KOLOKIUM PENYELIDIKAN 2021
INSTITUT TADBIRAN AWAM NEGARA

APPLICATION OF INFRARED SPECTROSCOPY FOR DETERMINATION OF WOOD NATURAL DURABILITY

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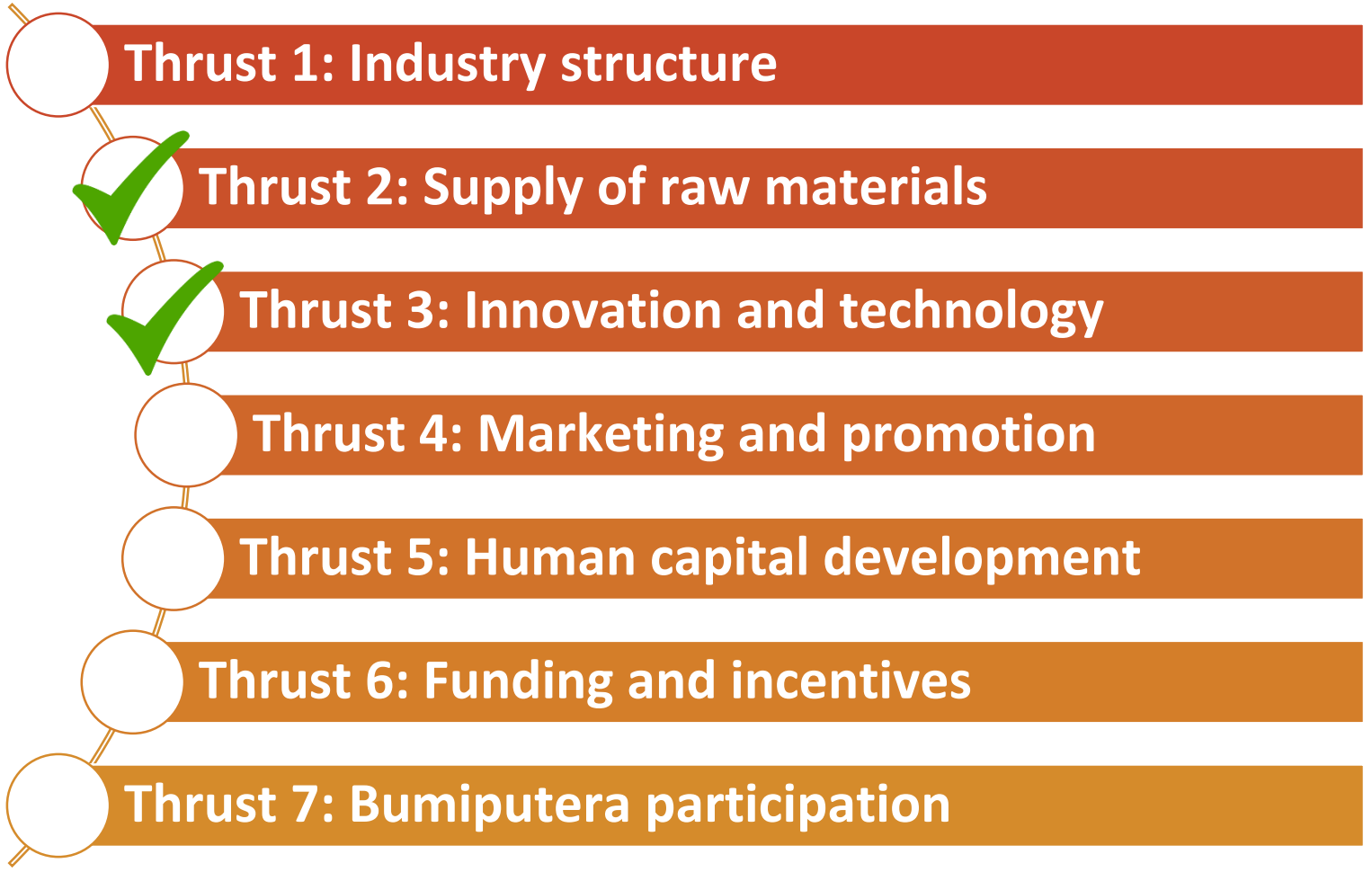
NATIONAL TIMBER INDUSTRY POLICY (NATIP)

