THE UNIVERSITY OF THE WEST INDIES

ST. AUGUSTINE CAMPUS

MANUFACTURING PROFILE 3A: ESSENTIAL OILS AND OLEORESINS PART 1

The Development of Project Profiles for the

Manufacturing Sector of T&T

ABSTRACT

This profile explores the production of oleoresins by Supercritical Fluid Extraction (SFE) in Trinidad. Oleoresins are non-volatile extracts which may be used for food flavours, aromatherapy products, nutraceuticals/ pharmaceuticals, perfumes and various other uses such as security sprays, insecticides, dyes etc.

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1 Description of the Opportunity

This potential opportunity seeks to capitalise on the growing demand for essential oils and oleoresins. The food, cosmetics, health food and supplement industries have been so fraught with processed products containing large amounts of chemicals, that there is now a trend wherein consumers are turning away from prepared products and exhibiting a preference for purchasing pure oils and creating their own cosmetics for hair care and skincare. Oils find increasing use in areas such as nutraceuticals, phytomedicine, cosmeceuticals, hair care, skincare, fragrances, aromatherapy, insect repellents, flavourings and colourants.

Caribbean islands are significant global producers of raw materials required for four (4) areas identified by Seaforth and Tikasingh (2005) as having good potential for industrial development. These include *bayleaf* (Dominica), *nutmeg* (Grenada), *pimento* (Jamaica) and *vetivier* (Haiti). However, all of the plants identified in Table 1, flourish in the region and it is argued therefore that T&T could take a lead role in producing the oils for commercialisation including branding and sale to consumers or for use in other value added downstream industries which will benefit the country or region economically.

Table 1: Oils with Proven Commercial Value

OIL	PROVEN INDUSTRIAL USE
Bayleaf	hair care, cosmetics

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Carapa seed	cosmetics, soaps, insect repellent
Cascarilla	Fragrance
Castor	health care, hair care
Cocoa butter	cosmetics, food
Coconut	virgin, wet milled with heat – health food, hair and skin care
Ginger	flavour, fragrance
Lemongrass	fragrance, aromatherapy
Nutmeg	health care, flavour
Pimento	flavour, fragrance
Pumpkin	health care
Turmeric (rhizome)	nutraceutical, cosmeceutical, flavouring, colour
Vetivier	Fragrance

1.1 Summary

This profile explores the production of oleoresins by Supercritical Fluid Extraction (SFE) in Trinidad. Oleoresins are non-volatile extracts which may be used for food flavours, aromatherapy products, nutraceuticals/pharmaceuticals, perfumes and various other uses such as security sprays, insecticides, dyes etc. The global market for oleoresins was estimated to be approximately US$1b in 2014, increasing to US$1.6b in 2020. The major

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oleoresin products from tropical plant species are extracted from hot peppers, ginger, turmeric and cardamom; all of which can be produced by SFE. This proposal is based on the oleoresins extracted from turmeric having multiple uses such as a food flavouring and as a pharmaceutical used in cancer treatment.

Professor Emeritus David Mc Gaw of the UWI and his team have done considerable research in this and are willing to form a partnership whereby the team provides technical support and lab services for the venture. As such, this profile consists of a partnership with the team from UWI.

It is proposed that the raw materials be produced by contract farmers who will supply to the factory gate, the projected price being US$0.60 per kg. The raw materials will then be dried and milled prior to charging to a three extractor vessel SFE unit, with the oleoresins being extracted by contacted with carbon dioxide at high pressure (approx.. 250 bar). It is envisaged that they will be marketed initially through the global broker system. The current world market price is estimated to be US$50 per kg.

SFE is a batch process and a turnaround time of three (3) hours is projected with an oil yield of 10% based on dried material. Extensive laboratory testing has been carried out on locally produced turmeric in order to identify processing conditions and evaluate extraction characteristics. The order of magnitude capital cost has been estimated to be US$7.5m, mainly for the purchase of the plant equipment and the requisite buildings. Working capital of US$1.86m would also be required at the start of the project.

Operating costs for raw material purchase, crop processing, marketing and administration were estimated to be US$4.27m annually. The financial analysis indicated an IRR of 21% over 5 years, making the proposal well worthy for further analysis, with a view to subsequent investment and implementation, especially when the plant life should exceed 20 years. The venture proposed in this profile is summarised in Table 2.

Table 2: Essential Oils and Oleoresins Part 1 Summary

INVESTMENT	PAYBACK PERIOD	5 YEAR NPV	IRR (5YR)
$9.4mUS	5 Years	$2.68mUS	21%

1.2 Product Mix

The major oleoresin products from tropical plant species are extracted from hot peppers, ginger, cardamom and turmeric as shown in Figure 1. However, this opportunity will focus

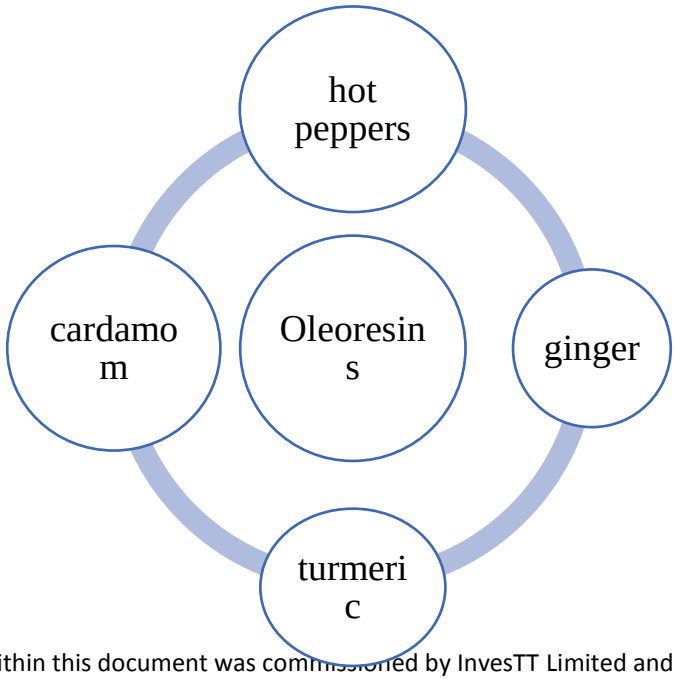

Figure 1: Major Oleoresins from Tropical Plants

on turmeric.

