CEDAR OIL
A FOREST PRODUCT IN BRITISH COLUMBIA

by

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ABASTRACT

The production of cedar oil as a non-timber forest product in British Columbia is a relatively unknown industry. The product, processing, and raw material supply were investigated and insights into why the product has relatively few producers in British Columbia are given.

Key Words: cedar leaf oil, cedarleaf, *Thuja*, essential oil, volatile oil, thujone, thujaplicin, steam distillation.

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INTRODUCTION

During the past century in Canada when competitive forces were limited, the wood supply seemingly inexhaustible, and world demand was great, the forest industry thrived on producing lumber and pulp and paper products with little regard to utilizing any other forest products. After all, business was extremely profitable and unemployment was not an issue. Today, with a decreasing supply of high quality wood, world competitive forces becoming more threatening and our economy still dependent on the forest industry, more effective use of all forest related products must be made a priority. As other industries have found, total utilization and the clever marketing of byproducts has proven to be financially rewarding.

Non-timber forest products (NTFP), such as essential oils, are becoming increasingly important in the forest sector of British Columbia's economy. They are estimated to have a monetary value grossing CAD $280 million per year in British Columbia alone (Tedder *et al*, 2002). Harvesting of these products occurs on a seasonal basis and is usually carried out by rural residents. Many harvesters have a tendency to do business "under the table", thus the government fails to tax a share of the asset.

NTFP are any organic material and plants harvested from the forest that are used to generate revenue or have cultural value. It is not a product of standing or merchantable timber. In British Columbia "they can be characterized as a common pool resource where restricting access is difficult and the supply is subtractable" (Tedder *et al*, 2001). British Columbia's Ministry of Forests has divided non-timber forest products into two groups: special forest products and botanical forest products. Special forest products are products that are derived from trees, usually salvage timber, such as shakes and shingles and are taxed using stumpage rates. Botanical forest products are products that are not timber related.

They have been categorized into eight classes as shown in Table 1. It is within these groups that cedar oil is categorized.

Table 1. Classification of Botanical Forest Products

1.) Wild edible mushrooms (i.e.. Pine mushrooms, chanterelles, morels)	5.) Medicinal and pharmaceutical products (i.e.. western yew bark, red cedar boughs)
2.) Floral and greenery products (i.e.. conifer boughs, cones, falsebox, salal, misc. mosses)	6.) Craft products (i.e.. misc. trees and tree bark used for furniture, carvings, baskets)
3.) Wild berries and fruit (i.e.. wild blueberries, salmonberries, raspberries)	7.) Landscaping products (i.e.. juniper, arbutus, boxwood, misc. ferns)
4.) Herb and vegetable products (i.e.. wild ginger, chickweed, fiddleheads)	8.) Miscellaneous botanical forest products (i.e.. smoke woods, honey)

Source: Kennah 1998

Essential oils have been distilled from coniferous trees for a number of years, but the industry in B.C. has never really found a solid foothold. The oil from branches of the *Thuja* genus of trees, otherwise known as cedar leaf oil, has been distilled in the eastern United States and eastern Canada for over a hundred years (Thomas and Schumann, 1993). Oil is also distilled from the wood of the *Thuja* genus of trees. The name cedarwood oil is not used to describe oil obtained from the wood of *Thuja* as this name is reserved for oil produced from *Juniperus Mexicana* (Texas cedarwood oil) and *Juniperus Virginiana* (Virginian cedarwood oil). The *Thuja* genus of trees includes eastern white cedar (*Thuja occindentalis)* and western redcedar (*Thuja plicata)*.

Thuja oil is usually produced through steam distillation. Steam distillation is one of several methods of extraction that is commonly used to produce a variety of essential oils; other such methods include cold pressing, enfleurage, turbo distillation, solvent extraction, and carbon dioxide extraction (Dean Coleman, 2003). In some cases, solvent extraction is used to extract *Thuja* oil; only it is not nearly as popular of a method as is steam distillation.