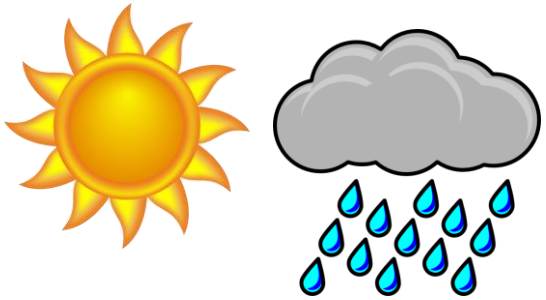
2009-2020

"…to achieve the target of RM53 billion by 2020, through an average annual growth rate of 6.4%"



WOOD AS BIOLOGICAL MATERIAL



- Wood as versatile material, high strength, workability and aesthetically pleasant
- Susceptibility to degradation (weather, rain, UV) and food resources to many organisms (decay fungi and termites)
- Contain extractives (non-structural wood compounds) that contribute to wood natural durability

DURABILITY ISSUES

Using one common local trade name

- *Dipterocarpus* spp. (~30 species) are grouped together as ‘Keruing’
- Durability from class I (durable) to class IV (non-durable)

WOOD DURABILITY ASSESSMENT

- Time consuming, laborious, small samples size
- Standardize methods – AWPA, EN, AUS, JIS

Class	Classification	Life of test stake in field, tropics, i.e. Malaysia	Life of test stake in field, temperate, i.e. England
I	Very durable	>10 years	>25 years
II	Durable	5-10 years	15-20 years
III	Moderately durable	2-5 years	10-15 years
IV	Non-durable	<2 years	5-10 years
V	Perishable	-	<5 years

Field test

Laboratory test

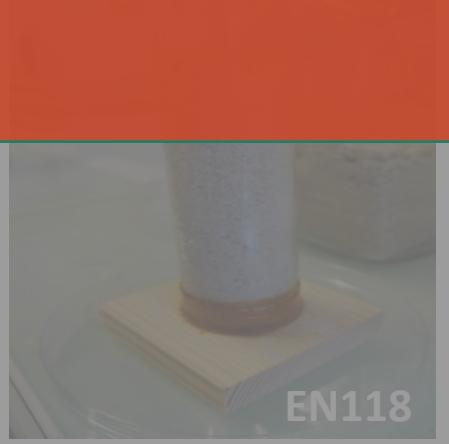
WOOD DURABILITY ASSESSMENT

Field test

- Time consuming, laborious, small samples size
- Standardize methods – AWPA, EN, AUS, JIS

Class	Classification	Life of test stake in field in ground contact	Life of test stake in field above ground
I	Very durable	>10 years	>25 years
II	Durable	5-10 years	15-25 years
III	Moderately durable	2-5 years	10-15 years
IV	Non-durable	<2 years	5-10 years
V	Perishable	-	<5 years

Laboratory test



Need for rapid, non-destructive method for assessing wood durability

APPLICATION OF INFRARED SPECTROSCOPY FOR DETERMINATION OF WOOD NATURAL DURABILITY

AIM: Rapid, non-destructive technique for sorting wood durability using infrared spectroscopy and chemometric analysis.