It should be stressed, that the process plant is entirely flexible, and therefore suitable for use to produce any other essential oils or oleoresins if market conditions deem suitable. In addition, the operation described in this proposal would only be the first step in the development of the industry, with the value added opportunities for the production of consumer products and downstream processing to be introduced later.

1.3 Description of Activities

Oleoresins are not volatile, so steam distillation is not appropriate to their extraction. The traditional extraction technique has been to contact the plant material with a suitable solvent e.g. ethanol, in an agitated vessel where the oleoresin dissolves in the solvent. When the bulk of the oleoresin has been dissolved, the solvent with the oleoresin is separated from the exhausted plant material. The oleoresin then has to be separated from the solvent, usually by fractional distillation. There will however be some solvent contamination in the oleoresin product.

However, a new extraction technique has been developed more recently, whereby carbon dioxide at close to atmospheric temperature is pressurized to a supercritical condition and passed through the bed of plant material. The extract is taken up into the carbon dioxide stream and after exiting the vessel, the pressure is dropped back to atmospheric pressure whereby the carbon dioxide reverts to a gas from which the extract liquid can be easily

separated. Carbon dioxide is readily available in Trinidad as a by-product in ammonia manufacture.

The advantage of using supercritical fluid extraction is that it can be used to extract both essential oils and oleoresins, thereby making it much more flexible than the traditional methods. The drawback is that the capital cost is greater. It has however effectively replaced solvent extraction to extract oleoresins in modern extraction systems, because there is no solvent contamination in the final product.

It is important to note that both of the extraction technologies projected for commercial use have the flexibility to process different raw materials at different times. The only issue in operating that approach is the ability to flush out the equipment completely before the change of product.

After drying and milling, the raw materials will be charged to the processing unit where the oils will be extracted. A diagram of the SFE process is shown in Figure 2. It is a batch process whereby the raw material is charged into a basket close to the extraction vessel and when full the basket is hoisted up and deposited on a perforated grid at the base of the vessel. The top lid is then closed down and clamped after which carbon dioxide at high pressure is passed to the underside of the grid. The carbon dioxide then passes through the plant material taking up the extracted oils from the material. The production of oils is highest at the beginning of the run but as the plant material's oil content reduces with time, the oil production rate drops off until the material is exhausted.

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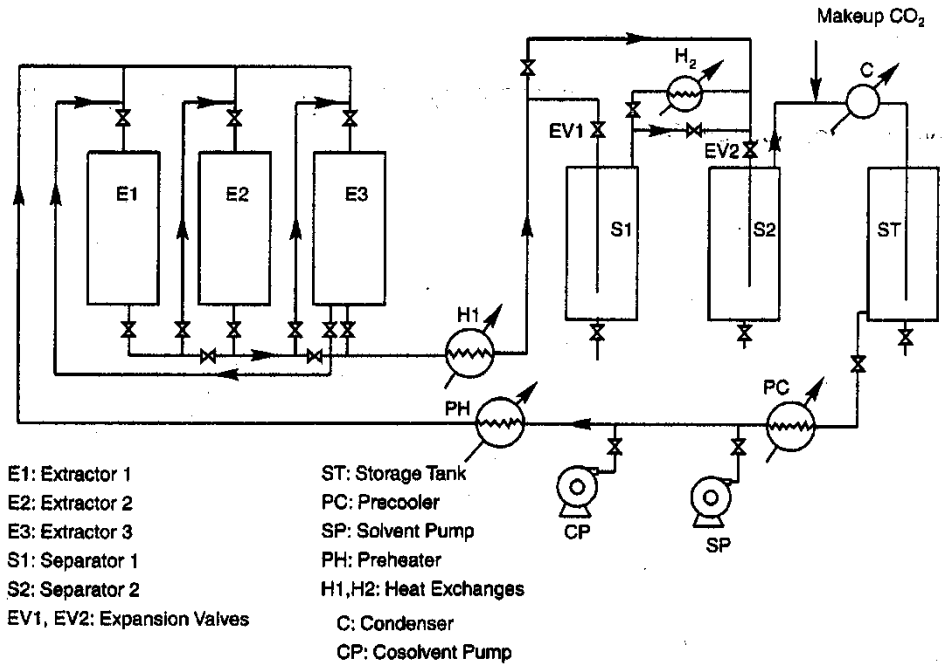

Figure 2: Semi-Continuous SFE Process

When the rate of production drops off to a low level, the flow of carbon dioxide is stopped. The top lid is then opened up and the basket removed. The spent material is taken out of the basket and a new charge introduced. The process is then repeated. It is proposed to compost the spent leaves, with the compost produced to be utilized in the agricultural production.

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2 Industry Overview

2.1 Industry Description

Grand View Research (2015) estimated the global essential oil market to be approximately US$5.5b in 2014. They stated that increasing essential oil penetration in aromatherapy, coupled with rising demand for fragrances and flavours in food and beverages, is expected to remain a key driving factor for the global market. In terms of final consumer products, Shukla (2015) estimated the global fragrance and flavour market to be US$21b.

Growing consumer preference for natural products has led to the development of novel applications in personal care and beauty products. Rapid industrialization and growing disposable incomes, particularly in emerging economies such as China, India, Vietnam and Thailand, are some of the macro factors steering growth.

In addition, rising application scope on account of growing consumer awareness regarding health benefits, and negligible side effects associated with the use of essential oils, is expected to spur their demand in the medical industry. Growing demand for aromatic flavours and fragrances in cosmetics, perfumes, as well as spa and relaxation applications is also expected to fuel demand in the coming years.

Specifically, Grand View Research (2015) estimated that the US essential oil market revenue will double from US$2.0b in 2015 to more than US$4.0b in 2022, with breakdowns

being given for the top 10 oils. The European market was valued at US$2.4b in 2014, but growth was expected to remain stagnant in that market.

Oleoresins are basically used in food flavours, natural pharmaceuticals, and various other products such as security sprays. Market Research.com (2014) carried out an in-depth analysis of the Global Oleoresin Industry dated August 2014; this study incorporated up and downstream evaluations, giving industry development trends as well as providing background for New Project Feasibility Analysis. Details are only available on purchase of the study, but it is clear that there should be significant potential for expansion particularly in the pharmaceutical area. However Grand View Research (2015) estimated world trade in oleoresins to be US$1.14b in 2014, and they expected it would rise to US$1.69b by 2022.

