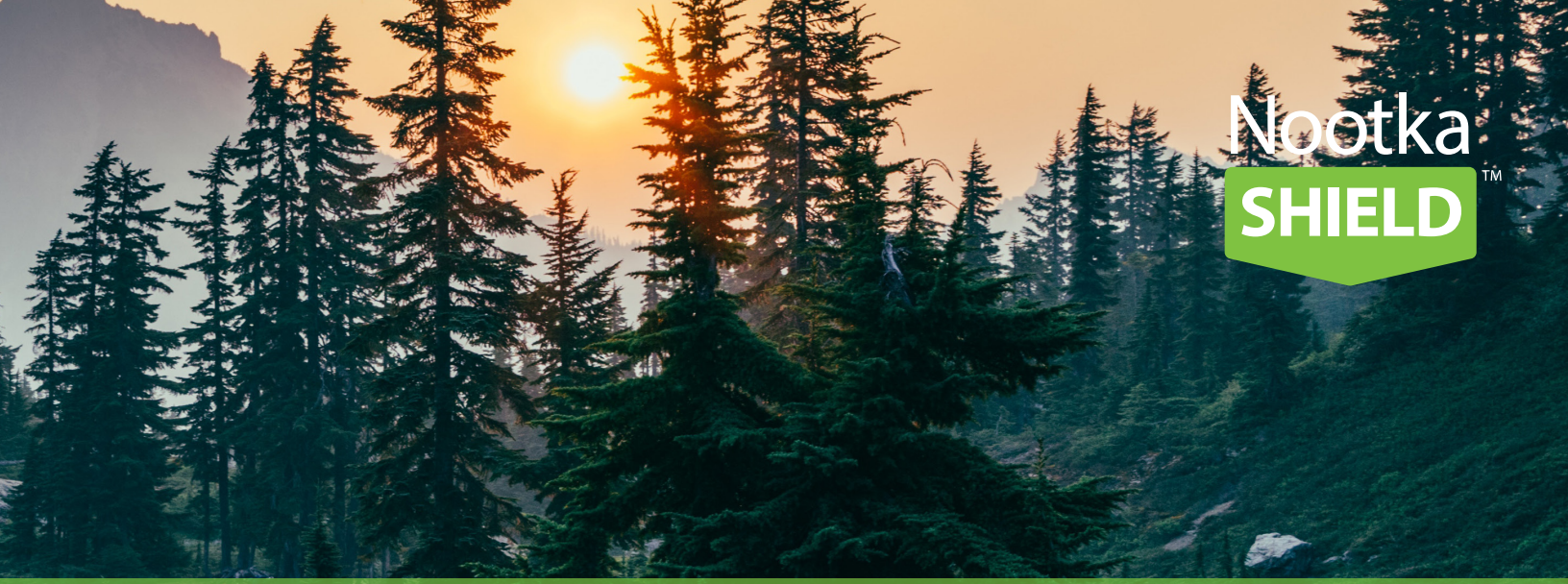


NootkaShield™ Nootkatone

An ingredient found in nature for effective insect repellent and control

NootkaShield.com

The prevalence of insect-borne diseases has increased dramatically in recent years. However, there has been no significant advances in the pest repellent market for decades – until CDC and Evolva partnered to unlock the potential of nootkatone, a natural compound effective for killing and repelling mosquitoes, ticks and a variety of other insects.[1]

To date, DEET remains a leading ingredient in the pest repellent category; it was first brought to market in a repellent product in 1956. DEET is an undesirable ingredient for many consumers who dislike the harsh chemical smell and have concerns about its toxicity and incompatibility with plastic.

Found naturally in the heartwood of Alaskan yellow cedar and grapefruit rind, nootkatone isn't just effective as a repellent – it also offers an alternative ingredient to the industry with a fresh scent. Extracting natural nootkatone in quantities suitable for large-scale use isn't practical or sustainable, but Evolva saw a different opportunity. Experienced at developing bio-identical compounds of difficult-to-source ingredients, the company created a disruptive technology for production of nootkatone through yeast fermentation.