ESSENTIAL OILS

Overview

Essential oils are volatile oils, oils that vaporize readily, derived from vegetation that give plants their distinctive odors. Also known as aromatic oils, these non-timber forest products must be stored with care to avoid vaporization. They vary in strength, but this is not to say that they ever occur as dilute substances; they usually need to be adulterated to smell best (Schmincke, 1997). The plants produce these oils in special secretory structures during regular growth (Thomas and Schumann, 1993).

Essential oils have a number of uses ranging from flavoring and fragrances to utilization for their therapeutic properties. These therapeutic properties are enjoyed through aromatherapy and medical application. Three hundred of the estimated three thousand essential oils are of commercial importance (Schmincke, 1997). One wholesale distributor, Alt-Canada, supplies over four hundred different essential oils produced from more than twenty different countries (Alt-Canada, 2003). The majority of these commercially important oils are derived from agriculturally grown plants, but some are derived from wild vegetation, including trees (Iqbal cited in FAO, 1995)

Status of Cedar Oil

Cedar leaf oil fits into the scheme of essential oils in the fragrance and patent medicine departments (Thomas and Schumann, 1993). It has a use in aromatherapy, but many aromatherapists and suppliers of aromatherapy products have fallen away from using or selling it due to the debatable toxicity of thujone. The oil is considered to be a powerful anit-infection agent. When used by aromatherapists, it is for this purpose.

Thujone is a ketone with two isomers; α-thujone and β-thujone (Guenther, 1949). Approximately 60 percent of this essential oil is made of thujone, in conjunction with another ketone, fenchone (Schmincke, 1997). All three of these ketones have been identified to have convulsant effects on humans, which, in the case of a child, has caused death (Burkhard *et al*, 1999). When taken orally α-thujone can cause seizures, brain damage and death, while β-thujone is less toxic it still hazardous (Thompson, 2002). It is unknown if the ketone can be absorbed through the skin or if inhalation of the fumes has a detrimental effect since no reliable studies have been done in these areas (Thompson, 2002). This is the main reason for the debatable toxicity label mentioned above.

Cedar leaf oil is used in many of commercial products (Table 2). Especially for its fragrant properties, it used in the production of embalming fluids, cleaning fluids, slaves, shoe polishes, industrial cleaners, soaps, perfumes, pharmaceuticals, liniments, and deodorants (Thomas and Schumann, 1993). When blended with pine oil, it is used as an ingredient in many insecticides and room spray (Thomas and Schumann, 1993). In perfumes, cedar leaf oil is usually used as a fixative (Poucher, 1974). The oil is also used in such product as Vicks Vap-O-Rub and other patent medicines (Thomas and Schumann, 1993). On a different note, the recent reodorizing of instant fire logs is becoming a trend that exploits the natural smell of the oil well (Thomas and Schumann, 1993).

Thuja wood oil fits into the essential oil industry in a different sector then that of the leaf oil. The wood oil is used as an ingredient in products such as household insect repellants, wood-restoration solutions, room sprays, and leather dressings and preservatives

(Mohammed, 1999). These products take advantage of the unsaturated ketone thujaplicin found in the product. Thujaplicin has three isomers of which the β-thujaplicin and the γ-thujaplicin are found in North American trees (Guenther, 1952). This ketone is believed to be responsible for western redcedar's resistance to rot (Guenther, 1952).

Table 2. Cedar Oil Uses

Raw Material	Type of Oil	Current Uses	
Cedar Boughs	Cedar Leaf Oil	embalming fluid	shoe polishes
		microscope slide slips	soaps
		industrial cleaners	patient medicines
		liniments	re-odorizing sawdust logs
		perfumes	
Sawdust	Oil from Cedar Wood	insect repellants	
		wood restoration solutions	
		room sprays	
		leather dressings	
		preservatives	

Source: Thomas and Schumann 1993, Mohammed 1999

PROCESSING

Facilities Required

The facilities, and therefore the capital, required to extract oil from the western redcedar tree range from the use of homemade to multimillion-dollar equipment. The basic technology needed to be able to extract essential oils has been around for over a century. In most cases the oil from the wood and branches is retrieved using a batch distillation process. There are some commercial extractors that are using a continuous distillation process – such as Texarome Inc. located in Texas -, although I could not find any for *Thuja plicata* oil.