2.2 Incentives

2.2 Incentives

A number of incentives are available for investors. In addition to general incentives, there are incentives related to manufacturing as well as agro-processing. (All values for incentives are in $TT where US $1. = TT $6.74 on 17 August, 2016)

- ***The Fiscal Incentives Act***, offers a waiver of income tax on dividends or other distributions, other than interest, out of profits derived from manufacture of approved products.

- ***Total Relief from Value Added Tax*** on imports for highly capital intensive enterprises.
- ***The Customs & Excise Act*** offers investors duty free importation of plant, machinery, equipment, components and raw materials, as specified in the Third Schedule of the Customs Tariff.
- ***The Foreign Investment Act*** allows a foreign investor to purchase land not exceeding one acre for residential purposes and five acres for commercial purposes without obtaining a license. In order to purchase land in excess of these amounts, a foreign investor must apply for a license from the Minister of Finance. Additionally, foreign investors are allowed to purchase up to 30 per cent of the cumulative shareholding in a public company.
- ***Agro-processing Incentives*** offered by the government including rebates of:
    - 50% of the cost of establishing approved facilities for Agro-Processing of approved commodities to a maximum of $50,000
    - 50% of the cost of refurbishing of approved facilities for Agro-Processing of approved commodities to a maximum of $20,000
    - 50% towards the cost of packaging material to a maximum of $15,000 annually
    - 40% of the cost of Hazard Analysis and Critical Control Points (HACCP) upgrade to a maximum of $40,000

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3 Stakeholder Analysis

The various stakeholders were analysed using Mitchell, Agle and Wood's Power Legitimacy Urgency model. The Power, Legitimacy, Urgency model results in eight different stakeholder groups. These groups are defined by which of the three (3) attributes each individual stakeholder group possesses. Each of the stakeholders in this study was rated on a scale from 1 to 5 for degree of possession of each attribute where 1 was lowest and 5 was highest. The stakeholder was deemed to possess the attribute of power, legitimacy or urgency when given a ranking of 3 or higher. The results of the stakeholders' assessment are shown in Figures 3 and 4 and Tables 3 and 4.

RAW MATERIALS	PRODUCTION	SUPPLY CHAIN (MARKETING AND DISTRIBUTION)	AGENCIES, ETC.
•Farmers •Labourers •Cooperatives •Suppliers •Plastic Bottles •Bottlecaps •Cartons •Glass Bottles	•Manufacturers •Operators •Employees •Equipment Suppliers	•Website Designer/Manager •Health Food Stores - Local •Health Food Stores - Foreign •Supermarkets - Local •Supermarkets - Foreign •Salons •Herbal Stores •Pharmacies •Internet Service Provider	•Customs And Excise •E-Teck •Cariri •CFDD •Ministry of Health •UWI •CHBA •Cardi •Carapa •IICA •UG •InvesTT

Figure 3: Key Stakeholder Groups

Each of the thirty-one (31) stakeholders in this study was rated on a scale from 1 to 5 for degree of possession of each attribute where 1 was lowest and 5 was highest. The stakeholder was deemed to possess the attribute of power, legitimacy or urgency when given a ranking of 3 or higher. The result of this preliminary analysis is summarized in Table 3.

Table 3: Stakeholder Analysis of Essential Oils and Oleoresins

STAKEHOLDERS	POWER	LEGITIMACY	URGENCY	TOTAL
University of Guyana	2	4	2	**8**
UWI (St. Aug, Mona and Cave Hill)	2	4	2	**8**
CARAPA	2	3	2	**7**
Suppliers - Bottle caps	2	3	2	**7**
Suppliers – Cartons	2	3	2	**7**
Suppliers - Plastic Bottles	2	3	2	**7**
Ministry of Health	5	5	2	**12**
Labourers	5	3	2	**10**
Supermarkets – Foreign	4	3	2	**9**
Supermarkets – Local	4	3	2	**9**
Suppliers - Glass Containers	4	3	2	**9**
Equipment Suppliers	3	2	4	**9**
CARDI	2	4	4	**10**
CARIRI	2	4	4	**10**
Caribbean Herbal Business Ass'n	2	3	4	**9**
Chemistry Food and Drugs Division	5	5	3	**13**
Customs and Excise	5	5	3	**13**
Farmers	5	4	3	**12**
Cooperatives	4	4	4	**12**
Employees	4	4	4	**12**
Operators	4	4	3	**11**

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Salons	4	3	4	**11**
Health Food Stores – Foreign	4	3	3	**10**
Health Food Stores – Local	4	3	3	**10**
Herbal Stores	4	3	3	**10**
Pharmacies	4	3	3	**10**
INVESTT	3	5	5	**13**
E-Teck	3	4	4	**11**
IICA	3	3	4	**10**
Website Designer/Manager	3	3	4	**10**
Manufacturers	3	3	3	**9**