ULTIMATE OBJECTIVES

Rapid assessment

- Real time sorting of wood into durability classes

Service life

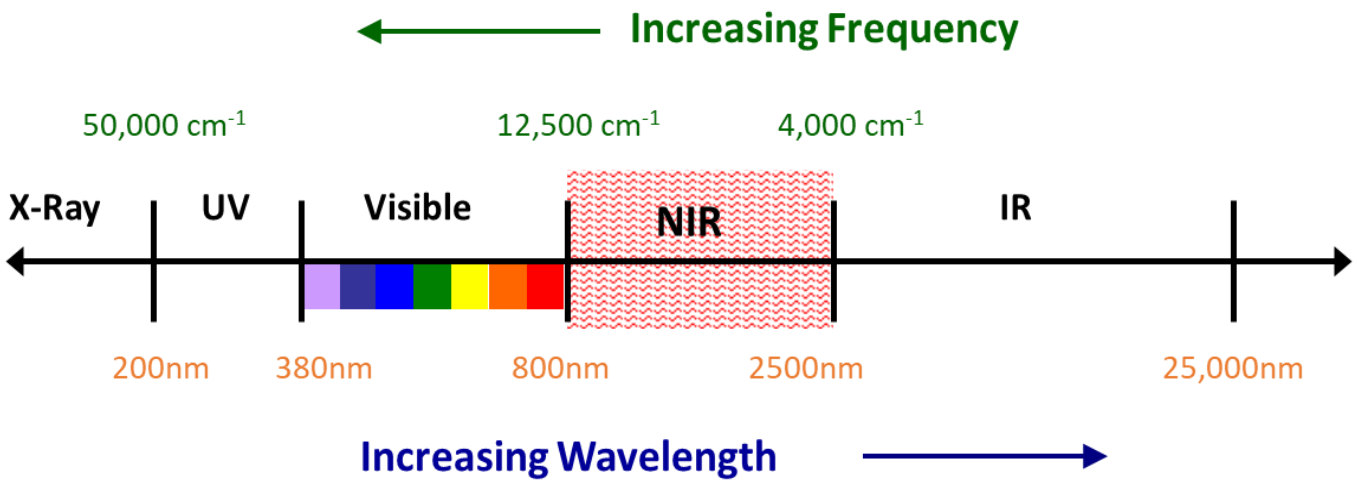
- Proper application according to durability classification

Market

- Improve consumer confidence

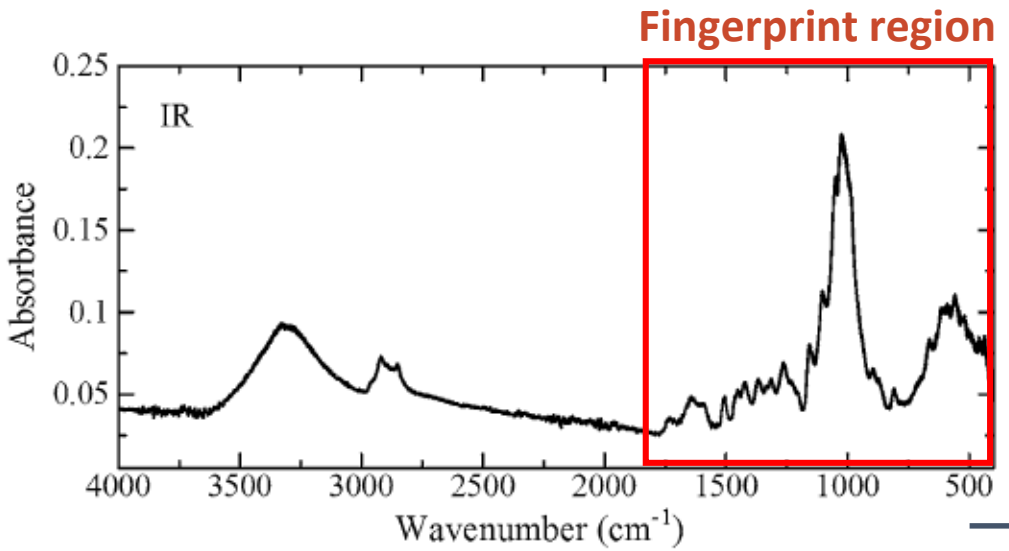
INFRARED SPECTROSCOPY

Electromagnetic spectrum



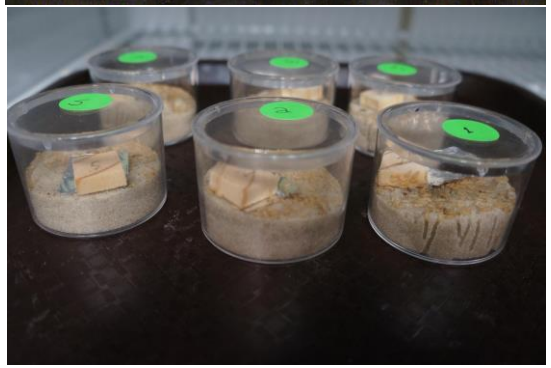
- **Frequency = 1 / wavelength**

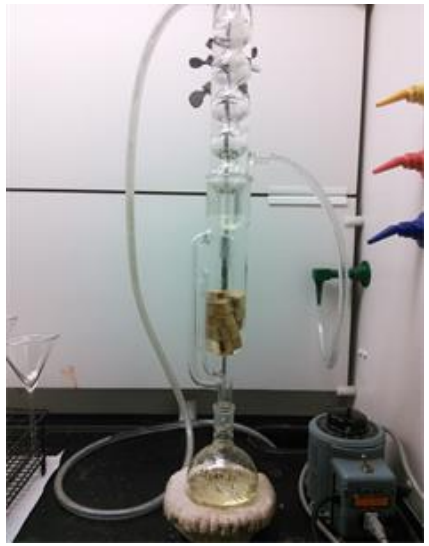
Fourier-transform infrared spectroscopy (FT-IR)