There are four main parts to a batch steam distillation unit (Figure 1). The first is a boiler, a place where steam is generated for the extraction process. The second is a hopper, a container that will hold the raw material still containing the oil. The third is a condenser. It condenses the steam oil mixture into a liquid, where the oil and water form two different layers based on their specific gravities (Aksu Gida San. ve Tic. Ltd, 2000). Finally, the fourth part of the batch steam distillation unit is the separator. It, as its name indicates, separates the two layers of liquid.

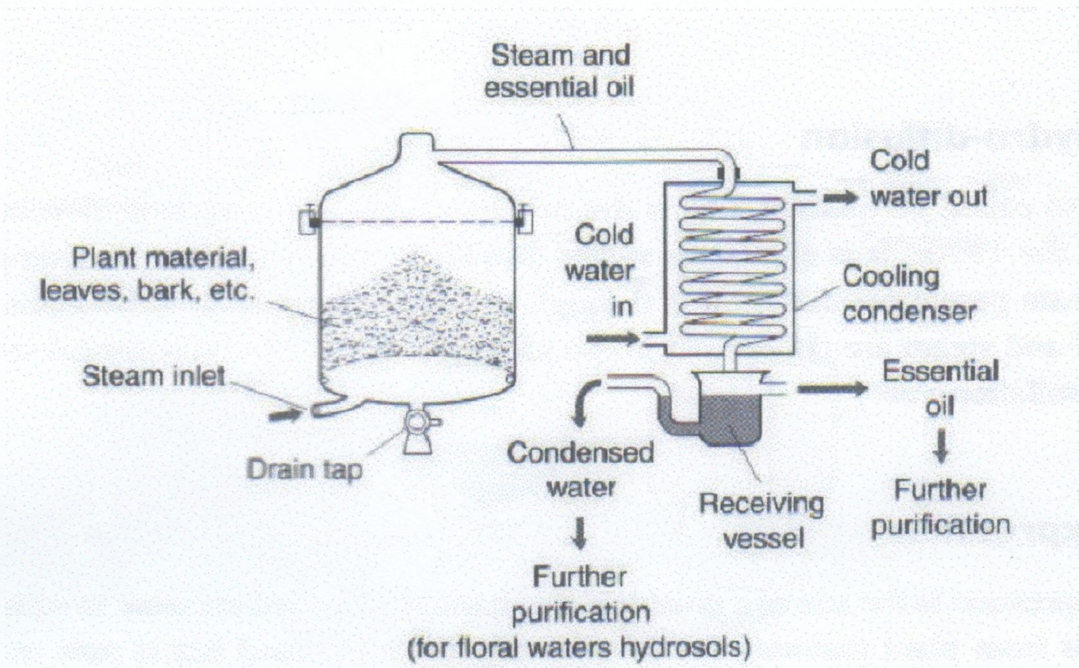

Figure 1. Schematic of an Industrial Steam Distillation Setup
Source: redrawn from Clarke, 2002

Steam is generated in the boiler and filtered, under pressure, through the hopper and into the prepped raw material. Prepping the raw material consists of increasing the surface area through mechanical means (Thomas and Schumann, 1993). In the case of cedar leaf oil the cedar boughs are pulverized using a chipper or hand tools such as machetes and hatchets. The essential oil is released as the heat from the steam opens the intercellular pockets (Dean Coleman, 2003). Once released, the oil evaporates combining with the steam where it travels to the condenser (FatBoy Fresh Inc., 2002). In the condenser, the steam along with the essential oil is cooled, thus reverting it back into liquid form. The constituents, that are not water-soluble, but still have properties that make them volatile enough to be driven from the raw material, form a layer, either on or underneath the water, due to their hydrophobic properties (Clark, 2002). The two liquids are then separated into different containers where the essential oil is purified further if required (Clark, 2002). Although not sold commercially for aromatherapy use when derived from the *Thuja* genus, the water that is separated from the essential oil is know as a hydrosol or hydrolat and contains many of the therapeutic properties of the plant (Dean Coleman, 2003).