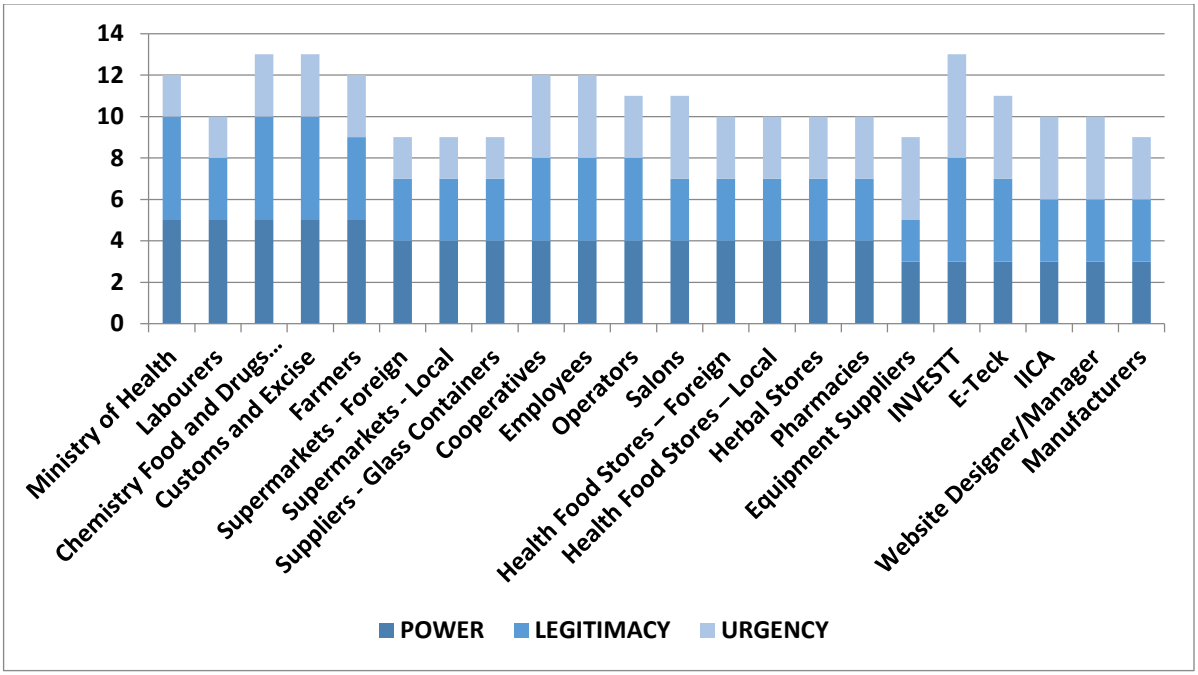

Figure 4: Major Stakeholders in the Manufacture of Essential Oils and Oleoresins

Table 4: Stakeholder Categorisation for the Manufacture of Essential Oils and Oleoresins

NO	STAKEHOLDER GROUP	ATTRIBUTES
1	Dormant stakeholders	N/A
2	Discretionary stakeholders	University of Guyana, UWI (St. Aug, Mona and Cave Hill), CARAPA, Suppliers – Bottle caps, Suppliers – Cartons, Suppliers - Plastic Bottles
3	Demanding stakeholders	N/A
4	Dominant stakeholders	Ministry of Health, Labourers, Supermarkets – Foreign, Supermarkets – Local, Suppliers - Glass Containers
5	Dangerous stakeholders	Equipment Suppliers
6	Dependent stakeholders	CARDI, CARIRI, Caribbean Herbal Business Association
7	Definite stakeholders	Chemistry Food and Drugs Division, Customs and Excise, Farmers, Cooperatives, Employees, Operators, Salons, Health Food Stores – Foreign, Health Food Stores – Local, Herbal Stores, Pharmacies, INVESTT, E-Teck, IICA, Website Designer/Manager, Manufacturers

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4 Environmental Scan

4.1 External Analysis

PESTLE

The environmental scan started with an evaluation of the external environment for the Essential Oils and Oleoresins. This was done using the PESTLE tool where Political, Economic, Social, Technological, Legal and Environmental (physical) benefits or concerns regarding the venture were identified and their potential impact individually assessed. See Table 5.

Table 5: PESTLE Analysis for Essential Oils and Oleoresins

CATEGORY	SITUATION	POTENTIAL IMPACT
Political	Governments in the region have not selected this area for special attention.	In order for this industry to be viable, CARICOM members would have to regulate the industry. For example, the world's largest producer of a key ingredient in fragrance exists in the region but the foreign customers extract and use the oil with the local population generally unaware of its use or value. A national programme to educate populations of the value of these extracted oils and careful regulation of its use is required.
Economic	Consumers view these oils as more valuable than products	Sales at a premium price are assured in this

	with additives and are prepared to pay more.	market.
	The oils, sold in industrial and consumer markets may be more valuable than any products created from them.	The combined effect of less processing and higher prices, mean higher margins. In this growing industry, less processing may be better.
Social	Use of fragrance in cosmetics is declining.	This would negatively affect the demand for certain oils used specifically for their fragrance. For example, oils traditionally used in soaps, shampoos and deodorants. However, these products are among the cheaper and lower value added products in which essential oils are used.
	Significant customers are now choosing to make their own products at home.	There is increased demand for pure oils instead of products for hair care and skin care, particularly in the multi-billion-dollar black hair care market.
Technological	Basic technology required. Just screw and/or hydraulic presses are the major pieces of equipment needed.	Barriers to entry are low – once the raw material is available, other producers can enter the same industry. Branding and integrity are key in the 'pure' oil market.
Legal	Individuals sometimes consume these oils for various health reasons and this could result in legal issues for the investor(s) if problems arise.	Negative publicity could result from adverse effects due to individuals wrongly consuming oils or using them on their body. This could be managed somewhat by proper labelling and packaging. The problem arises when individuals believe anything natural must be

		harmless.
Environmental	This industry has the potential to consume certain agricultural products rapidly.	Sustainability issues need to be addressed pro-actively.
	The region north of Trinidad is vulnerable to hurricanes.	This is a serious consideration for an industry based on fragile agricultural products. Hurricane Ivan impacted Grenada's nutmeg industry negatively in 2004.

PORTER'S 5 FORCES

The second part of the external analysis was an analysis of the competitive environment. For this analysis Porter's 5 Forces (P5F) was used. P5F looks at the rivalry among existing competitors, the threat of new entrants, the threat of substitute products, the bargaining power of suppliers and the bargaining power of customers. Using the P5F tool is superior to simply identifying competitors in the marketplace and assessing their potential threat. This is because this tool also allows for the analysis of threats that may not already exist and be visible or threats from other products or ventures that may not be identical or even operate in the same industry but which are threats, nonetheless. See Table 6.