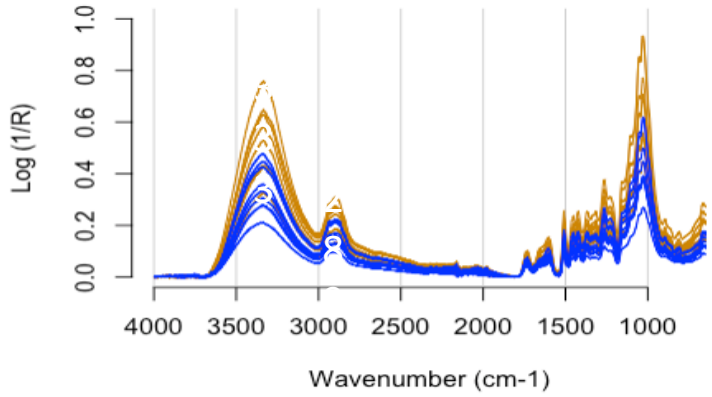


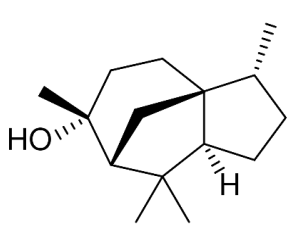
METHODOLOGY

Wood preparation → Assess decay and termite resistance → Chemical analysis (extractives) → FT-IR & chemometrics analysis

