DownUnder
enterprises

Traceable
Sustainable
Botanicals

Sandalwood

Beyond the fragrance

UL PROSPECTOR GLOBAL WEBINAR

SPEAKERS:

DEE-ANN PRATHER, PRESIDENT, DOWN UNDER ENTERPRISES
DR DHANUSHKA HETTIARACHCHI, DIRECTOR, PHYTOCOGNOSY
CAMPBELL SANDERSON, MANAGER SALES & INNOVATION, FOREST PRODUCTS COMMISSION

11 JULY 2019

DownUnder enterprises

Traceable Sustainable Botanicals

Our Speakers

Dee-Ann Prather

President
Down Under Enterprises

Dr. Dhanushka Hettiarachchi
(Danny)
Founder/Director
Phytocognosy

Campbell Sanderson
Manager Sales & Innovation
Forest Products Commission
Western Australian Government

Down Under Enterprises

We strive to be the most respected global provider of native Australian ingredients.

Our products are 100% pure, 100% natural, and 100% traceable. Our products are grown, developed, and brought to market in the most environmentally friendly and sustainable manner possible.

We develop and support our team members to be knowledgeable and highly capable, enabling them to take pride in supporting – beyond expectations – our customers' requirements.

Tea Tree
(*M. alternifolia*)

Sandalwood
(*Santalum spicatum* and *Santalum album*)

Eucalyptus
(*7 different varieties*)

Over 15 other native Australian essential oils

Americas **Australia** **Asia** **Europe**

DownUnder enterprises

Traceable Sustainable Botanicals

Announcing our new EMEA partner

Univar Solutions

Innovate. Grow. Together.

- Effective immediately
- Down Under's full product line
- Distribution and customer support in EMEA
  - 5 Formulation labs, Europe + Dubai
  - Local European warehouse - local supply
- Extends Univar's move into Naturals, including Cargill and Hallstar distribution and acquisition of EarthOils in 2018

Compliments our direct sales and warehouse operations in North America and Australia, and our network of Commercial Partners across Asia

DownUnder enterprises

Traceable Sustainable Botanicals

Sandalwood – Beyond the Fragrance

Webinar Agenda

- Variety and distribution of Sandalwoods
- Therapeutic properties
- Traceability: The case for Australian Sandalwood
- Sustainability of Sandalwood

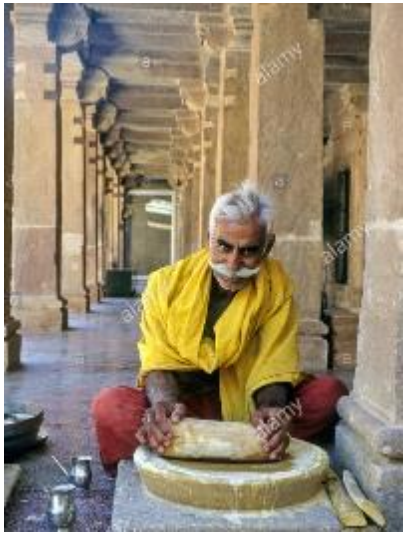
DownUnder
enterprises

Traceable
Sustainable
Botanicals

Background

Throughout recorded human history, sandalwood has been used as a cosmetic, medicine and ritualistic offering.

Sandalwood is referenced in many in ancient texts and traditions.



DownUnder enterprises

Traceable Sustainable Botanicals

Functions and Uses of Sandalwood

Fragrance base note

Cosmetic formulations

Traditional religious applications

DownUnder enterprises

Traceable Sustainable Botanicals

Botanical definition

Sandalwood Oil is derived from the heartwood of several species of the genus *Santalum* (family Santalaceae).

Found as a perennial tree or a shrub.

To produce good quality Sandalwood, a tree needs to reach 20-30 years age (minimum)

New plantations don't develop overnight.

