Potential of antifungal and antitermitic activity of several essential oils

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BACKGROUNG

- Use in traditional practices dating back at least 150 years

  ✓Protection of stored commodities or to repel pests from human habitation (Clausen et al, 2008 ; Skandamis, P et al, 2002,).

  ✓Cosmetic Industry.

  ✓Food industry, flavoring.

  ✓ Pharmaceutical industry. (Cogne, 2002);

Properties attributed to essential oils

- ✓Antiseptic
- ✓Antibacterial
- ✓Antifungal
- ✓Antihistamine
- ✓Anti-inflammatory
- ✓Antipruitic
- ✓Antitussive
- ✓Antiviral
- ✓Antiemetic
- ✓Deodorant
- ✓Diuretic
- ✓Immunostimulant
- ✓Repels insects
- ✓Improve sleep
- ✓Kills parasite

ESSENTIAL OILS

- Essential oils are the product of secondary metabolites from vegetative plants.

- Obtained from the volatile fraction by steam distillation.

- Complex mixture of monoterpene and sesquiterpenes with several functional group

ESSENTIAL OILS

- Present in about 50 botanical families.

- Located in flowers, leaves, barks, wood, seeds, fruits, rhyzomes, needles, resins…

- Chemical profiles are affected by climate, soil and yearly growing conditions, environmental conditions…

ECOLOGICAL ROLE

Communication

Defense

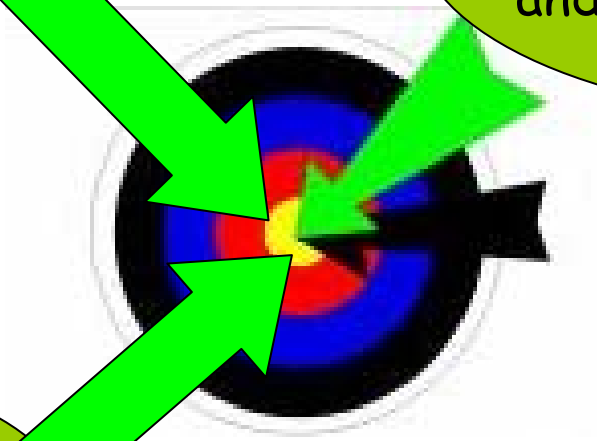
Reproduction

Essential oils

Challenge and motivation

Renewable resource

Need of environmentally friendly fungitoxic and insecticidal chemicals



More favourable ecotoxicological and toxicological profile

There is a niche market 1 billion $ world: fungicide 20%; insecticide 27%.

OBJECTIVE

- Identify essential oils with desirable effect on termites and fungi.

- Propose a formulation with essentials oil, with or without classical biocides active against termites and fungi.

SELECTED ESSENTIAL OILS

Dill (*Anethum graveolens*)

Celery (*Apium graveolens*)

Tagete (*Tageta bipinata*)

Catnip (*Nepeta cataria*)

Mint (*Mentha piperita*)

Oregano(*Origanum vulgare*)

Basil (*Ocimum basilicum*)

Marjoram(*Origanum majorana*)

Rosemary camphored (*Rosmarinus officinalis V)*

Rosemary verbenone (*Rosmarinus officinalis C)*

Apiaceae

Astéraceae

Lamiaceae

SELECTED ESSENTIAL OILS

Savory (*Satureia montana*)

Sage (*Salvia sclarea*)

Lavander (*Lavendula latifolia*)

Thyme (*Thymus vulgaris*)

Lemon(*Citrus limonum*)

Citronnella (*Cymbopogon winterianus*)

Lemongrass (*Cymbopogon citrates*)

Vetiver (*Vetiveria zizanoides*)

Geranium (*Pelargonium graveolens*)

Lamiaceae

Rutaceae

Poaceae

Geraniaceae

LIST OF ESSENTIAL OILS

Tea tree (*Melaleuca alternifolia)*

Clove (*Eugenia caryophillus*)

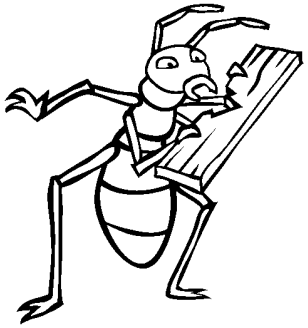
Eucalyptus (*Eucalyptus globulus*)