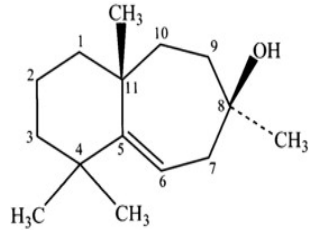








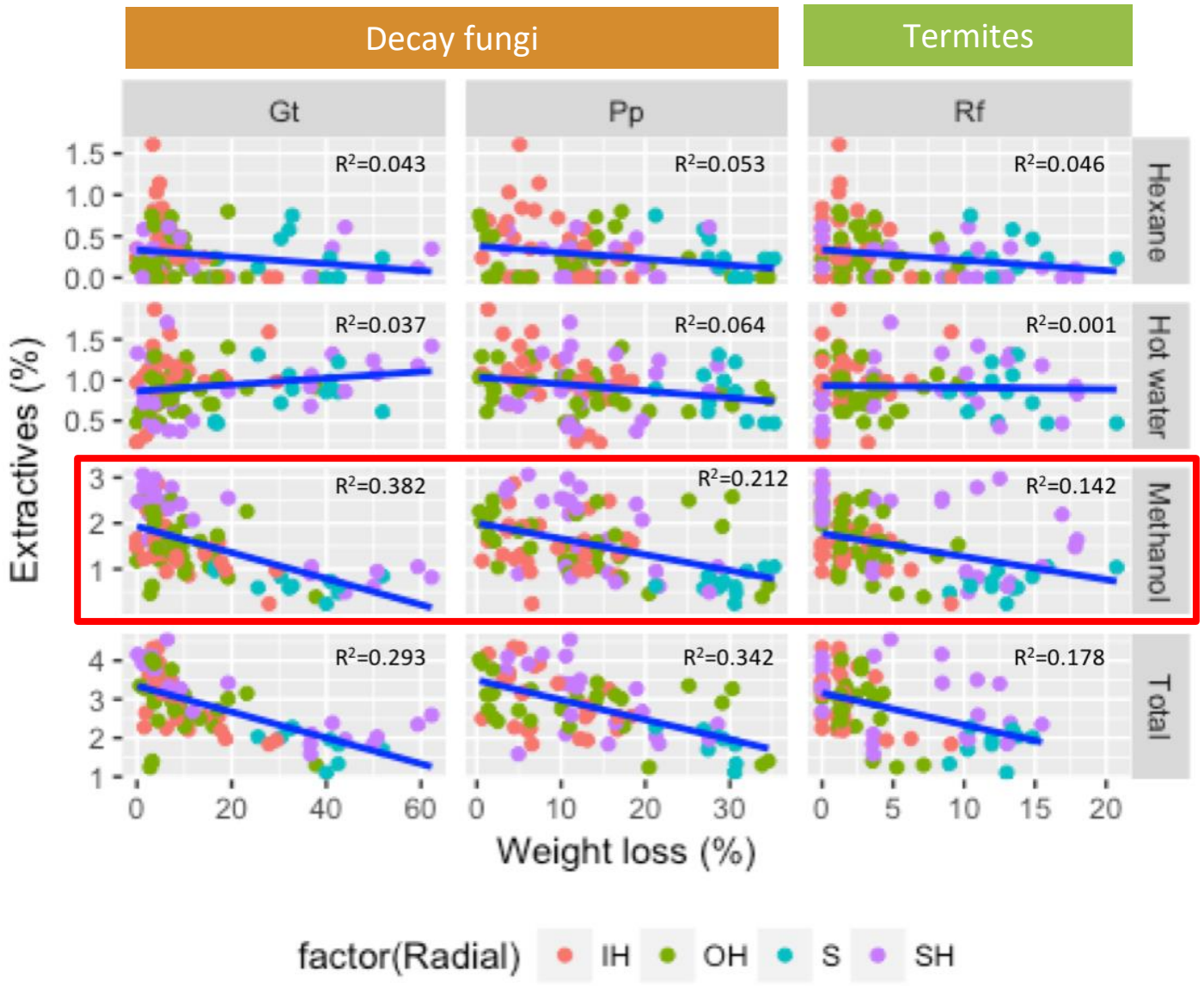
Cedrol



Widdrol

RESULTS

1) EXTRACTIVES AND WEIGHT LOSS



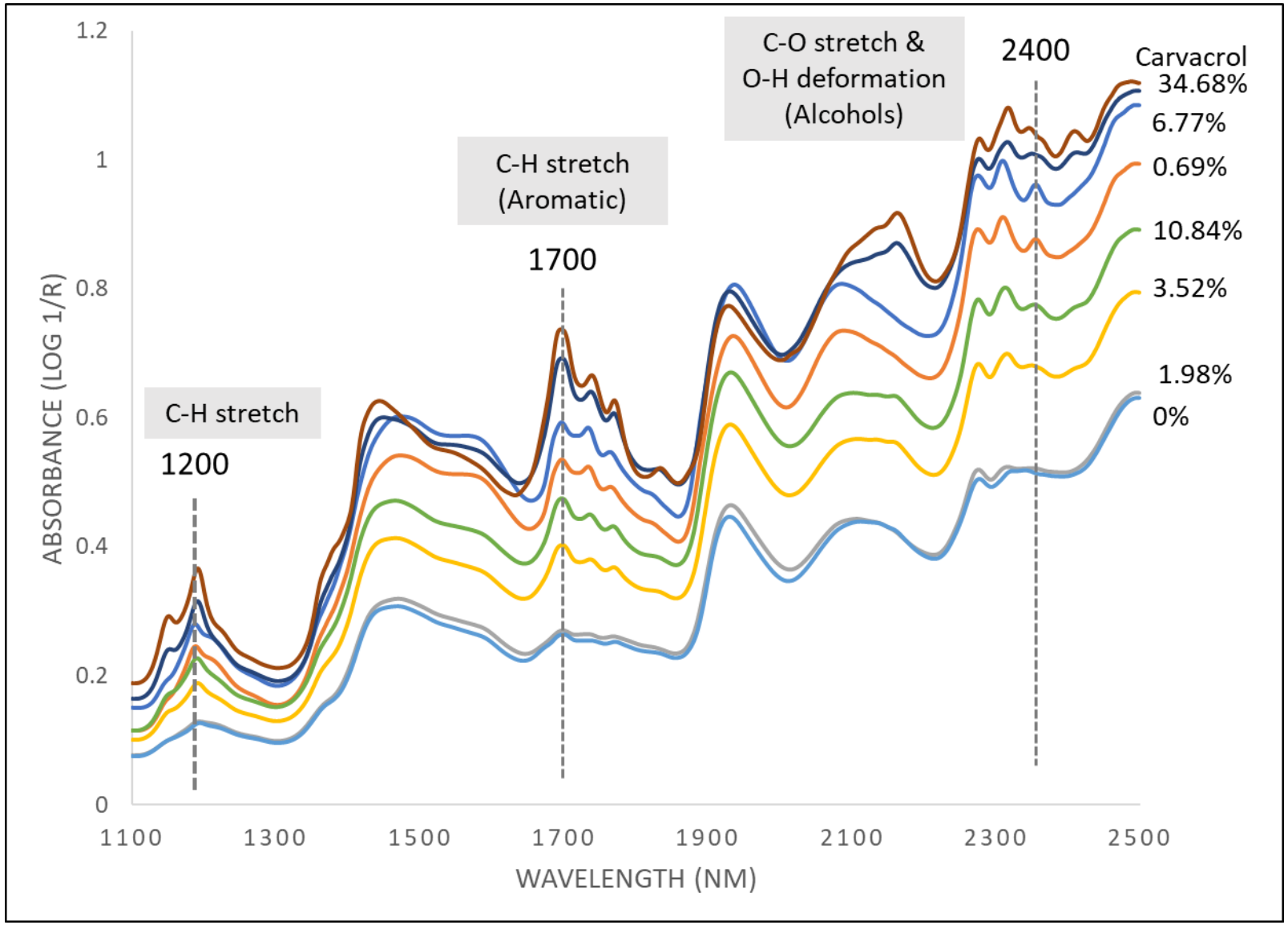
Aliphatic compounds

Sugars
Starch

Phenolic substances
Terpenoids

IH: Inner heartwood, OH: Outer heartwood, SH: Sapwood-heartwood, S: Sapwood