Evolva's NootkaShield is produced at commercial scale volumes with consistent quality and purity, and offers reliable sourcing and product traceability. In different applications, nootkatone can repel or kill harmful insects, reducing their threat to human health and safety. With this technology breakthrough, Evolva has opened the door to wide industry adoption and product innovation.

POWERFUL PROTECTION

NootkaShield combats the spread of insect-borne diseases

TICKBORNE DISEASE
(Such as Lyme Disease)

MOSQUITO-BORNE DISEASE
(Such as Zika Virus)



Rising Need for Insect Repellency and Control

Insect bites pose an increasingly serious risk for the US population. According to the US Centers for Disease Control and Prevention (CDC), the number of reported vector-borne disease cases (diseases transmitted by mosquitoes, ticks, fleas, etc.) has doubled from 2004 to 2018.[2] Disease cases from ticks have doubled, and mosquito-borne disease epidemics are happening more frequently.

The consequences of contracting these diseases can be severe. Lyme disease is debilitating, with common symptoms such as rash, facial paralysis and arthritis. If left untreated, infection can spread to joints, the heart and the nervous system.[3] Contracting the Zika virus while pregnant can cause severe birth defects, and there have been increased reports of Guillain-Barré syndrome, an uncommon nervous system disease, in areas affected by Zika.[4] Preventing the spread of these and other diseases must be a priority – and now experts are taking a fresh approach with unique alternatives like NootkaShield™ nootkatone.

It's time to make insect repellency and control a priority in daily life.

3X ↑ Disease cases from mosquito, tick and flea bites have increased threefold from 2004 – 2016

Insect bites can happen anywhere – not just on vacation or during outdoor excursions, but in the backyard or even on the living room couch. Consumers need new solutions that they feel comfortable using to protect themselves and their families every day. NootkaShield can help meet this need.

The Protective Power of NootkaShield

Plants produce natural compounds to protect themselves from insects and disease. Nootkatone is one of these powerful compounds, found in the heartwood of Alaskan yellow cedar trees and in grapefruit skin. Nootkatone has been used for decades in high-priced perfumes, but obtaining nootkatone from nature has been cost prohibitive for many other product uses. It takes several tons of grapefruit to produce just 1 kg of nootkatone, and the Alaskan yellow cedar is under review for potential designation as threatened or endangered by the US Fish & Wildlife Service.[5]

As CDC's exclusively licensed partner to advance next-generation insect repellent and control products, Evolva developed advanced production technology that takes its cue from nootkatone's natural sources. NootkaShield is produced to at least 99% purity – identical to the compound found in nature. It's the only nootkatone product approved as an active ingredient by the Environmental Protection Agency (EPA).

NootkaShield is designed by nature to offer a more comfortable, acceptable experience for users. Many consumers simply don't like the insect repellents on the market today. Most products contain ingredients that are perceived as toxic, feel greasy or have an unpleasant odor. These all represent significant barriers to making insect repellent and control part of a daily routine.

While still highly effective for repelling and killing harmful insects, NootkaShield has a pleasant citrus aroma and lightweight feel on the skin. Most importantly, it is not classified as a carcinogen, it is not genotoxic and it is in Class IV for toxicity, the lowest possible acute toxicity classification. It has tremendous potential for use in a range of applications – and is produced at commercial scale, with consistent quality. With NootkaShield, Evolva has opened the door to wide product innovation and industry adoption.

PRODUCT INNOVATION

NootkaShield supports a range of innovative, potential products to protect consumers from insect bites and disease:

- Garden sprays
- Foaming body soaps
- Lotion



NootkaShield™ Nootkatone at Work

Studies show that NootkaShield is an effective repellent for use against ticks and a range of insects.