Santalum album
The 'Underbelly' of Indian Sandalwood

DownUnder enterprises

Traceable Sustainable Botanicals

- Uncontrolled harvesting and destruction of Indian sandalwood forests
- Indian plantations are many years away
- Traceability is a key consideration for secure Sandalwood supply chain management

DownUnder enterprises

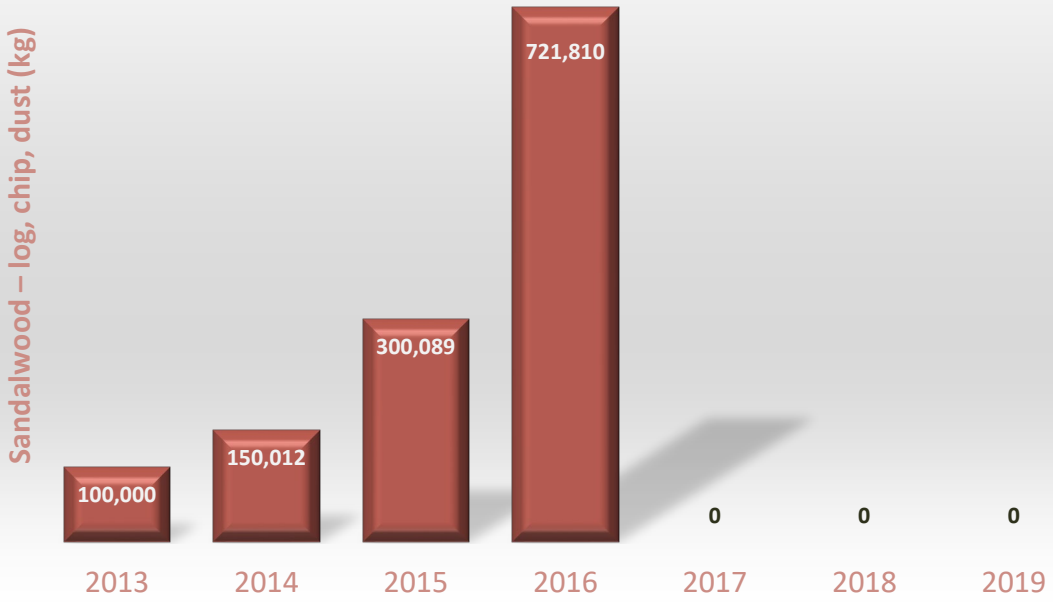
Traceable Sustainable Botanicals

Australian Sandalwood Exports to India

Australian Raw Sandalwood

HS code: 1211.9050

Exports to India from 2013 to 2019



Source: Australian Government Bureau of Statistics, April 2019

DownUnder enterprises

Traceable Sustainable Botanicals

Therapeutic Uses – An Overview

Dr Dhanushka Hettiarachchi, Phytocognosy

Sandalwood is among the most revered medicines in the ancient times.

It was first recorded as a medicine in Charaka Samhita (220 CE) an early Ayurvedic compendium.

Sandalwood
Distribution of *Santalaceae family*

- Sandalwood species are distributed across SE Asia and West Pacific
- Characterized by ISO standards
    - ISO3518:2002 for Oil of *Santalum album* (Indian Sandalwood)
    - ISO22769:2009 for Oil of *Santalum spicatum* (Australian Sandalwood)

DownUnder enterprises

Traceable Sustainable Botanicals

Sandalwood Standards and Compositions

Compound	Australian Sandalwood (*Santalum spicatum*)		Indian Sandalwood (*Santalum album*)	
	ISO 22769:2009	Observed Values	ISO 3518:2002	Observed Values
cis-α-santalol	15-25	2-48	41-55	20-58
epi-α-bisabalol	2-12.5	2-30	-	-
t-α-bergamotol	2-10	1-8	-	
epi-α-santalol	0.5-3.5	0.5-5	-	
cis-β-santalol	5-20	1-22	16-24	10-25
t,t-farnesol	2.5-15	3-35	-	
cis-nuciferol	2-15	4-32	-	
cis-lanceol	2-10	1-20	-	

DownUnder enterprises

Traceable Sustainable Botanicals

Traditional Medicines

Sandalwood is commonly used in traditional medicinal preparations for skin conditions such as inflammation, allergy, urticaria, vaginitis and eye infections.

Ayurveda Pharmacopoeia

- Blood purifier, Diarrhoea with bleeding intrinsic haemorrhage, bleeding piles
- Vomiting, poisoning, initial phase of pox
- Sunstroke, bronchitis, palpitations and sepsis.