2)NIR SPECTRA – EXTRACTIVES (CARVACROL)



✔ Differentiate between extractives (carvacrol) even with lower concentrations

3)DETECTION OF EXTRACTIVES IN WOOD

% Carvacrol solutions	% Carvacrol in wood
0	0.00
1	0.69
3	1.98
5	3.52
10	6.77
15	10.84
50	34.68
100	78.19

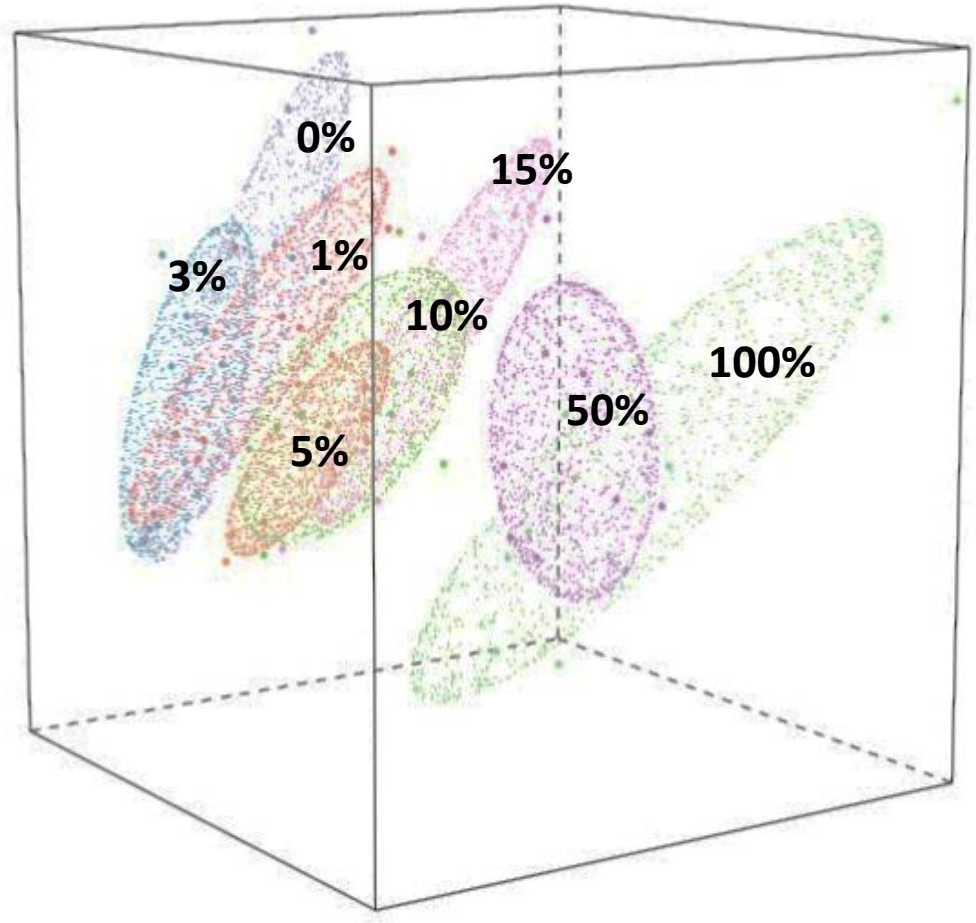
Wood extractives (1-5%)