Table 6: Major Competitive Issues in Essential Oils and Oleoresins

FORCE	SITUATION	THREAT
Competition	There are few manufacturers of high value oils in many of the areas cited, however there is strong competition in certain areas from larger countries such as India and Africa from where some of the same, (e.g. vetivier) or competing (shea butter which competes with cocoa butter) originate.	**MEDIUM**
Threat of new entrants	Even though the availability of raw materials and the indigenous knowledge in the industry may limit competition, the actual manufacturing is basic and new entrants could easily enter especially with a willing strategic partner to circumnavigate disadvantages.	**HIGH**
Threat of substitutes	Substitute products include preparations which have sometimes been found to have little to none of the essential oils they claim to possess. However, these are sold at a much lower price point and are affordable in mass markets. The industry proposed should capitalise on this by developing product lines, with a distinctly different image which capitalises on this 'budget' market so as to participate and gain sales from different levels of customers.	**HIGH**
Bargaining power of customers	Bargaining power of customers in this industry is high since knowledge is share peer-to-peer via YouTube and social media groups and these are the most trusted media for information sharing. The customers in the industry are not overly swayed by advertisements etc. but value the opinion of their peers much higher.	**HIGH**
Bargaining power of suppliers	Bargaining power of suppliers is moderate since there will be many different suppliers. This is despite the fact that the industry is based on achieving a good raw material supply.	**MEDIUM**

4.2 Internal Analysis

SWOT

The SWOT tool was used to conduct an Internal Analysis for the venture. The first phase of the SWOT tool identified the Strengths and Weaknesses inherent to the proposed project; and major Opportunities in and Threats to the industry (see Table 7). The second phase recommends how strengths and opportunities can be exploited and threats can be mitigated and weaknesses addressed respectively; this is addressed elsewhere in the report.

Table 7: SWOT Analysis for Essential Oils and Oleoresins

STRENGTHS	WEAKNESSES
• Raw material is available throughout the region for this sub-sector. • Research institutions and labs exist with expert staff. • The UWI and UTT produce scientists and engineers who are capable of assisting to take this industry to the next stage. • The technology required for this industry is well understood and basic by T&T's standards.	• Raw material supply may vary unless properly managed. • Capital must be sourced for R&D because the industry would not be sustainable without industrial upgrading. • Strong knowledge of marketing within the industry would also be paramount. This could mean participating in existing value streams as well as the creation of new ones. • There is low knowledge and acceptance of lean manufacturing in the region. This small batch manufacturing system is probably best for this industry. The

	preferred manufacturing paradigm locally is based on low unit cost or economies of scope, regardless of the product.
OPPORTUNITIES • There is a movement towards pure oils for purposes of healthier food and skin and hair health. • Consumers are trending towards blending their own products rather than buying chemical laden products from the supermarket or beauty store. • Consumers are choosing cosmetics with medicinal benefits as derived from products such as those mentioned in this profile. • The multi-billion-dollar global black hair care industry is trending towards natural hair and among the major products are pure oils. • There is the opportunity for developing value added products from some of these oils for everything from insect repellents to fragrances. • There is the opportunity to become lead producers in local, regional and global value streams for products derived from these oils.	THREATS • There is a main culture in the Caribbean that continues to view agriculture negatively and as a poor career choice for talented individuals. • Quality technical human resources for the industry need to be made available. UTT and UWI may be key in stepping up to the challenge of having a special programme in essential and other oils. • Training in hygiene factors is not widespread in T&T in the manufacturing industry. This can cripple the industry if not properly implemented and managed. • The climate of the region may be an issue. Hurricane Ivan negatively affected the nutmeg industry in Grenada a decade ago.

5 Sub-Sector Assessment

The Essential Oils and Oleoresins Plant, was assessed on various criteria including market demand, raw material cost and availability, energy use, investment value, finished product value and availability of labour. This was based on a factor rating method developed by subject-matter experts. On each of the criterion, the venture was given a rating from 1 to 10. These were weighted according to the relative importance of the criteria and a final score calculated. The final score for the Essentials Oils and Oleoresins Plant was 7.001 out of a possible 10, which was above average among the potential investment opportunities. See Table 8.

Table 8: Subsector Assessment for Essential Oils and Oleoresins

CRITERIA	ASSESSMENT	WEIGHT	RATING 1-10	SCORE
Demand	Large market size, high growth	**19.6%**	**7**	**1.372**
Finished product value	High, in comparison to inputs	**17.4%**	**8**	**1.392**
Raw material (availability)	There are issues with availability for all the raw material in T&T but this opportunity is actually multi-faceted so a creative approach could be taken	**13.0%**	**4**	**0.52**

Raw material (cost)	Low with respect to finished product value	**13.0%**	**7**	**0.91**
Legislation/regulation/ government focus	No special legislation for or against the opportunity. Average support for industry	**10.9%**	**5**	**0.545**
Energy	Relatively low utilisation of energy	**8.7%**	**8**	**0.696**
Labour market	Job-ready employees available. The technology is well known in T&T's industries and relatively basic	**8.7%**	**9**	**0.783**
Investment value	Less than 5m USD in investment for the different processes e.g. distillation, pressing, screw type oil expeller	**6.5%**	**9**	**0.585**
Technology	Familiar technology as compared to local existing capability	**2.2%**	**9**	**0.198**
Job creation	Not a largely labour intensive manufacturing operation	**0.0%**	**2**	**0**
		100%	**68**	**7.001**

6 Identification of Value Added Services

Value stream analysis, VSM has its genesis in the Toyota Production System of Lean Manufacturing. It essentially shows, on a single page, how value is created along the extended value chain from suppliers to customers for a single product type. When the value stream is mapped and assessed, opportunities for improvement may only then be identified. The value stream indicates other services that will be necessary for the successful realization of the venture. See Figure 5.