Financing

Depending on the production capabilities that are desired, the cost of distillation units can range from a couple of thousand dollars to multimillion-dollar plants. With funding from IDRC (International Development Research Centre) along with help from a number of other groups, distillations units were built in Bolivia for a cost of CAD $3,000 to $10,000 (IDRC, 1999). The units had capacities that ranged in size from 1.5 to 5 cubic meters, but they were built from local materials. Distillation.co.uk is a company located in the United Kingdom that specializes in the sale of steam distillers. They have a range of distillers for sale that can be seen online along with an automated module to help potential buyers to estimate the type and cost of the unit desired. The module is based on the companies experience with essential oil production and sales of essential oil distillers.

According to Mr. Gueric Boucard, president of Texarome Inc., there are two basic ways of entering into the business of producing essential oils. One way is to incorporate a small-scale distillation business with another business venture that is already producing a different product, but still dealing with the same type of raw material. The other way is to invest a large sum and become one of the major players in the market. An example of this would be a US $1 to $2 million investment in a distillation plant, which could process in excess of 50 tons of raw material per day (Boucard cited in Thomas and Schumann, 1993).

For those wishing to enter into the market using the first strategy, there are a couple of points to keep in mind. Reliability of the supply in sufficient quantities is a major concern of buyers, especially when they are selling consumer-based products. It is unacceptable to promote a product only to have one of the ingredients suddenly become unavailable due to small production supplies. For this reason, it may be difficult for small volume producers to convince potential buyers that they are capable of producing a sufficient supply of the essential oil without access to a reliable and secured source of the raw material (Boucard cited in Thomas and Schumann, 1993).

If the method used is to enter into the market in a major way then there are different conditions to consider. Boucard suggests eight criterions that should be met before the investment is made. First, the byproduct produced in the production of the oil must have a value that will help to reduce the oil production cost. In Boucard's case, the byproduct from the distillation of cedar wood oil from *Juniperus Mexicana* is used as boiler fuel. Second, is that large quantities of oil, but less than 25% of the current world production, should be processed to achieve economies of scale. While not creating an over supply that would drive down the price, this would put the producer in a position to become a major supplier. Third, new technology needs to be utilized when large-scale production is done. So the most cost-efficient technology should be employed. Fourth, one must be able to offer a flexible product. That is, having the capabilities to remove dark colors and/or resins from the oil or to fractionate it into its valuable components. Fifth, on must have a fixed buyer or use for the product before production is started. This could be a contract with a buyer to sell a portion of the plants production or to produce products that require the oil themselves. Sixth, the producer should have sufficient capital to be able to produce the oil for at least 6 months without sales. This is due to a tactic that some of the veteran producers use to drive new producers out of business. Seventh, one must have sufficient capital to be able to offer and deliver substantial quantities of oil for immediate delivery. This will allow for adaptation to the current trend in the flavor and fragrance industry where buyers are keeping inventories low. Eighth, one must be able to produce the oil at a cost of 1/2 to 2/3 of its lowest selling price in the past 10 years (Boucard cited in Thomas and Schumann, 1993).

PRODUCT DEMAND AND PRICING

Existing Markets

A US $10 billion market is estimated for the U.S. food flavorings and cosmetic industry in 1993 with essential oils being a corner post for these industries. Part of the reason the retail market has thrived, and continues to do so, is from the irreplaceability of the essential oils in certain formulas (Thomas and Schumann, 1993). The necessity to use naturally occurring oils is due to the fact that synthetics, although often cheaper, are of an inferior quality and do not contain the same range of compounds (Clarke, 2002).

The quality of the oil plays a large part in how much a buyer will pay for a barrel. The realized producer price is not based on producers meeting a minimum standard with each batch, but instead is based on the quality of oil in each batch. Chris Berlin, a former producer of cedar leaf oil from the interior of B.C., indicated that clear leaf oil fetched the highest price, while oil with a brownish tinge was considered second rate. The distributor he sold to did not do any chemical testing before his purchases, but did perform a quick visual and a preliminary viscosity sampling to determine the price he would pay (Berlin, personal correspondence).

