

## Lemon eucalyptus essential oil

During field test of a lemon eucalyptus repellent against *Leptoconops* biting midges, ten subjects tested spray and lotion formulations on 2 consecutive days, along with a deet-positive control and an untreated control, with 6 h of continuous exposure per treatment. Half of the eucalyptus subjects received no bites, and the true median protection time probably exceeded the test duration.<sup>1</sup>

*C. Citratus*, *E. tereticornis*, *E. citriodora*, *C. ambrosioides* and *C. schoenanthus* are potential promising plant sources for alternative compounds to pyrethroids, for the control of the *Anopheles malaria* vector in Benin. The efficacy of their essential oils is possibly based on their chemical compositions in which major and/or minor compounds have reported insecticidal activities on various pests and disease vectors such as *Anopheles*.<sup>2</sup>

The diphenyl-1-picrylhydazyl (DPPH) radical scavenging activity and percentage inhibition of linoleic acid oxidation were highest in *E. citriodora* (82.1% and 83.8%, respectively) followed by *E. camaldulensis* (81.9% and 83.3%, respectively). The great variation in chemical composition of EOs from *Eucalyptus*, highlight its potential for medicinal and nutraceutical applications<sup>3</sup>.

The volatile oil extracted from the leaves of *Eucalyptus citriodora* showed a wide spectrum of antifungal activity<sup>4</sup>.

## Cedarwood essential oil

The bioactivity of carbon dioxide-derived cedarwood oil (CWO) toward several species of ants and cedrol toward ticks was determined. Repellency was tested for ants, and toxicity was tested for ticks. Ants in an outdoor bioassay were significantly repelled by the presence of CWO on a pole leading to a sugar-water solution. Similarly, CWO was a significant repellent barrier to red imported fire ants and prevented them from finding a typical food source. Black-legged tick nymphs exhibited dosage-dependent mortality when exposed to cedrol and at the highest dosage (i.e., 6.3 mg/ml) tested, the cedrol killed 100% of the ticks. These repellency and toxicity results together demonstrate a clear potential for the use of CWO as a pest control agent<sup>5</sup>.

Cedarwood oil has antimicrobial properties. It is effective against *Escherichia coli* O157:H7, *Bacillus subtilis*, and *Pseudomonas aeruginosa*. Although the mechanism of antibacterial activity is not well established, it is thought to be attributed to its constituents, thujol, cedrol, and  $\alpha$ - and  $\beta$ -cedrene. A likely mechanism is the disturbance of the cytoplasmic membrane due to the penetration of some of the oil's components<sup>6</sup>.

Ethnobotanical surveys indicated that in the traditional medicines worldwide, several *Juniperus* species are utilized as anthelmintic, diuretic, stimulant, antiseptic, carminative, stomachic, antirheumatic, antifungal, and for wound healing. In the present study, essential oils obtained from heartwood samples of *Juniperus virginiana* L., *Juniperus occidentalis* Hook.

and *Juniperus ashei* J. Buchholz were evaluated for wound healing and anti-inflammatory activities by using in vivo experimental methods<sup>7</sup>.

## Clove essential oil

In a clinical study, the topical treatment of chronic pruritus with clove oils is effective, easy to use, safe, cheap, and more acceptable for whom topical and systemic treatments tend to be irritating, contraindicated, or less well tolerated<sup>8</sup>.

The essential oil showed high DPPH scavenging capacity and low hydroxyl radical inhibition. Clove essential oil showed in vitro inhibitory and bactericidal effect against *S. aureus*, *E. coli*, *L. monocytogenes* and *S. Typhimurium*. In addition, in situ antimicrobial activity of clove oil against *S. aureus* was superior to nitrite<sup>9</sup>.

*Dermacentor reticulatus* ticks are among the most important arthropod vectors of zoonotic disease agents in Europe. Eleven essential oils, namely basil (*Ocimum basilicum*), bergamot (*Citrus bergamia*), clove bud (*Syzygium aromaticum*), citronella (*Cymbopogon winterianus*), creeping thyme (*Thymus serpyllum*), lavender (*Lavandula angustifolia*), lemonscented gum (*Corymbia citriodora*), marjoram (*Origanum majorana*), peppermint (*Mentha piperita*), spearmint (*M. spicata*), and red thyme (*Thymus vulgaris*) were tested for repellency against adult *D. reticulatus* ticks at concentrations of 1 and 3%. Clove bud, creeping thyme and red thyme essential oils were the most efficient – repelling 83, 82 and 68% of ticks when diluted to 3%, respectively<sup>10</sup>.

