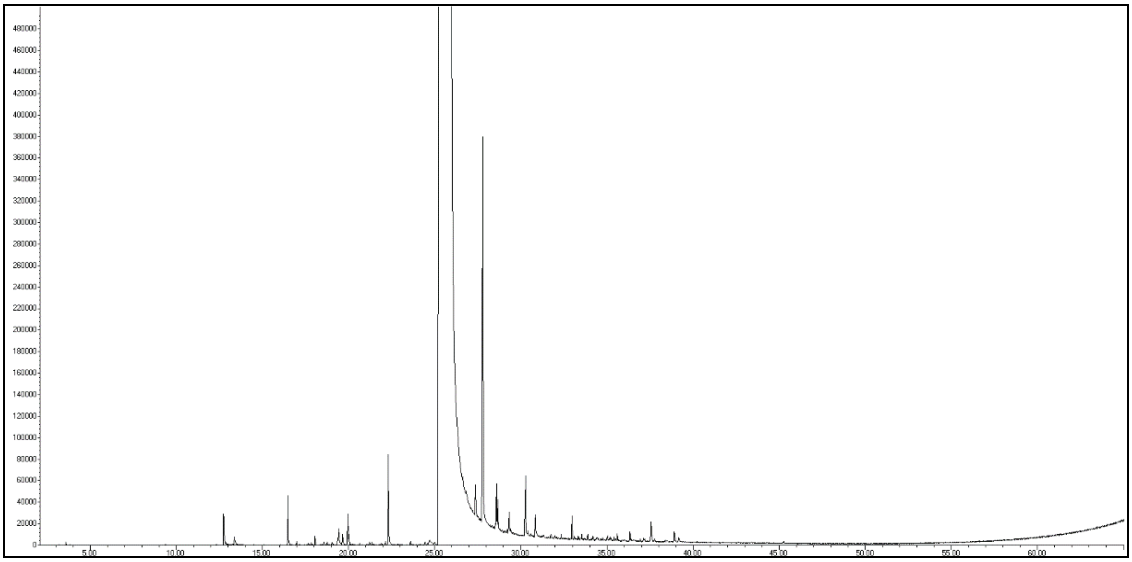

Fig 2: Natural Wintergreen Oil

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