Literature on the existing markets and prices for *Thuja plicata* oil is quite limited. One work, written in the 1990's, quoted bulk prices for the leaf oil in the 1970's without any further price listings or trends. The information that is readily available is that pertaining to the aromatherapy market. The price of small vials of oil ranging from 10 to 50ml, which, as suggested by Thomas and Schumann (1993), can be as much as five times more than the price per milliliter when bought by the barrel. As one can see this information may be a bit misleading when trying to determine the price that the oil producers are getting for their product. Aromatherapy distributors usually do these small volume sales and do not tend to find the need to supply their audience with large quantities of this particular essential oil. Even bulk purchases from aromatherapy distributors tend to be same scale with bulk sales coming in 2lb (0.91kg) quantities (Appendix 1). The price seems to have remained relatively constant for the small-scale sale of cedar leaf oil. The selling price of cedar leaf oil by the Gritman Corparation, an aromatherapy distributor, has shown a price difference of one cent from their 1998 price to their 2003 price. They currently sell the oil for a retail price of US $7.86/10mL bottle and still use a retail catalog from their 2001-2002 fiscal year (Gritman Corparation, 2003).

Markets for Similar Products

Similar products to *Thuja plicata* oil are *Thuja occidentalis* (white cedar) oil and other oils from coniferous trees. White cedar oil is almost identical to the oil of western redcedar and they are usually classified together under the term of cedar leaf oil. Oils derived from different coniferous trees are used in many of the same products, soaps and cleaners, as western redcedar oil; they are used when a slightly different aroma is desired (Thomas and Schumann, 1993). Western redcedar oil can be synthesized, but as noted by Clarke, the quality of the synthetic does not rival the authentic oil.

Market Trends

The producer's price of cedar leaf oil took a drastic fall during the mid 1990's and has not since recovered. Chris Berlin resigned from production after the producer price dropped by almost a third from CAD $32/lb to CAD $22/lb. This price drop took place from 1994 to 1996 and was primarily thought to be caused by increased supply created by growth in the number of producers (Berlin, personal correspondence). Currently, *Thuja plicata* oil retails for approximately US $12.87 per 15mL bottle pending distributor (Appendix 1). When sold by the barrel the market price is estimated to be in the vicinity of US $44/Kg, US $20/lb (B. Turner, David Cookson and Co., cited in Mohammed, 1999). When both essential oils that fall under the name of cedar leaf oil (western redcedar oil and white cedar oil) are sold by the same aromatherapy distributor the western redcedar oil usually costs a little bit more.

DISTRIBUTION

Producers commonly ship amounts of up to 10 Kg of oil in aluminum containers with internally coated surfaces. Steel containers with internally coated surfaces are used for shipments weighing more then 10kg per barrel. The internal coatings keep the oil from interacting with the metals. Aromatherapists find glass bottles made from neutral glass suitable for their needs. In either case, whether the oil is stored in glass bottles or metal barrels, the containers must be sealed. If they are not one or possibly all three of the following may occur: oxidation, which will form new compounds, water vapor may enter, oil components may escape as vapors (Clarke, 2002).

RAW MATERIAL SUPPLY

Property Rights

Currently, there is an open access style of management used for NTFP in British Columbia. Unfortunately, this means there is no security for anyone who wishes to harvest NTFP from crown land. The property rights belong to the crown and the management system employed does not give exclusive rights to harvesters. Since 94% of the province's land base is public land (Tedder *et al*, 2002), there is not really much of an opportunity to do otherwise either. For this reason, it is difficult for potential producers to identify to buyers that they can provide a secure stream of a commodity since they do not have secured access to the raw material. There are two other major downfalls to this system of management. The first is that it is almost impossible to know what a sustainable rate of harvest is when inventories are not kept and databases are not made for these products. The second of the two is that people are not willing to make investments, thereby not increasing the potential revenue, without some form of insurance on being able to collect the rewards.

It is fairly simple to get allowance to harvest NTFPs in British Columbia. The process is described in a publication, Botanical Forest Products in British Columbia An Overview (1995), for the Salmon Arm, Vernon, and Arrow forest districts. These districts authorize the collection of cedar boughs, the branches used in the production of cedar leaf oil as well as wreaths, from six different harvest areas. These areas are given priorities and ranked as described in Table 3.