Eucalyptus (*Eucalyptus globulus*)

Cinnamon (*Cinnamomum cassia*)

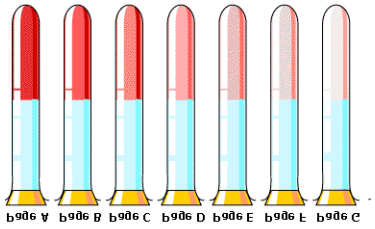
Myrtaceae

Lauraceae



METHODOLOGY

24 essential oils

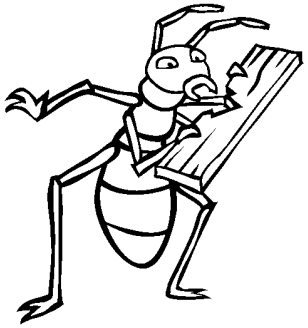


Dilution (1% to 10 %)

No choice test

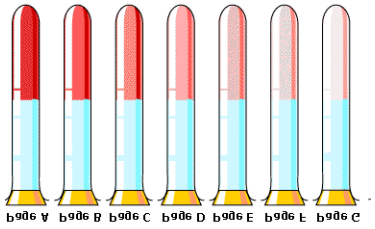
Reticulitermes santonensis

30 termites / treated paper



METHODOLOGY

24 essential oils



Dilution

No choice test

Reticulitermes santonensis

Mortality rate
Consumption rate

RESULTS

Group I: threshold < 1% (v/v)

Savory (Lamiaceae)

Died after
1 day exposure

Group II: threshold between 1 – 5 % (v/v)

Clove (Myrtaceae)

Died after
1 day exposure

RESULTS

Group III: threshold between 5 % - 10 % (v/v)

Geranium (Geraniaceae)

Lemongrass (Poaceae)

Mint (Lamiaceae)

Oregano (Lamiaceae)

Repellent

Died after
1 or 2 days exposure

RESULTS

Group IV: threshold > 10 % (v/v)

Cinnamon (Lauraceae)

Dill (Lamiaceae)

Thyme (Lamiaceae)

Antifeedent

RESULTS

Group V: at 100 % (v/v)

Rosemary C (Lamiaceae)

Celery (Apiceae)

Antifeedent

CONCLUSION

- Essential oils with oxygenated monoterpenes particularly phenolic compounds are more toxic against workers: savory, clove, oregano, lemongrass, mint, thyme.

- The activity is also the result of the synergetic effect with other components (monoterpene hydrocarbone).

Development of a formula

- **Development of formula in aqueous phase**

Mixture of essential oils : 11 oils (3 to 8 % v/v)

+ Adjuvants

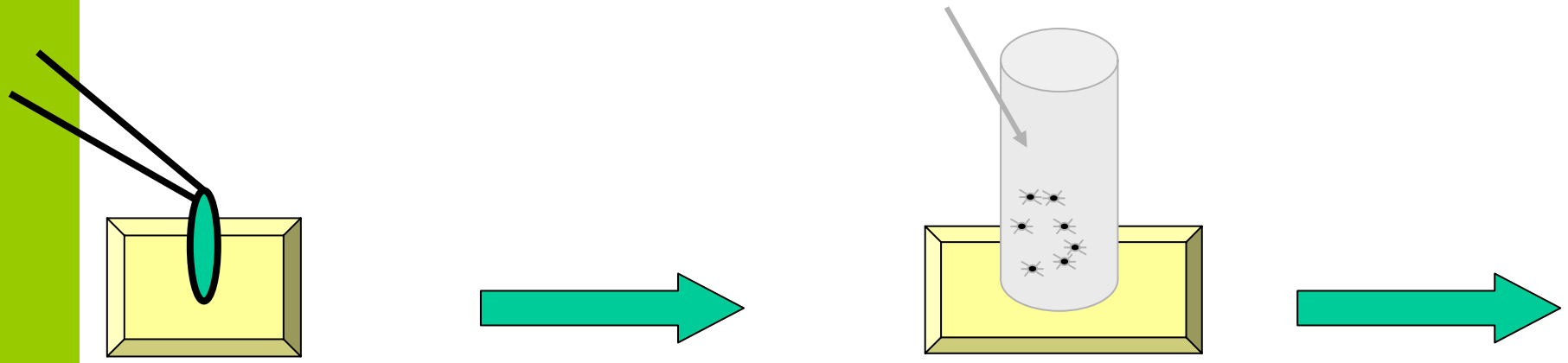
+ Water

Assessment of the formulations

- Formulation 1 = mixture of essential oils (3 - 8 % v/v);
- Formulation 2 = mixture of essential oils (3 - 8 % v/v);
  + 1 biocide;
- Formulation 3 = mixture of essential oils (3 - 8 % v/v)
  + combination of two biocides.