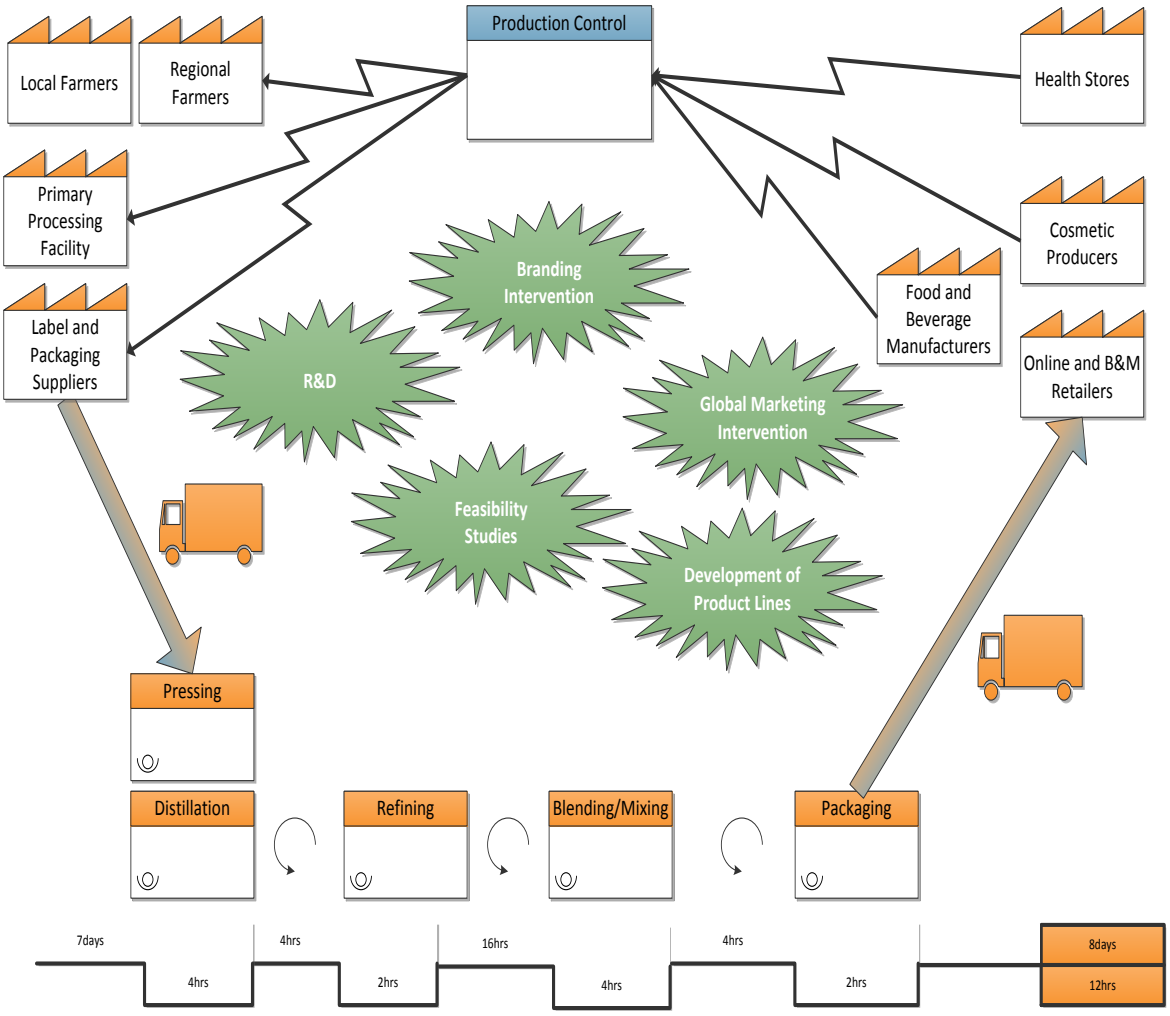

Figure 5: Value Stream Map for the Oils Industry

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7 Financial Analysis

7.1 Infrastructure

An order of magnitude estimate of the fixed capital investment is shown in Table 9, which effectively assumes the development of a green field site. This estimate incorporates land development, the installation of the process plant operation, as well as the construction of a small office building to house the administrative staff. The basic assumptions used in making up Table 9 are discussed below.

A scale will be needed to weigh the farmers' turmeric when delivered to site. A packaged system is proposed with 3 extraction vessels each of 1000L together with 2 separators. The carbon dioxide will be recycled to minimize carbon dioxide use. The main supplier of commercial size Supercritical Fluid Extraction systems in the USA has given an estimated price of such a system with a maximum operating pressure of up to 500bar of **US$6.3m.** A floor area of approximately 200m^2 was assumed for the administration facilities.

Table 9: Infrastructure Summary

COST CENTER	**COST (USD)**
Scale for weighing raw materials	***50,000***
Buildings	
- *Process Plant Building*	80,000
- *Administration Facilities (to house GM, Sales, Financial Controller, Support Staff, Board Room etc.)*	140,000
- *Auxiliary Buildings (including QC lab, control room, stores,*	40,000

garage and workers' facilities)	
- *Office Equipment*	20,000
Sub-Total	***280,000***
Site Preparation Development	
- *Site Preparation*	***50,000***
Service Facilities	
- *Utilities*	50,000
- *Waste Disposal*	20,000
- *Distribution and Packaging*	50,000
Sub-Total	***120,000***
Indirect Costs	
- Construction, Installation & Inspection	80,000
- Consultant's Fee	80,000
- Contractor's Fee	40,000
- Legal Costs	10,000
- Freight & Insurance Fees, Duties	40,000
- Contingency	50,000
Sub-Total	***300,000***
TOTAL	**800,000**

The plant is scheduled to operate for 310 days per year with a plant utilization of 85%. This should allow for maintenance and the possibility of occasional raw material supply issues. Batch turnaround time based on laboratory experimentation is assumed to be 3 hours. It is

estimated that the raw material will be supplied at a moisture content of ~80%wb (wet basis). This will need to be dried to ~15%wb before charging to the plant.

7.2 Annual Utilities Usage

The main utilities necessary would be water, fuel and electricity. See Table 10.

Table 10: Annual Estimated

UTILITY	**COST (USD)**
Fuel	100,000
Electricity	40,000
Water	20,000
Subtotal	**160,000**

7.3 Salaries

The Marketing and Sales efforts are important for this opportunity to realise its potential. The total cost for their salaries is US$330,000/yr. All other major salaries are shown below. See Table 11.

Table 11: Annual Salaries

POSITION	**ANNUAL SALARY (USD)**
Supervisor	25,000

Operating Labour - 2 Ops. per shift	100,000
Labourers- 3 off	25,000
Laboratory Technician/Storekeeper	15,000
Maintenance Technician	15,000
Security - approx. 4-5 people	60,000
General Manager (Process Eng.)	40,000
Office Supervisor	15,000
Accounting Assistant	15,000
Sales Assistant	10,000
Driver/Messenger/cleaner	10,000
TOTAL	**330,000**

7.4 Legal/Statutory Costs

Legal and statutory fees are estimated at $10K USD/yr. This is included in administrative expenses.

7.5 Base Operational Costs

Raw materials and salaries and wages represent the biggest expenses regarding base operational costs. A summary of the base operational costs is shown in Table 12.