Table 3. Areas Authorized for Cedar Bough Collection

Ranking	Description of Area
1)	unharvested areas approved for clearcutting
2)	areas with ongoing, approved clearcutting
3)	post-harvesting areas: residual branches and tops from standing trees awaiting three-meter knockdown
4)	rights-of-way (B.C. Hydro, Ministry of Transportation and Highways)
5)	forestry operations roads (excluding private and public roads) that would benefit from right-of-way brushing
6)	areas where juvenile spacing has been completed.

Source: de Geus 1995

A potential harvester must complete an application indicating the volume of cedar boughs to be harvested and the area in which they intend to do so. Successful applicants are then presented with a form of agreement, which they and the district manager sign. In the form of agreement, harvesting specifications and conditions are described and must be met. If these conditions and specifications are not met the harvester forfeits his/her security deposit and operation may be suspended (de Geus, 1995).

It is important to realize that these permits do not exclude others from harvesting the same NTFP in the same area. In districts, such as the Arrow district, there is not enough demand for harvesting products such as cedar boughs for the purpose of oil production to cause problems. Competition is not a problem in this region, but in areas such as the Chilliwack District, conflict does occur. However, this conflict is conflict in general and not just between harvesters of cedar boughs. Due to the lack of resources that the MoF has to deal with these conflicts and to handle applications, the Chilliwack district does not require permits to harvest NTFPs, except in TFL 26 (Kennah, 1998).

Some type of formal management system is needed in B.C. to manage NTFPs in a sustainable manner and to solidify property rights for investors. Currently Sinclair Tedder, of the Economics and Trade Branch, is heading a project to develop guidelines for testing in a possible pilot setting. Some of the possible approaches are a TFL option, a First Nations and TFL holder option, a stewardship model, a government approach(es), and an auction or request based approach. This is by no means an exhaustive list, but it does identify some of the major approaches being considered. In a TFL holder option it would be up to the licensee to manage the NTFPs within their boundaries. A First Nations and TFL holder option would be based on a co-management regime that would manage both commercial and non-commercial species. A stewardship model is fairly flexible and has the ability to be applied in numerous forms. An example of one of these forms would be if the rights to a NTFP were given to a local user group. They would then, in turn, be responsible for its management. Possible government approaches would be based on establishing rights and regulations, but they would not be hands on type approaches. Auction or request based approaches would be used for areas where specific interest was shown (Tedder, personal correspondence).

Supply Source

As mentioned in the property rights section of this paper, it is not possible to get a secured supply source for NTFPs from crown land. This is not to say that there is not an adequate supply of potential source areas for the collection of cedar boughs used for oil production. Areas that are considered high quality are roadside areas that have a high composition of juvenile aged western redcedar trees. They are considered high quality for two reasons. When oil is produced from boughs of juvenile trees instead of mature trees, up to a fifty percent greater yield is obtained. Risi and Brule showed this in a study that took place in Quebec. Using *Thuja occidentalis*, they compared yields of oil produced from a fifteen-year-old tree with that of a thirty-year-old tree (cited in Guenther, 1952). The other reason is the proximity to the road. If the raw material does not have to be taken far before it can be loaded into a truck or the hopper itself, then the harvesting costs are kept to a minimum. Dust on the foliage is not a concern during distillation because it does not hamper the process. If dirty foliage is used, extra clean up is needed when removing the mulch byproduct.

Mike DesRochers, an Assistant Forester on TFL 6 for Western Forest Products' Port McNeill operation, deals with providing supply sources of cedar boughs for a small oil distillation operation located at Fort Rupert near Port Hardy. The supply sources are always areas that have met free-to-grow requirements and are accessible by pick-up trucks or ATVs. These areas do not include riparian reserve zones along streams, and often the contractor chooses to provide an additional buffer to the RRZ, just to be on the safe side. To collect in these areas an agreement must be signed outlining the management standards for this work. There are no fees for the commercial use of the roads, but the contractor must prune to a rigid standard. This provides the licensee with properly pruned trees that enhance future wood quality and provide for increased visual safety along roads as a form of payment (DesRochers, personal correspondence).