## Cypress essential oil

Essential oil and extracts of *Cupressus sempervirens* L. (cypress) possess antimicrobial and antibiofilm properties, and therefore, can be used as natural preservative ingredients in food and/or pharmaceuticals<sup>11</sup>.

Mosquito repellent potential of Cupressaceae EOs has been investigated giving varying results<sup>12</sup>. Essential oils consist of volatile, natural complex compounds and their repellent activity has been associated to the presence of sesquiterpenes and monoterpenes<sup>13</sup>.

In a comparative study of different Moroccan essential oils, *C. sempervirens* EO was the most effective in scavenging NO free radicals<sup>14</sup>

## Catnip essential oil

The repellent activity of the essential oil of the catmint plant, *Nepeta cataria* (Lamiaceae), and the main iridoid compounds (4aS,7S,7aR) and (4aS,7S,7aS)-nepetalactone, was assessed against (i) major Afro-tropical pathogen vector mosquitoes, i.e. the malaria mosquito, *Anopheles gambiae* s.s. and the Southern house mosquito, *Culex quinquefasciatus*, using a World Health Organisation (WHO)-approved topical application bioassay (ii) the brown ear tick, *Rhipicephalus appendiculatus*, using a climbing repellency assay, and (iii) the red poultry mite, *Dermanyssus gallinae*, using field trapping experiments. Gas chromatography (GC) and coupled GC-mass spectrometry (GC-MS) analysis of two *N. cataria* chemotypes (A and B) used in the repellency assays showed that (4aS,7S,7aR) and (4aS,7S,7aS)-nepetalactone were present in different proportions, with one of the oils (from chemotype A) being dominated by the (4aS,7S,7aR) isomer (91.95% by GC), and the other oil (from chemotype B) containing the two (4aS,7S,7aR) and (4aS,7S,7aS) isomers in 16.98% and 69.83% (by GC), respectively. In summary, these data suggest that although the nepetalactone isomers have the potential to be used in human and livestock protection against major pathogen vectors, intact, i.e. unfractionated, *Nepeta* spp. oils offer potentially greater protection, due to the presence of both nepetalactone isomers and other components such as (E)-(1R,9S)-caryophyllene<sup>15</sup>. *Nepeta* essential oil (Neo; catnip) and its major component, nepetalactone, have long been known to repel insects including mosquitoes. However, the neural mechanisms through which these repellents are detected by mosquitoes, including the yellow fever mosquito *Aedes aegypti* (L.), an important vector of Zika virus, were poorly understood. Here we show that Neo volatiles activate olfactory receptor neurons within the basiconic sensilla on the maxillary palps of female *Ae. aegypti*. A gustatory receptor neuron sensitive to the feeding deterrent quinine

and housed within sensilla on the labella of females was activated by both Neo and nepetalactone. Activity of a second gustatory receptor neuron sensitive to the feeding stimulant sucrose was suppressed by both repellents. Our results provide neural pathways for the reported spatial repellency and feeding deterrence of these repellents. A better understanding of the neural input through which female mosquitoes make decisions to feed will facilitate design of new repellents and management strategies involving their use<sup>16</sup>.

## **Basil extract**

*Ocimum basilicum* L. leaf material was extracted by maceration with (80:20:1 v/v/v) methanol: water: acetic acid to produce a crude extract (CE), which was further fractionated by liquid-liquid extraction to isolate light petroleum (PE), ethyl acetate (EtOAc), n-butanol (n-BuOH) and H<sub>2</sub>O-soluble sub-fractions. The total phenol and flavonoid contents of the resulting samples were estimated using colorimetric-based methods, and their iron(III) reductive and free radical scavenging activities were determined in a battery of in vitro assays. The CE and sub-fractions contained phenolic compounds and flavonoids. The samples, except for PE, gave a positive result for the presence of flavones and flavonols; however, flavanones only appeared to be present in the CE. In iron(III) reduction, CE and n-BuOH were the most potent followed by EtOAc and H<sub>2</sub>O (statistically indistinguishable,  $p > 0.05$ ). However, in the ferric reducing antioxidant power assay, H<sub>2</sub>O was the most potent followed by CE and EtOAc (statistically indistinguishable,  $p > 0.05$ ) and n-BuOH and PE. In 1,1-diphenyl-2-picrylhydrazyl scavenging, all the samples, except PE, were effective against this reactive nitrogen species, with CE, EtOAc and n-BuOH being the most potent (statistically indistinguishable,  $p > 0.05$ ). In alkylperoxyl scavenging, all the samples, except for PE, were effective against this reactive oxygen species (ROS). In superoxide anion scavenging, all the samples were capable of scavenging this ROS with CE being the most effective, followed by n-BuOH and H<sub>2</sub>O (statistically indistinguishable,  $p > 0.05$ ) and EtOAc and PE. Similarly, in hydroxyl scavenging, all the samples were capable of scavenging this ROS with CE and n-BuOH being the most effective (statistically indistinguishable,  $p > 0.05$ ) followed by EtOAc and H<sub>2</sub>O (statistically indistinguishable,  $p > 0.05$ ) and PE<sup>17</sup>.