Table 12: Base Operational Costs

COST CENTER	**COST (USD)**

Land Rent	
Subtotal US$	***100,000***
Cost of Raw Material (delivered to factory)	
Subtotal US$	***3,600,000***
Other Processing Costs	
- Safety & Protection Equipment	3,000
- Maintenance & Repairs	2,000
- Contract Services	2,000
- Chemicals & Lab Equipment	5,000
- Miscellaneous	3,000
Subtotal US$	***15,000***
General Administration Costs	
- Office Supplies	2,000
- Engineering & Legal	2,000
- Office Utilities	2,000
- Communications	2,000
- Licenses (Software etc.)	1,000
-Office Maintenance	1,000
Subtotal US$	***10,000***
Distribution & Marketing of Products	
- Marketing/Advertising	10,000
- Insurance	5,000
- Customs Costs	5,000
- Transportation (1 container/mth)	30,000

Subtotal US$	***50,000***
TOTAL	**4,265,000**

7.6 Equipment Costs

Table 13 shows the major equipment that would be used for the Essential Oils and Oleoresins Plant. The sub total cost is US$6,700,000.00

Table 13: Summary of Equipment Costs

COST CENTER	**COST (USD)**
SFE Plant package	6,300,000
Dryer/size reduction equipment	200,000
Mobile unit to load and offload raw materials	200,000
TOTAL	**6,700,000**

7.6 Financial Analysis

Projected raw material needs, oil production and revenues are given in Table 14 for the single product operation.

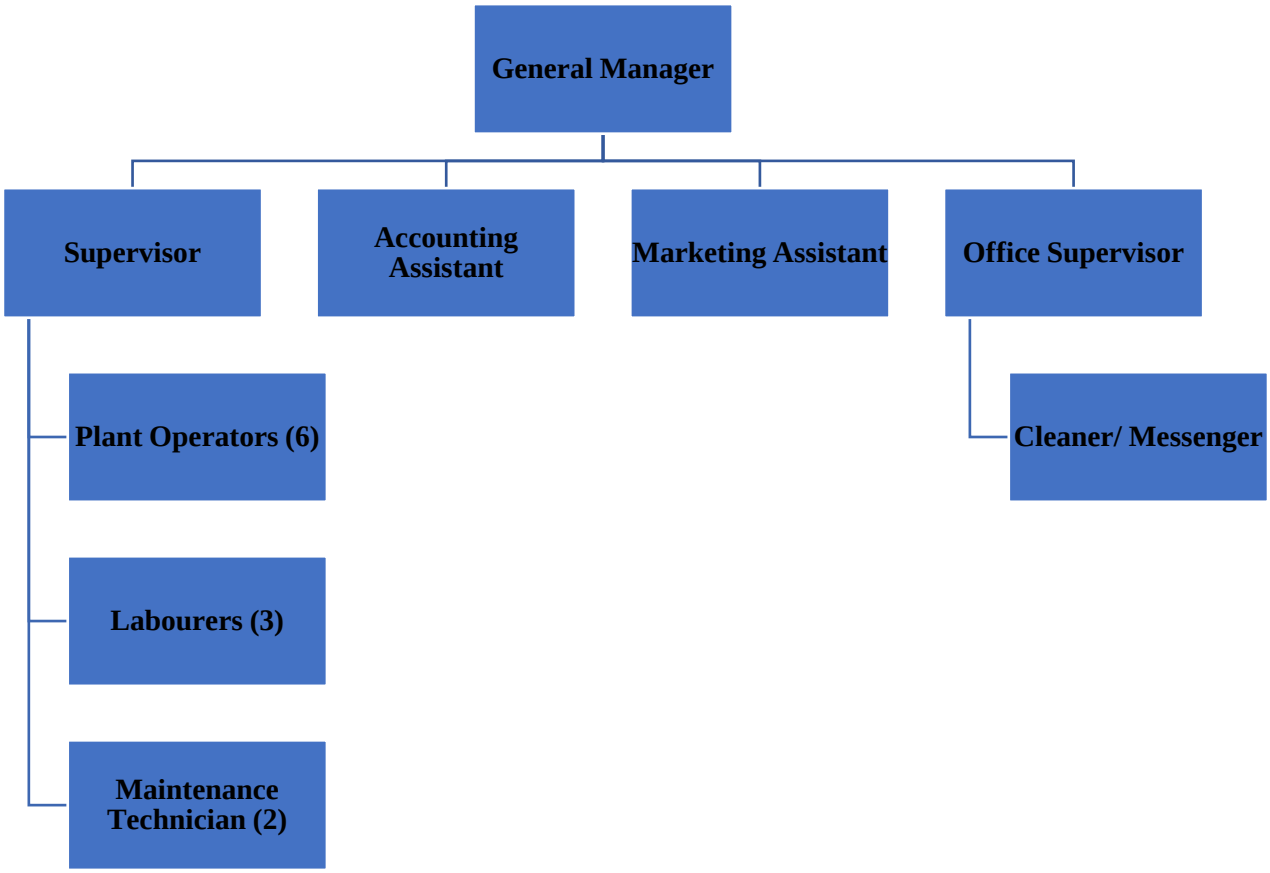
Table 14: Revenue Projection

CROP	**CROP ACQUISITION TONNES/YR**	**OIL PRODUCTION KG/YR**	**REVENUE US$/YR**
Turmeric	6000	148800	7,440,000

8 Human Resources

8.1 Organisation Chart

The organisation would permanently employ seventeen (17) employees with one (1) Marketing Assistant, one (1) Accounting Assistant, twelve (12) in the Production Department, two (2) in Administration. In charge would be a General Manager who would ideally be an Industrial Engineer, as would the Production Manager. They should both be



familiar with Lean Production and Total Productive Maintenance. See Figure 6.

Figure 6: The organizational structure of the Essential Oils and Oleoresins

8.2 Job Descriptions for Key Positions

Brief descriptions for the key permanent positions in the Essential Oils and Oleoresins Plant are in Table 16.

Table 15: Job Descriptions

POSITION	DESCRIPTION
General Manager	The General Manager will assume overall responsibility for the management and operations of the organization. Included would be product development, business development, operations, production, financial control, quality control, and training of employees in all aspects of the operation.
Office Supervisor	Responsible for managing the office, document management and internal communication.
Factory Supervisor	Responsible for ensuring that all processes that are supposed to be carried out per shift are done in a timely manner and assigning duties to plant operators, labourers and maintenance technician.
Maintenance Technician	The maintenance technician is responsible for preventative measures as well as troubleshooting processes and diagnosing mechanical, hydraulic and pneumatic problems associated with process equipment.