Material

Cedar boughs are needed for the production of leaf oil and cedar heartwood is needed for the production of wood oil. On average, one tonne of cedar boughs produces between 12 and 16 pounds of oil (Berlin, personal correspondence). One tonne of boughs is roughly equivalent to three heaping truckloads (Berlin, personal correspondence). The heartwood used for oil production is usually in the form of sawdust from the waste produced by furniture factories and lumber mills (FAO, 1995).

The time of the year will also affect the yield retrieved from the boughs. This is not to say that collection should only take place during one of the four seasons, but it will affect the production. Spring is the best time to collect, while summer and winter, during which the trees are drought stressed or dominant, are the worst (Guenther, 1952).

When collecting boughs proper pruning techniques should be used. This will help to reduce the chance of infection, maintain the growth potential, and produce clear wood in the juvenile trees (Table 4.).

Table 4. Proper Pruning Techniques

Technique	Description
1)	using cutting tools such as pruning shears or saws that produce flush cuts parallel to the branch collar
2)	not cutting boughs from the top half of the tree and to a maximum height of 2.5m
3)	not leaving stubs greater then 5cm in length
4)	pruning to the ground, removing live and dead branches alike

Source: Kennah 1998

DISCUSSION

In a society that emphasizes economic stability and well being it is important to have an infrastructure that takes advantage of local resources, especially renewable ones. Cedar oil produced in British Columbia is a high value product that does not have a formally developed market nor governmental marketing agencies currently interested in selling this product. The price of the facilities required to produce the oil are quite humble and there is a supply source, even if it is not presently a securable and excludable resource. Although a sustainable sector could be developed in the sale of this product, one must always ask why it has not.

If the reason for this lack of growth were from problems due to exclusion and security of reliable supplies, then it would be expected that areas such as Clayoquot Sound, where stands are up to 70% cedar, would show signs of vigorous competition. Instead, large slash piles of cedar lay roadside in harvested areas. It is more likely that the reason for this lack of development is due to the production of these oils being cheaper in areas other then British Columbia. This would explain the high turnover rate of the British Columbians entering and exiting the market each year as (Berlin, personal correspondence).

What is needed to have a boom in the sector is to have the development of secondary products increase the demand for the oil. Such products could include alcoholic beverages such as absinthe. Absinthe is a drink developed in Europe, which has a hallucinatory effect due to the presence of thujone (Arsberetning engelsk vers, 2001). This drink was banned in 1915 in France, but is available today with a lower thujone component, 10 mg/L (Arsberetning engelsk vers, 2001). An increase in production of products that cedar oil has traditionally been included in within British Columbia would also work.

CONCLUSION

If a buyer can be secured, one can produce cedar oil in a profitable manner. The return does not seem to be great, remember that one tonne of boughs produces about 14 lbs. of oil, which was selling for CAD $22/lb in 1996, but adequate enough for a secondary source of income. It is in this area I believe that there may be growth in cedar oil production. As a secondary source of income, less return is usually expected on investments. For this reason I believe that there is a niche for cedar oil production in British Columbia, but it will remain small until there is a greater demand for the oil. The provincial government could assist in the marketing of the cedar oil product worldwide and provide funding for research and development of new products that would utilize cedar to increase this demand. If they do take this course of action it is not only imperative that they establish policies that outline harvesting techniques but guarantee the availability of supply of cedar boughs to allow the cedar oil industry to ensure the delivery of the product as it is requested.