Evolva's research includes testing with a variety of NootkaShield formulations to determine the length of time each formulation offers complete insect protection for human skin, as well as the formulation's effect on the insect.

Knockdown and killing activity against lone star ticks[7]

Evolva has tested many nootkatone ingredient formulations to determine the most effective for controlling insects after application. In the case of lone star ticks, a study revealed that Evolva's NootkaShield ingredient performs just as well when compared to a commercial formulation.

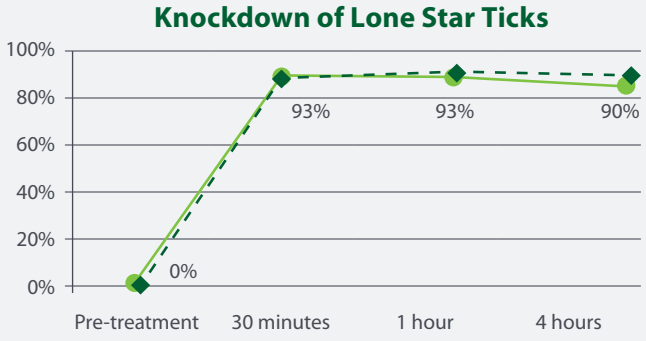
Laboratory Test: Ticks[6]

Prototype Formulation with 10% nootkatone	Average CPT
F-610	**4.3 hours**

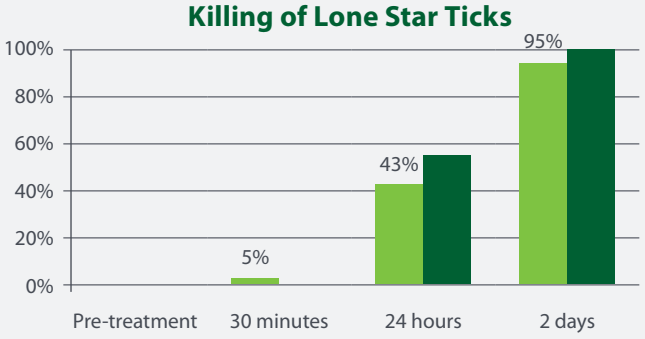
Complete Protection Time (CPT) is defined as minutes elapsed between repellent application and the first confirmed event of insect landing and/or probing. A confirmed event is one or more landing(s), probe(s), bite(s), followed by another similar event within 30 minutes. The first event is confirmed by the second; the second event is the confirming event.

Prototype Formulation F-542 with 1% nootkatone

Commercial Comparison Harmonix™ with 0.03% pyrethrins



- Thirty minutes after application, Evolva's prototype formulation F-542 containing 1% nootkatone was as effective as the commercial comparison at incapacitating, or knocking down, lone star ticks.



- Thirty minutes after application, the prototype formulation F-542 containing 1% nootkatone follows the trend of the commercial product at killing lone star ticks.
- Two days after application, the same F-542 formulation containing 1% nootkatone showed similar results to the commercial product comparison, killing 95% of lone star ticks.

About Evolva

NootkaShield™ is produced by Evolva, a Swiss biotech company focused on the research, development and commercialization of products based on nature. We have leading businesses in flavors and fragrances, health ingredients and health protection. Evolva's employees are dedicated to producing the best ingredients that can contribute to health, wellbeing and sensory enjoyment. Find out more at www.evolva.com.

Footnotes

1. Panella NA, Dolan MC, Karchesy JJ, Xiong Y, Peralta-Cruz J, Khasawneh M, Montenieri JA, Maupin GO. Use of novel compounds for pest control: insecticidal and acaricidal activity of essential oil components from heartwood of Alaska yellow cedar. *Journal of medical entomology*. 2005 May;42(3):352-8.
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3. CDC. "Lyme Disease." 21 December 2018. www.cdc.gov/lyme.
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7. Snell Scientifics. "EvolvaTickDirect17." 30 March 2017.