Accounting Assistant	The processing of bills, invoices, accounts payable and receivable, etc.
Marketing Assistant	Planning, advertising, public relations, product development and distribution. The sales officer is the point of contact between the company and the customer and is required to establish and maintain strong relationships between both parties.
Plant Operators	Responsible for operating the equipment to make the products, set-up, keeping the work area clean and tidy and basic machine maintenance.
Labourers	The labourers ensure smooth operation by performing duties such as cleaning, packing, forklift drivers, storage, etc.
Cleaner/Messenger	The primary duty of this staff member would be to transportation and courier services for the venture. Clean up functions on-site will also be required.

8.3 Labour Availability

Table 16: Potential labour pools for proposed positions

CATEGORY	UNEMPLOYED	EMPLOYED	POTENTIAL EMPLOYMENT POOL
Professionals	900	36700	Graduates from any of the sixteen (16) Universities of the West Indies Open Campus locations in

• Office Supervisor • Factory Supervisor • Accounting Assistant • Marketing Assistant			the Caribbean, and/or any of UTT campuses in Trinidad.
Legislators, senior officials, managers • General Manager	400	61300	Sourced from the existing pool of unemployed and employed persons through interviews and the subsequent process of filtering.
Clerks • Sales Officer	5100	67100	Can be sourced from several training centres in Trinidad registered under the Accreditation Council of Trinidad and Tobago (ACTT) E.g. Crane Safe Technical Institute, Advanced Solutions Technical Institute and Technical Institute for Learning, just to list a few.
Technicians • Maintenance	1500	69300	
Plant Operators/Labourers	600	57700	

9 Location

This venture would be located in Trinidad in the Frederick Settlement Industrial Park, Caroni or in the Tamana InTech Park. Table 18 depicts a general assessment of locations in T&T. The assessment of the most suitable locations for the establishment of the proposed facility, was determined using a factor rating method. Fourteen (14) rating criteria were used in this particular instance. These criteria can be found in the first column of the Table 18.

It is followed by a list of the best general locations which may be used as a guide to find alternative locations to the recommended, if necessary. The locations considered were those that have previously been identified for national economic development, i.e., key economic zones. These locations were considered as they are well positioned for the establishment of new businesses. Accordingly, access to the necessary infrastructure, services and other critical resources would be more readily available, as compared to most other locations across the country.

Table 17: A general assessment of Locations in T&T

	Weight	Trincity	Aranguez	Central	Diego Martin	South	Arima	Tobago			
Availability of services and supplies	0.048	80	80	80	80	80	80	60		540	0.078763
Environmental considerations	0.010	75	75	75	75	75	75	90		540	0.078763
Infrastructure - land availability	0.095	65	70	90	60	60	75	60		480	0.070012
Infrastructure - land/construction costs	0.105	60	60	80	50	60	60	40		410	0.059802
Infrastructure - roadways/access	0.124	80	80	60	70	70	80	50		490	0.07147
Labor availability experience/skills	0.067	90	70	75	75	80	80	60		530	0.077305
Labour cost	0.048	75	75	75	75	75	75	65		515	0.075117
Proximity to emergency services	0.000									0	0
Proximity to port	0.086	80	80	80	80	70	75	60		525	0.076575
Proximity to raw materials	0.057	80	80	80	60	60	60	50		470	0.068553
Utilities - electricity	0.105	90	90	90	90	90	90	90		630	0.09189
Utilities - gas	0.086	90	90	90	90	90	90	80		620	0.090432
Utilities - telecom	0.086	90	90	90	90	90	90	90		630	0.09189
Utilities - water	0.086	75	75	70	60	75	70	50		475	0.069282
Total	1.000	1030	1015	1035	955	975	1000	845		6856	

Best Locations based on rankings

1) Central Trinidad: 1035
2) Trincity: 1030
3) Aranguez: 1015
4) Arima: 1000
5) South: 975
6) Diego Martin: 955
7) Tobago: 845

10 List of Potential Investors and Partners

Table 19 gives a list of potential investors and partners, together with contact information. The list is not exhaustive.

Table 18: List of Potential Investors and Partners

POTENTIAL INVESTOR/PARTNER	CONTACT
Biolandes	40420 LE SEN / FRANCE Tel. +33 (0)5 58 51 00 00 Fax. +33 (0)5 58 51 07 00 Purchasing / Subsidiaries：Benoît LEMONT Products / R&D：Philippe COUTIERE Sales：Cécile COUTIERE https://www.biolandes.com/contact.php?lg=en#
DoTerra	Global Headquarters dōTERRA International LLC. 389 South 1300 West Pleasant Grove, UT 84062 Monday-Friday 9:00am - 5:00pm (MST)

Ungerer and Company	U.S. Headquarters 4 Bridgewater Lane Lincoln Park, NJ 07035 P: 973-628-0600 F: 973-628-0251
Essential Oils of New Zealand	46 Waiora Lane PO BOX 591 Rangiora New Zealand Telephone 03 313 8032 Fax +64 3 313 8032 Email: sales@essentialoil.co.nz
Falcon and Ungerger Limited	Lincoln Park Headquarters 4 Bridgewater Lane Lincoln Park NJ 07035 Telephone: 610 868 7266
Farotti Essence	Via Coriano, 58 47900 Rimini Italy

	+390541384728
Young Living Essential Oils	Thanksgiving Point Business Park 3125 Executive Parkway Lehi, UT 84043 1-800-371-3515

11 Concluding Remarks

This profile concerns the production of oleoresins in Trinidad using Supercritical Fluid Extraction technology. The initial product is turmeric oil, however the technology is very flexible and capable of delivering a wide variety of essential oils and oleoresins as the market demands, and as raw material is available. Professor Emeritus David Mc Gaw of the UWI and his team have done considerable research in this area, would be providing technical support and lab services for the venture. While the analysis shows the venture to payback over a 5-year period despite the significant projected investment in equipment, quotations based on the actual design of the facility would be necessary to determine the final investment value. As with all the other profiles, a pre-feasibility followed by a complete feasibility study should be done before a decision is made on the project.

12 References

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