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APPENDIX

APPENDIX I: ALT-CANADA'S PRICE LISTING FOR CEDAR OIL

ATL Canada Presents

PURE NATURAL ESSENTIAL OILS. Wholesale Price List/Year 2003

Minimum Order - $50.00 US. All Prices are in $US

ATL CANADA Phone/Fax (519) - 434-6208 e-mail:info@pureessentialoils.com

Processing Abbreviations

S/D -Steam Distillation	V/D -Vacuum Distillatin	H/D - Hydrodistillation	USP- United States Pharmac NF National Formulary
SC/CO2 - Supercritical CO2 Extraction	S/E - Solvent Extraction	C/P - Cold Pressed	FCC - Food Chemical Codex
CO2 Total - CO2 Extraction at high Pressure	CNV - Conventional agriculture (100% pure and Natural	WG - Wild Grown	CoS/D Co-Distillation by Steam

#	Essential Oil	Botanical Name	Plant Part	Growing Method	Processing Method	1/6 oz	1/3 oz	1/2 oz	1 oz	4 oz	8 oz	16 oz 1 LB	32 oz 2 LB
195	Cedar Leaf (Bulgaria)	Thuja occidentalis	Leaves/twigs	WG	S/D	4.45	7.07	8.45	11.90	34.70	55.75	94.50	165.00
196	Cedar Leaf (White Eastern Cedar, Canada)	Thuja occidentalis	Leaves/twigs	WG	S/D	4.40	6.96	8.14	11.29	32.32	51.00	85.00	146.00
197	Cedar Leaf (USA)	Thuja occidentalis	Leaves/twigs	WG	S/D	4.46	7.08	8.50	11.99	35.07	56.50	96.00	168.00
198	Cedar Leaf (India)	Thuja occidentalis	Leaves/twigs	WG	S/D	4.46	7.08	8.50	11.99	35.07	56.50	96.00	168.00
199	Cedar Leaf Western Red (USA)	Thuja plicata	Leaves/twigs	WG	S/D	4.51	7.18	8.78	12.57	37.32	61.00	105.00	186.00
200	Cedar Wood (China)	Cupressus funebris Endl.	wood	WG	S/D	4.03	6.23	7.26	9.56	25.57	37.50	58.00	92.00
201	Cedar Wood Atlas (Morocco)	Cedrus atlantica Manetti	wood	WG	S/D	4.09	6.33	7.60	10.20	28.07	42.50	68.00	112.00
202	Cedar Wood Atlas (France)	Cedrus atlantica Manetti	wood	CNV	S/D	4.64	7.44	7.92	10.84	30.57	47.50	78.00	132.00
203	Cedar Wood, Crude (Himalaii)	Cedrus deodora	wood	WG	S/D	3.85	5.85	7.05	9.11	23.82	34.00	51.00	78.00
204	Cedar Wood, Rectified (Himalaii)	Cedrus deodora	wood	WG	S/D	3.87	5.89	7.16	9.36	24.82	36.00	55.00	86.00
205	Cedar Wood, Triple rectified (Himalaii)	Cedrus deodora	wood	WG	S/D	4.33	6.83	7.73	10.45	29.07	44.50	72.00	120.00
206	Cedar Wood, Perfumery Grade (Himalaii)	Cedrus deodora	wood	WG	S/D	4.41	6.99	8.21	11.42	32.82	52.00	87.00	150.00
207	Cedar Wood, Microscopy Grade (Himalaii)	Cedrus deodora	wood	WG	S/D	4.38	6.91	7.96	10.97	31.07	48.50	80.00	136.00
208	Cedar Wood (Mexico)	Cedrus mexicana	wood	WG	S/D	4.31	6.78	7.60	10.20	28.07	42.50	68.00	112.00
209	Cedar Wood (W. India)	Cedrus deodora	wood	WG	S/D	4.35	6.85	7.81	10.61	29.70	45.75	74.50	125.00
210	Cedar Wood (Oregon, USA)	Chamaesyparis lawsoniana	wood	WG	S/D	4.45	7.06	8.43	11.86	34.57	55.50	94.00	164.00
211	Cedar Wood Crude (Redistilled, Texas USA)	Juniperus ashei	wood	CNV	S/D	4.41	6.98	8.16	11.35	32.57	51.50	86.00	148.00

APPENDIX II: CONVERSIONS FOR UNITS

Metric		Imperial
1 kilogram (kg)	=	2.2046 pounds (lb)
1 tonne (t)	=	0.9842 tons
1 milliliter (ml)	=	0.0352 fluid ounces (fl oz)

CAD $1 = US $0.6766
April 6, 2003