Principal Component Analysis

PC1 (97%)

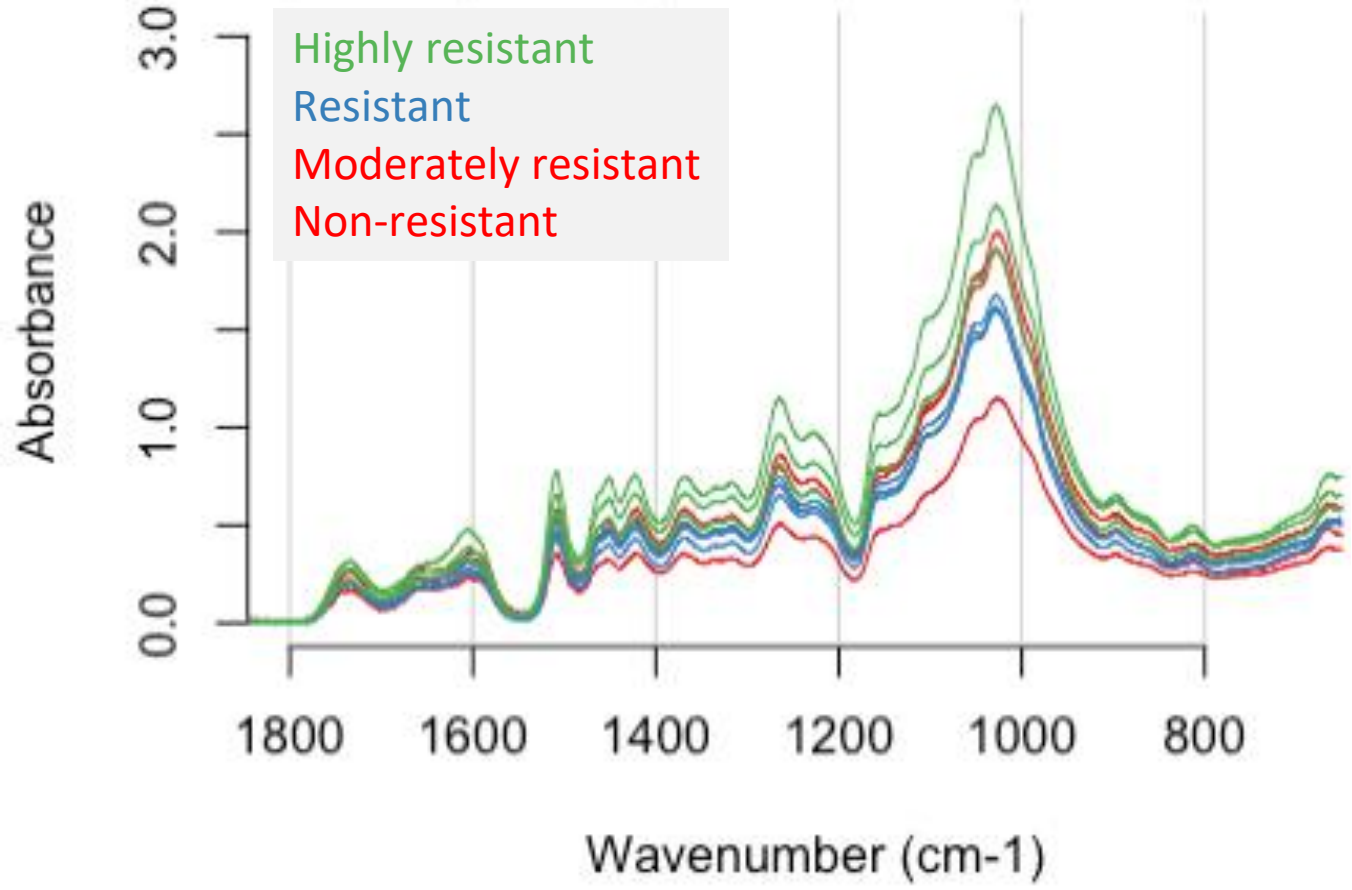
PC3 (0.11%)