Standardised tests: NF EN 118

250 workers
Reticulitermes santonensis



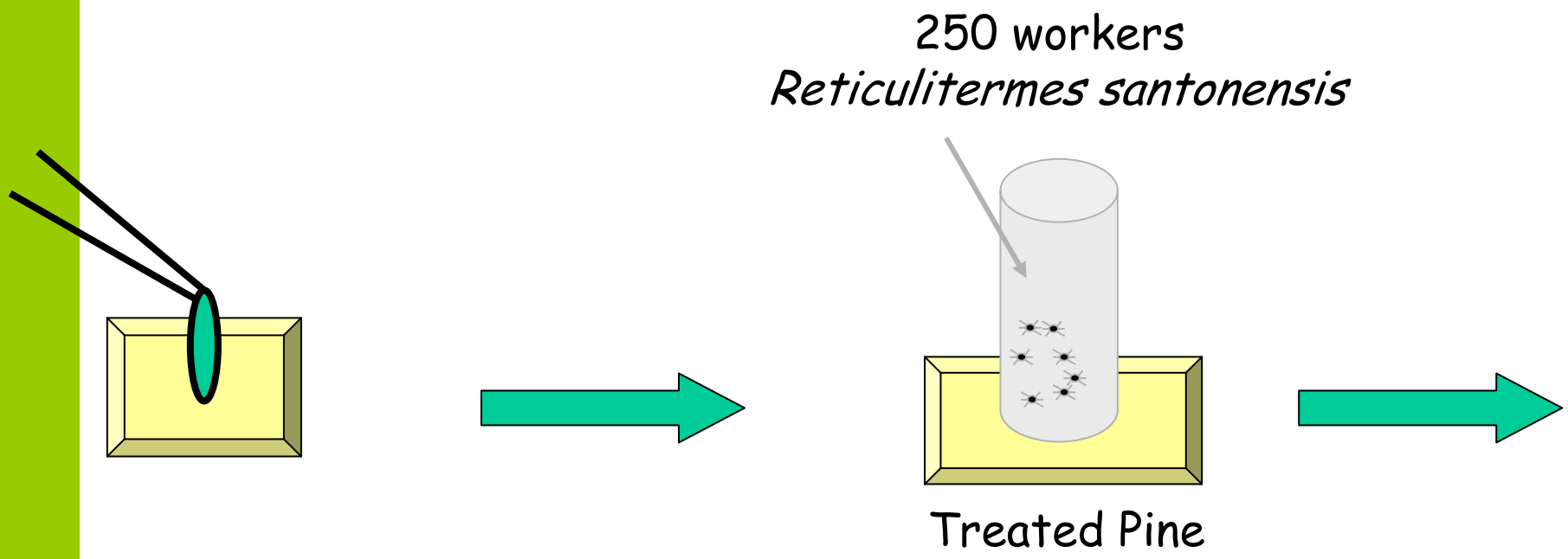
Treated Pine

1) Treatment and drying

2) Leaching procedure (EN 84) or not

3) Exposure to termites (8 weeks, 27°C – 70% HR)

Standardised tests: NF EN 118



Assessment

- Mortality rate
- Visual rating of the exposed sample

0 = no attack ; 4 strongly attack

Results

	Without leaching		With leaching (EN 84)	
	Mortality rate	Cotation	Mortality rate	Cotation
Control	0	4		
HE	100	3.7		
He + 1 biocide	100	0		
HE + 2 biocides	100	0		

Results

	Without leaching		With leaching (EN 84)	
	Mortality rate	Cotation	Mortality rate	Cotation
Control	0	4	0	4
HE	100	3.7	100	4
He + 1 biocide	100	0	100	4
HE + 2 biocides	100	0	100	4

CONCLUSION

- Without leaching, the formulae with biocide showed an efficient activity against termites.