Chinese Pharmacopoeia

- Sandalwood powder - epigastric pain with anorexia, coronary heart disease and angina pectoris
- Sandalwood oils - stimulant, diuretic, expectorant and antiseptic used in upper respiratory infection

DownUnder enterprises

Traceable Sustainable Botanicals

Sandalwood in Western Medicine

Until the discovery of antibiotics, Western Australian sandalwood was a first line antimicrobial treatment across the British Commonwealth

Well into the 20th Century, Sandalwood Oil was commonly used as a cure for venereal diseases and supplied through pharmacies and leading hospitals in England

Ayurvedic Pharmacopoeia of India, 1989
Pharmacopoeia of Peoples Republic of China, 2000
British Pharmacopoeia, 1932

DownUnder enterprises

Traceable Sustainable Botanicals

Antimicrobial Properties

Antimicrobial

Reported both sandalwood species have a varying MIC_{50} value between 6 to 600 ppm for four bacterial and one fungal strains (*Staph. aureus, E. coli, P. aeruginosa. K. pneumonia* and *C. albicans*)

Clostridium infections were controlled when sandalwood oil is administered <2% with topical subsequent application with vancomycin, metronidazole or fidaxomicin

Anti-protozoan/Antifungal

Sandalwood oil demonstrated activity against *Trichomonas vaginalis* and antifungal activity against *Crypotococcus neoformans*

Reference	Hammer et al.	Hire and Dhale	Misra and Dey	
Santalum species	**S. album**	**S. album**	**S. album**	
Microbial species	MIC (% v/v)	Zone of inhibition (mm)	Zone of inhibition (mm)	MIC50 (ppm)
Acinetobacter baumanii	>2.0			
Acinetobacter calcoaceticus			5.22 ± 0·8	5
Aeromonas sobria	>2·0			
Alcaligenes faecalis			6.5 ± 0·9	5 – 10
Arthrobacter nicotianae			18.9 ± 1.5	2.5 - 5
Bacillus cereus		15		
Bacillus subtilis			7.2 ± 2.3	1.25
Candida albicans	0.06			
Citrobacter fruendii			6.5 ± 1.2	1.25
Enterobacter cloacae			9.4 ± 2.1	10
Enterococcus faecalis	0.25	14		
Escherichia coli	>2.0	22	6.2 ± 0.5	0.156
Klebsiella aerogenes			6.5 ± 1.2	1.25
Klebsiella pneumoniae	>2.0			
Micrococcus fl avus			11.1 ± 1.1	
Proteous vulgaris		14		
Pseudomonas aeruginosa	>2.0		6.7 ± 0.4	2.5
Pseudomonas fluorescens			10.3 ± 2.2	1.25
Pseudomonas putida			9.4 ± 1.3	
Pseudomonas syringae		12		
Salmonella typhimurium	>2.0	16	12.2 ± 3	0078
Serratia marcescens	>2.0			
Staphylococcus aureus	0.12	17	18.5 ± 2.3	0.078

Source: Jirovetz et al., 2006; Warnke et al., 2009; Viollon and Chaumont, 1994; Viollon et al., 1996; Clements et al., 2017

DownUnder enterprises

Traceable Sustainable Botanicals

Acne vulgaris

Facial preparation containing sandalwood oil and salicylic acid has improved 69% of cohort; 4% of the test group demonstrated complete recovery from scars and acne recurrence.

A traditional formulation, Dashanga Lepa, containing sandalwood was effective in reducing surface area of acne.

Sandalwood oil acts as an antimicrobial against acne causing bacteria.

Moy *et al.*, 2012; Sawant and Zinjurke, 2015

DownUnder enterprises

Traceable Sustainable Botanicals

Antiviral Activity

Replication of herpes simplex virus (HSV) 1 and 2 was reported to be inhibited by sandalwood oil on an in-vitro antiviral assay.

Treating of cold sores and genital herpes induced by the infection of HSV-1 and HSV-2 by therapeutically active doses of sandalwood oil has been reported.

Sandalwood oil exhibited a high level of virucidal activity acyclovir-resistant HSV-1 clinical isolates and reduced plaque formation significantly.

Sandalwood oil has been successfully used against human papilloma virus (HPV) induced tumours and other skin conditions. This activity has been successfully patented for certain formulations containing sandalwood oil to treat genital warts.


United States Patent

Source: Benencia and Courreges, 1999; Singh and Nulu, 2010; Schnitzler et al., 2007; Haque and Haque, 2000; Haque and Haque, 2002

Anti-Inflammatory Action

Treatment with both Western Australian and East Indian sandalwood suppressed LPS-stimulated production of cytokines and chemokines by >75% at 45 µM and >90% at 90 µM.

Purified α-santalol and β-santalol also suppressed lipopolysaccharide-induced production of the eicosanoids, prostaglandin E2, and thromboxane B2, mimicking non-steroidal antiinflammatory drugs.