PC2 (2.9%)

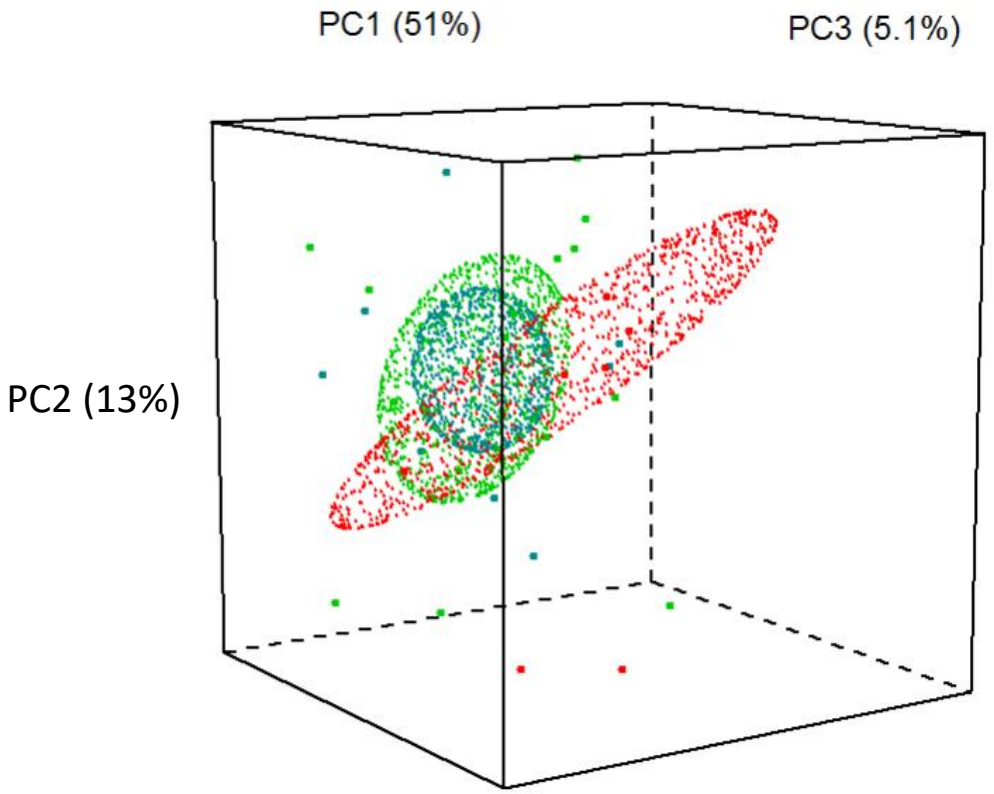


ATR-FTIR SPECTRA (FINGERPRINT REGION)

Durability – *G. trabeum*



Principal component analysis



OVERALL CONCLUSIONS

- Infrared spectroscopy can be used to detect extractives that contribute to wood natural durability, but only >5%.
- Potential for IR spectroscopy to sort durability
- Limitations:
  - Pre-processing of spectral data and chemometrics analysis
  - Moisture in wood and other factors (particle sizes)

ULTIMATE OBJECTIVES

Rapid assessment

- Real time sorting of wood into durability classes

Service life

- Proper application according to durability classification

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FUTURE WORK IN MALAYSIA

- Concentrate on wood with high extractives content – e.g. tropical species
- Combinations of field and laboratory tests to have more comprehensive durability information
- Possibility of using portable spectrometers for field applications
- Possibility of application for Malaysian timber industry
- Future for NATIP

nzdfi.org.nz

forestquality.com

Forest

Sawmill

mongabay.com

Tree nursery

plantnurseries.us

thompsonhardwoods.com

THANK YOU