- The use of essential oils allowed to decrease the content of classical biocide.

CONCLUSION

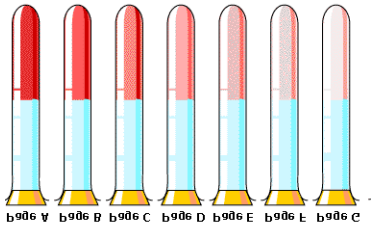
- After leaching procedure (EN 84) ➡ loss of effectivness.

- It is necessary to add additives which will allow the fixation of the compounds.

➡ **Hasard Class 1 (indoor applications)**

Antifungal tests

24 essential oils



Dilution

Coriolus versicolor
Poria Placenta

Antifungal index (AI)

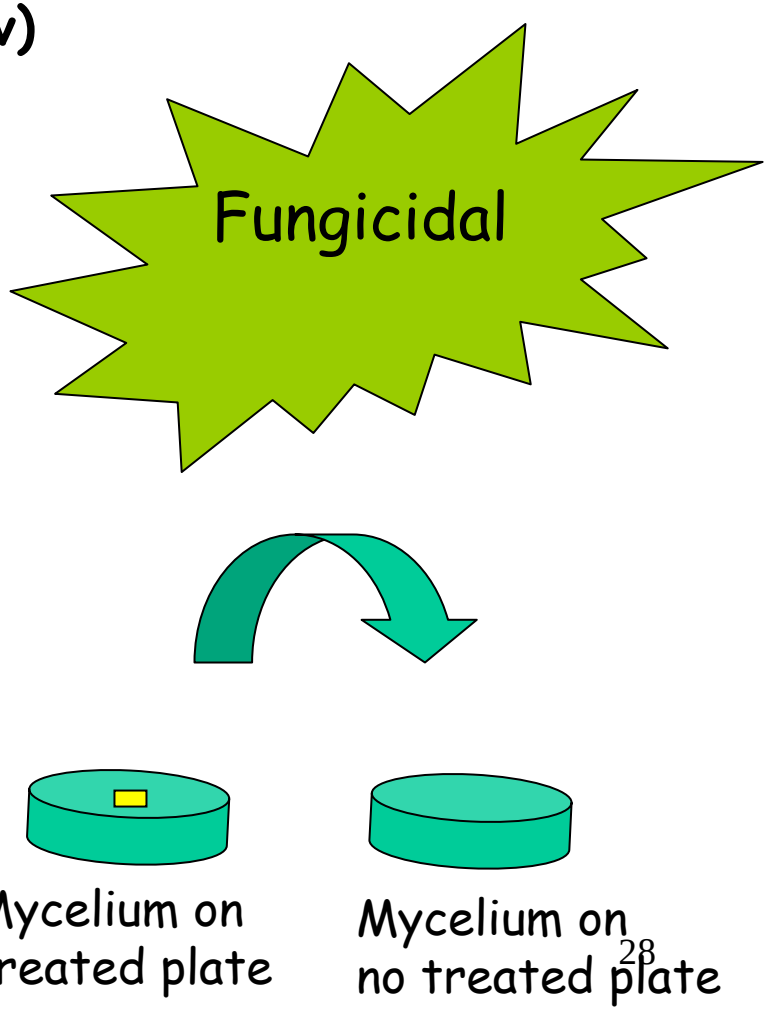
AI = 0 ➡ no activity

AI =100 ➡ activity

RESULTS

Group I : threshold <0.05% (v/v)

Cinnamon (Lauraceae)



RESULTS

Group II : threshold between 0.05 – 0.1% (v/v)

Geranium
Lemongrass
Catnip

Fungicidal

Thyme
Savory
Oregano

Fungistatic

RESULTS

Group III: threshold between 0.1 – 0.2% (v/v)

Clove

Citronnellal

RESULTS

Group IV: threshold between 0.2 – 1%

Mint
Marjoram
Lavender
Tea tree

Sage
Verbenone rosemary

CONCLUSION

- Essential oils with oxygenated monoterpene particularly phenolic compounds are more toxic against fungi: cinnamon, geranium, lemongrass, catnip, clove, citronnellal.

- The activity is also the result of the synergetic effect with other components (monoterpene hydrocarbone).

- **We are waiting for the results of EN 113**

THANK YOU FOR YOUR ATTENTION

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