These activities have been attributed to skin disorders, where sandalwood oil at below basal levels of 40 ppm have suppressed IL-8, IL-6, MCP-1 and TNF-α expression.

Phase-2 clinical studies conducted on psoriatic patients have observed symptom alleviation with clear reduction of lesions.

Sharma *et al.*, 2014; Clements *et al.*, 2012

Central Nervous System

Aromatherapy applications

- Inhalation of sandalwood oil may result in plasma concentrations of α-santalol and β-santalol in range of 6.1 - 5.3ng/L
- Neuroleptic-like responses - α- and β-santalols demonstrate pharmacological activities similar to chlorpromazine in mice, producing sedative and analgesic affects
- Transdermal application of sandalwood demonstrated to "uncouple" the typical direct relationship of physiological and behavioural arousal
  - decrease of physiological activity and increase of arousal

Source: Okugawa et al., 1995; Hongratanaworakit et al., 2004; Heuberger et al., 2006; Jirovetz et al., 1992

Sandalwood - Safety and Toxicity

- Acute oral toxicity, 3.8g/kg (murine)
- Dermal toxicity, >5g/kg (rabbit)
- No skin irritation, 10-20% sandalwood oil on human skin
- Contact Dermatitis
  - Sensitization for sandalwood oil varied between 0 to 2.4% in a sensitized population
  - *t,t*-Farnesol present in West Australian sandalwood is a known sensitising compound.

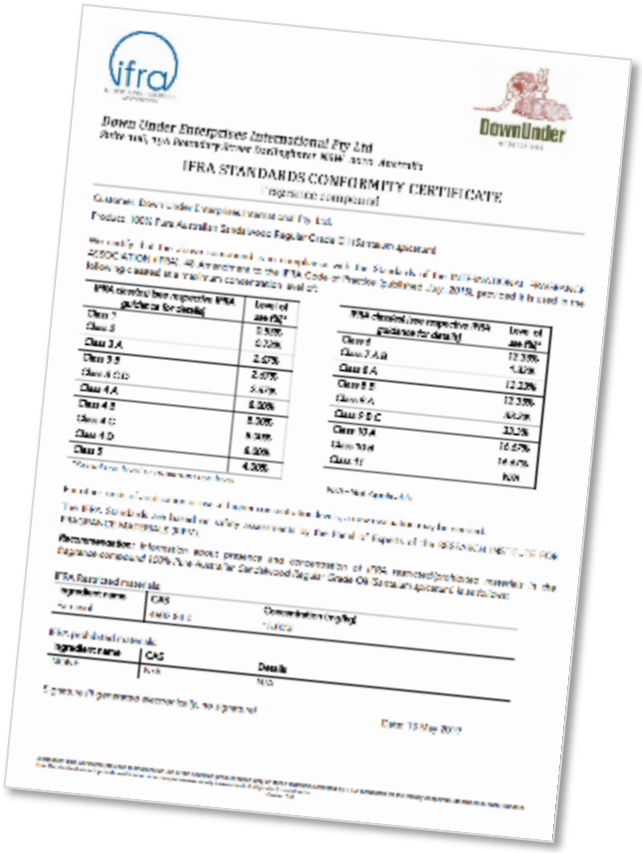
Burdock and Carabin, 2008, Bhatia et al., 2008.

DownUnder enterprises

Traceable Sustainable Botanicals

Regulatory Considerations

- Sandalwood oil is registered with US FDA and EC
- Flavour Extract Manufacturers Association (FEMA) classifies Sandalwood as GRAS 3
- IFRA and Allergen restrictions and labelling requirements exist for *t,t*-farnesol



Down Under Enterprises International Pty Ltd

IFRA STANDARDS CONFORMITY CERTIFICATE

DownUnder enterprises

Traceable Sustainable Botanicals

Sandalwood beyond the fragrance

- Traditional medicinal use for 1000's of years
- Used more recently in Western medicine
- May offer formulation benefits
  - Antibacterial (e.g. acne)
  - Antiviral
  - Anti-inflammatory
  - Emotional (e.g. mood/arousal)
- Safe – low levels of toxicity and skin irritation
- Regulatory
  - GRAS
  - IFRA certificates and Allergen Statements available from Down Under
- Traceability and Purity – Source with confidence