A single blinded study was conducted using non-invasive methods. Formulation containing 3% of the concentrated extract of Basil was developed by entrapping in the inner aqueous phase of w/o emulsion and base contained no extract. Both creams were stored at different storage conditions of 8°C, 25°C, 40°C and 40°C+ 75% relative humidity to predict their stabilities. The formulation and base were evaluated for their effects on various skin parameters i.e., moisture and trans epidermal water loss (TEWL), volume, energy and surface evaluation of the living skin (SELS). Significant effects ( $p \leq 0.05$ ) were observed for both creams in the case of TEWL. The base showed insignificant ( $p \leq 0.05$ ) while formulation showed significant effects on skin moisture. Volume, SELS SEr (skin roughness), SEsc (skin scaliness), SEsm (skin smoothness), SEw

(skin wrinkles) parameter showed significant decline while texture parameter of 'Energy' showed significant increase. The results statistically indicated that the active formulation containing extract of Basil exert antiaging effects when applied topically.<sup>18</sup>

## **Rosemary extract**

Recently, the natural spices and herbs such as rosemary, oregano, and caraway have been used for the processing of meat products. This study investigates the antioxidant activity of 13

spices commonly used in meat processing plants. The hot water extracts were then used for evaluation of total phenolic content, total flavonoids content and antioxidant activities. Our results show that the hot water extract of oregano gave the highest extraction yield (41.33%) whereas mace (7.64%) gave the lowest. The DPPH radical scavenging ability of the spice extracts can be ranked against ascorbic acid in the order ascorbic acid > clove > thyme > rosemary > savory > oregano. The values for superoxide anion radical scavenging activities were in the order of marjoram > rosemary > oregano > cumin > savory > basil > thyme > fennel > coriander > ascorbic acid. When compared to ascorbic acid (48.72%), the hydroxyl radical scavenging activities of turmeric and mace were found to be higher ( $p < 0.001$ ). Clove had the highest total phenolic content (108.28  $\mu\text{g}$  catechin equivalent (CE)/g). The total flavonoid content of the spices varied from 324.08  $\mu\text{g}$  quercetin equivalent (QE)/g for thyme to 3.38  $\mu\text{g}$  QE/g for coriander. Our results indicate that hot water extract of several spices had a high antioxidant activity which is partly due to the phenolic and flavonoid compounds<sup>19</sup>. The aim of another study was to estimate the potential of W/O/W emulsions based on natural ingredients (ethanolic rosemary extract and weak herbal gels) for skin irritation and phototoxicity using reconstructed 3D epidermis models in vitro and to evaluate in vivo its effect on human skin moisture, sebum content and pigmentation by biomedical examination using a dermatoscopic camera and corneometer. According to the results obtained after in vitro cell viability test the investigated emulsion was neither irritant nor phototoxic to human skin keratinocytes. W/O/W emulsion did not cause skin dryness in vivo, despite the fact that it contained ethanol. We can conclude that the emulsion is safe for use as a leave-on product due to the positive effect on human skin characteristics or as a semisolid pharmaceutical base where active compounds could be encapsulated<sup>20</sup>.

## Allantoin

Allantoin has proven helpful in reducing the signs and symptoms mild-to-moderate eczema<sup>21</sup>. The histological wound healing profile induced by allantoin in rats demonstrated that it is able to ameliorate and fasten the reestablishment of the normal skin<sup>22</sup>.

## Inulin

Inulin-type fructan is used in the manufacture of cosmetic rinse-off compositions for the treatment of the hair and/or the skin. The compositions comprise, apart from conventional ingredients in conventional amounts, from 0.10 to 10% of the inulin-type fructan, and are free from (i) cationic polymers, (ii) terpolymers comprising a non-ionic monomer bearing a urethane group, and (iii) polysaccharides that are different from inulin-type fructan. The inulin-type fructan, which is biodegradable and has no eutrophic effects on surface waters, can be used to completely substitute cationic polymeric conditioning agents in conventional cosmetic rinse-off compositions<sup>23</sup>.

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