100% Pure Australian Sandalwood Oil

Sandalwood Oil as a Therapeutic Agent

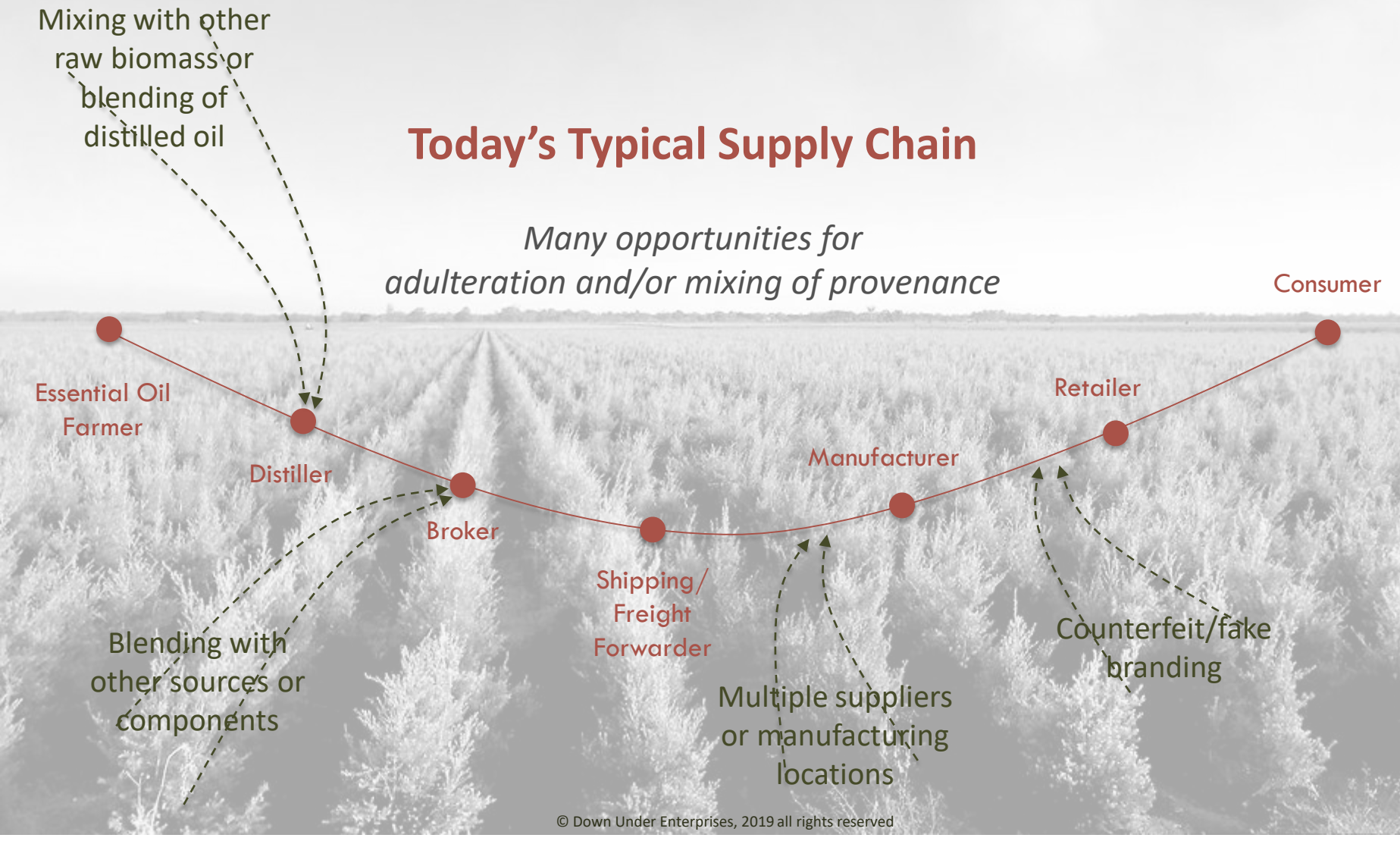
DownUnder enterprises

Traceable Sustainable Botanicals

Traceability

Today's Typical Supply Chain

Many opportunities for adulteration and/or mixing of provenance



DownUnder enterprises

Traceable Sustainable Botanicals

Sandalwood Adulterants

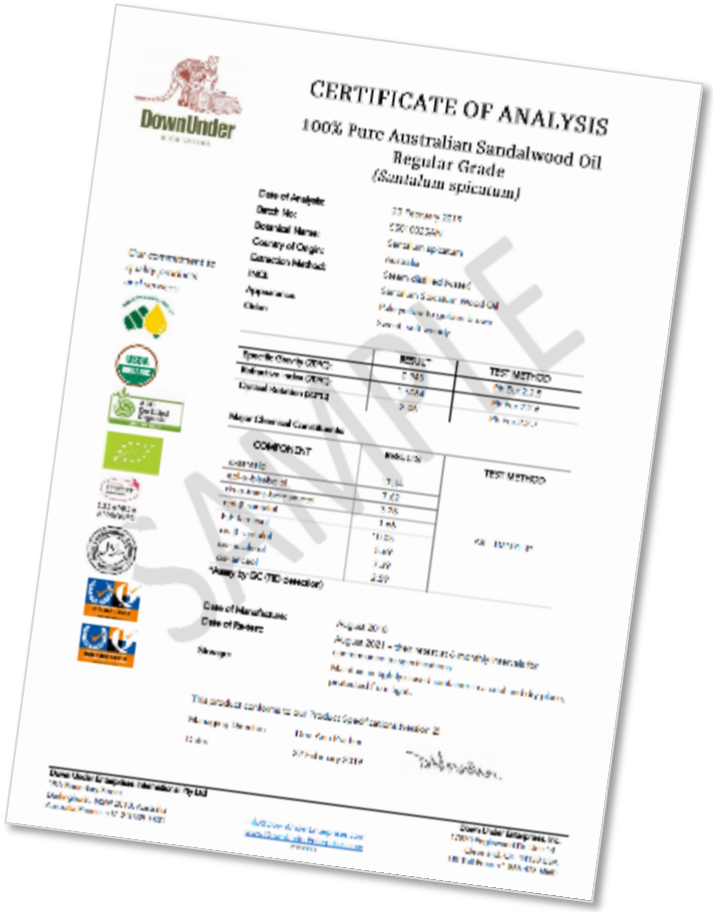
- Chemists have synthesised chemical analogues to α-santalol and β-santalol
- Synthetic mixtures of diethyl phthalate and dioctyl phthalate are often sold off as sandalwood oil
- The natural odour of sandalwood is a complex mix of constituents, more than α-santalol and β-santalol
- Complete replication by synthetics for human olfactory perception is unrealistic

DownUnder enterprises

Traceable Sustainable Botanicals

Source with Confidence

- Purity is key to safety and efficacy; beware of **Adulteration**
- Does the oil have an ISO standard?
- If new oil/supplier, ask for a sample and a COA for that batch. Does the COA comply with Specifications and standards?
- Test samples yourself - does it match?
- If price seems too good, it probably is


CERTIFICATE OF ANALYSIS

100% Pure Australian Sandalwood Oil
Regular Grade
(Santalum spicatum)

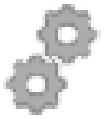
SAMPLE

Blockchain for Traceability

DownUnder enterprises

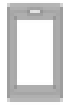
Traceable Sustainable Botanicals

Create trusted records of physical commodities, and assets, and attributes (e.g. geolocation, weather, components and percentages)



Integration with platforms (API), Internet of Things (IoT) devices, and machinery

Open source digital tools tailored for agriculture



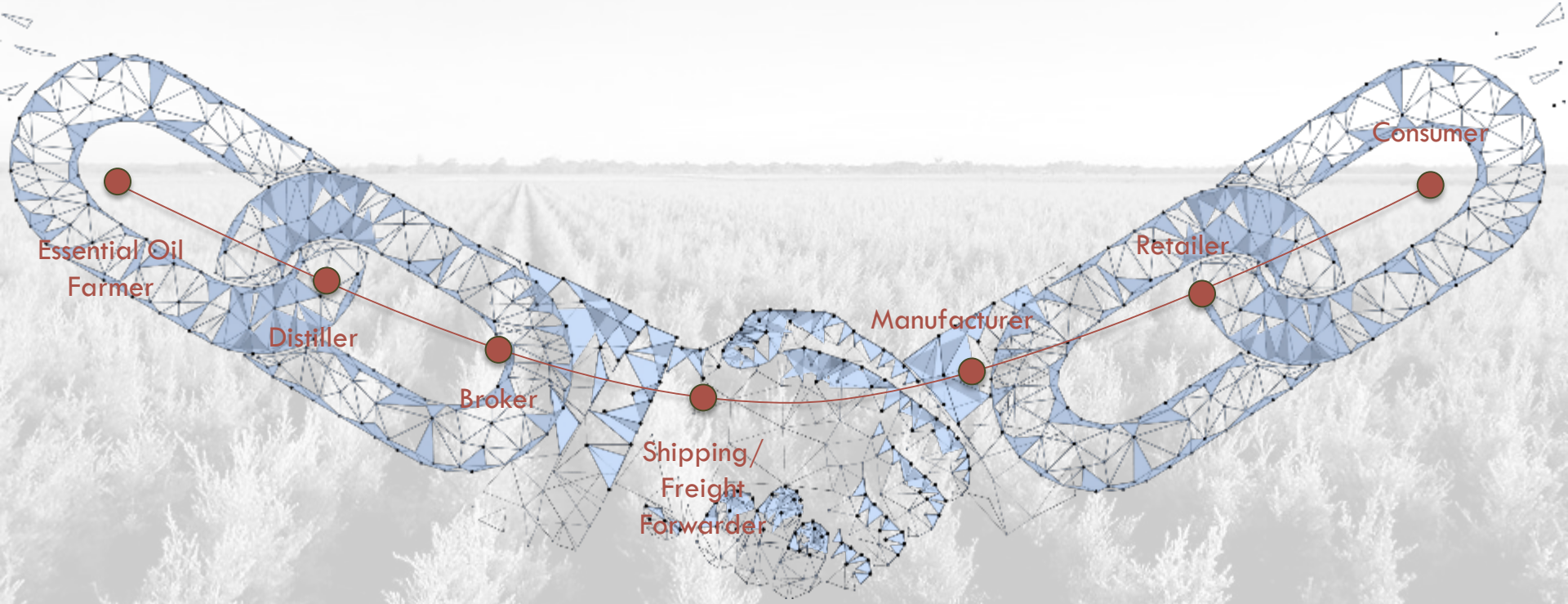
Mobile application captures real world data

Content provided by GEORA

DownUnder enterprises

Traceable Sustainable Botanicals

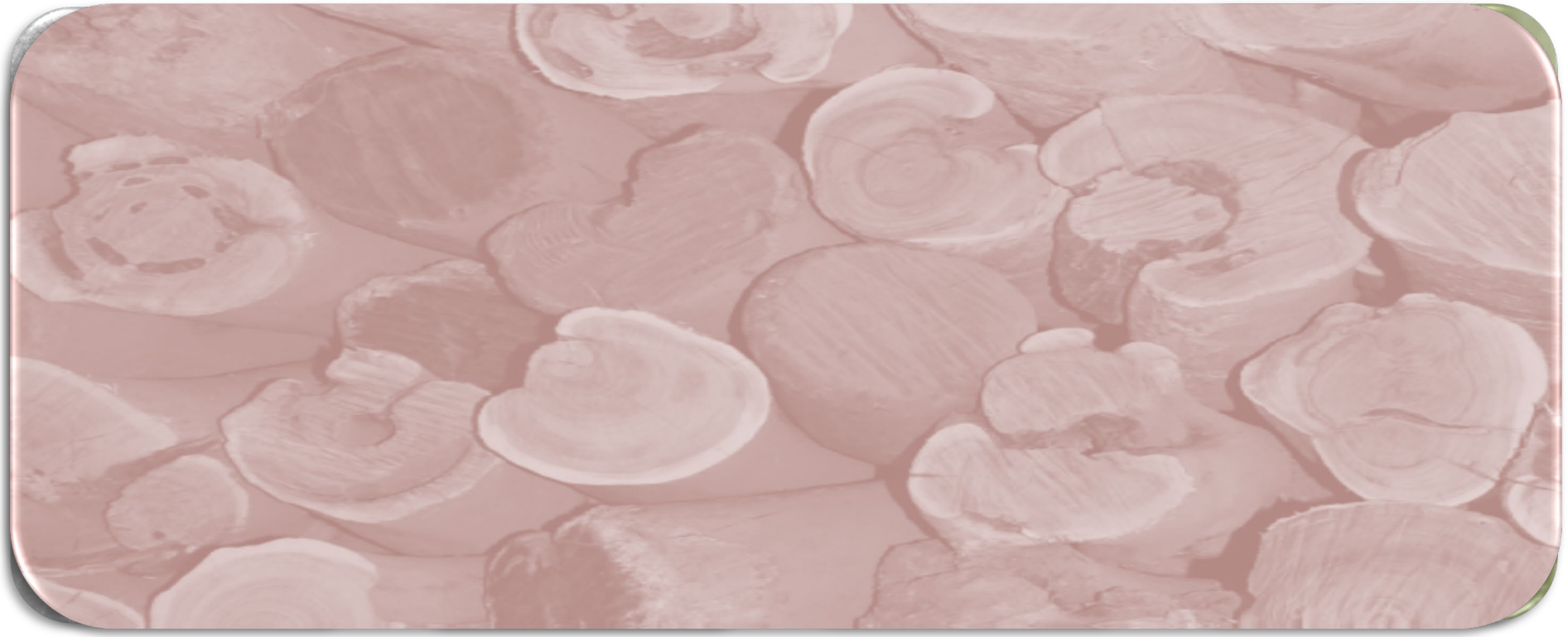
Blockchain for Traceability



Sandalwood:
A case study for Traceability

DownUnder enterprises

Traceable Sustainable Botanicals



TEA TREE SANDALWOOD LEMON MYRTLE EUCALYPTUS

The FPC at a glance

Forest Products Commission
WESTERN AUSTRALIA

Western Australian forestry – resources

Native Forests

Approximately 2.25 million ha of native forest is public land in South West Western Australia.

PUBLIC

38% Sustainably managed as multiple use forest including timber production

62% Set aside for conservation

NATIVE HARDWOOD

7,424 hectares harvested

850,000 hectares total accessible area

Plantations

There are around 360,000 ha of plantations in Western Australia.

Western Australia has an estimated 80,000 ha of softwood (pine) plantations.

Private property

State forests & timber reserves

Most softwood plantations are managed for sawn timber

1,836 ha
new plantations in 2018.

SOFTWOOD

5,951 hectares harvested

79,631 hectares total estate

Sandalwood

Native sandalwood occurs naturally in the southern half of the state in goldfields and rangelands.

Indian sandalwood has been planted in the Kimberley region.

6,000 ha
sandalwood plantations

SANDALWOOD

14,409 hectares harvested

spread across **14 million** hectares

Less than 0.01% harvested annually

FPC independent certification

The Forest Products Commission (FPC) is responsible for the sustainable management and development of Western Australia's native forest, plantation and sandalwood industries.

VISION - build and maintain an environmentally sustainable and commercially viable forest products industry that provides economic and social benefits to the people of Western Australia

CERTIFIED SUSTAINABLE AS4708: 2013 - Australian Forestry Standard (AFS) which is endorsed by the Program for the Endorsement of Forestry Certification (PEFC). *FPC is applying for AFS/PEFC certification in 2019*

ENVIRONMENTAL MANAGEMENT ISO14001: 2015 – Environmental Management System (EMS), the international standard for environmental management systems

Australian Sandalwood Strategy

DownUnder enterprises

Traceable Sustainable Botanicals

1. Aboriginal participation
2. Stop illegal harvesting
3. Promote Australian Sandalwood
4. Encourage innovation
5. Sustainability now and future

Available at:
www.fpc.wa.gov.au/sandalwoodstrategy

DownUnder enterprises

Traceable Sustainable Botanicals

FPC: Managing the Australian Sandalwood Industry

FPC: Operation Woylie

DownUnder enterprises

Traceable Sustainable Botanicals

- Woylie (a marsupial) is credited with broad distribution of sandalwood seeds – population crash due to feral cats
- >7 million seeds planted annually across 1500km (900mi)
- Aboriginal communities manually plant in culturally and ecologically sensitive areas

Images courtesy of Forest Products Commission

DownUnder
enterprises

Traceable Sustainable Botanicals

A Traceable Supply of Australian Sandalwood

Sandalwood – Beyond the Fragrance

Conclusions

- ISO Standards for Australian and Indian Sandalwood
- Therapeutic properties are possible
- Well accepted Safety and Regulatory considerations
- Adulteration risks both safety and efficacy
- Traceability & Sustainability supported by West Australian Government's FPC

Check your email tomorrow to download a copy of our White Paper, "Sandalwood as a Therapeutic Agent".

درد ا سر کے واسطے

چنداں لگانا ہے مفید

اس کا گھسسنا اور لگانا

درد ا سر یہ بھی تو ہے

“Sandalwood paste is the ideal cure for a headache,
(but) it’s preparation and application is a headache in itself!”

Urdu Shayari (poem) from Northern India