

# Development and Efficacy of a Novel Plant-Based Insect and Tick Repellent, BioUD<sup>®</sup>

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# HOMS LLC

Manufacturer of Bite Blocker



**Dr. Michael Roe**



# Outline

- Background
- BioUD<sup>®</sup> discovery
- Data from efficacy trials



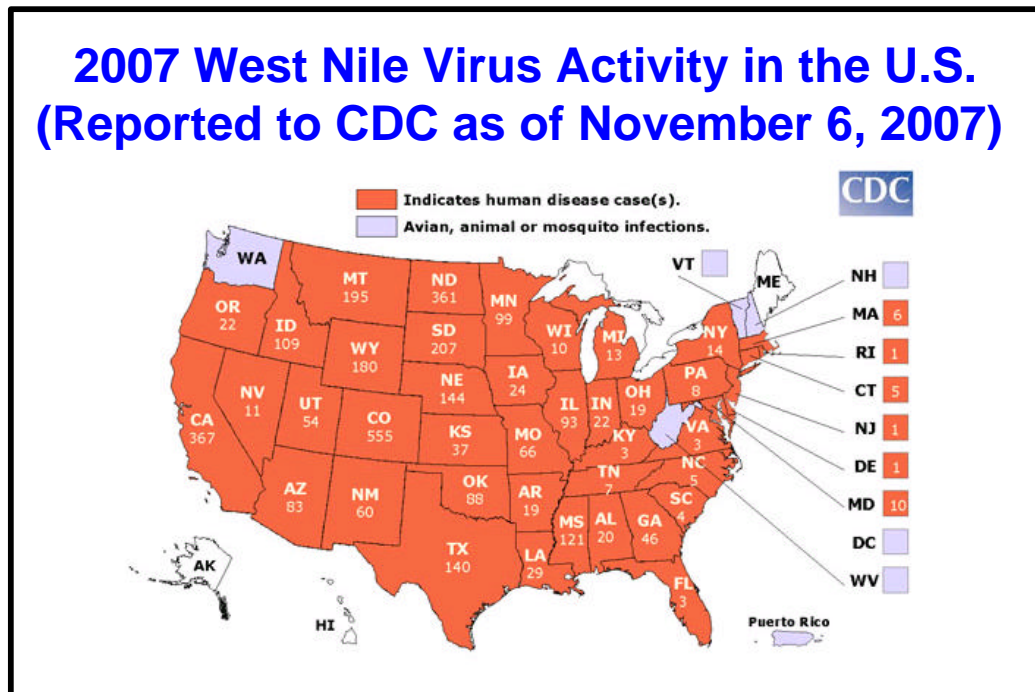
# Insect Repellents

- Repellents
  - Most common form of personal protection against biting arthropods
  - DEET
    - Odor & feel unpleasant
    - Flammable
    - Degrades hard plastics
    - Perceived negative health effects



# Insect Repellents

- Renewed interest in discovery
  - West Nile virus, Eastern Equine Encephalitis, St. Louis Encephalitis, LaCrosse Encephalitis



# Alternative Repellents

- Chemical
  - Picaridin (Bayer), IR3535 (Merck)
- Botanical
  - Oil of lemon eucalyptus, citronella, geraniol, etc.



# Bringing a New Repellent to Market

- Discovery
- Patenting
- Formulation
- Toxicity analysis
- Permission for human trials
- Perform efficacy trials
- EPA registration
- Marketing & distribution



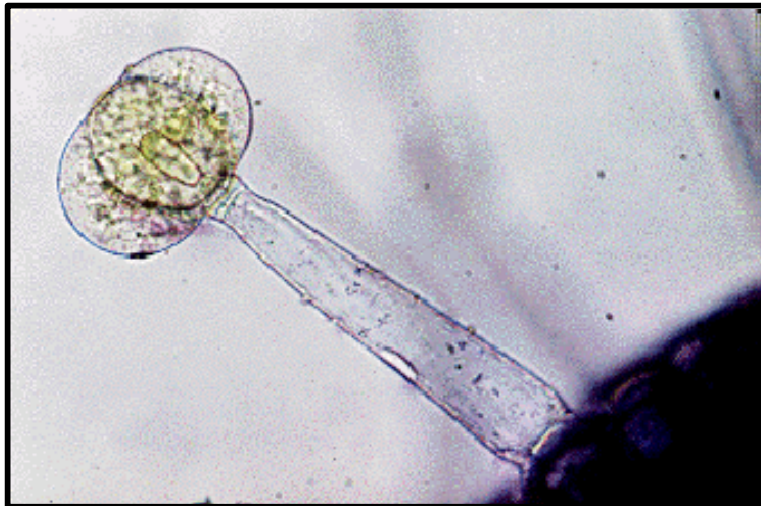
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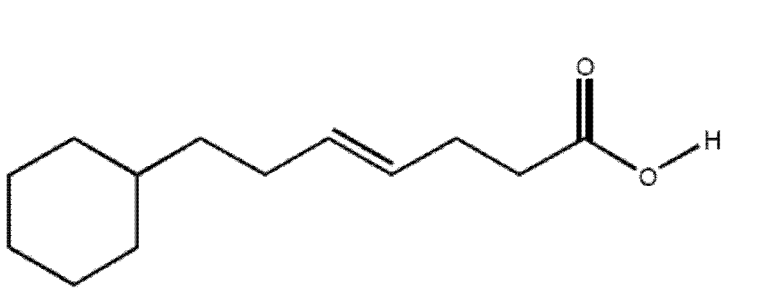
# Early Work

- *Lycopersicon hirsutum* f. *glabratum*  
(Kennedy et al.)
- Resistant to herbivory
- Tridecanone & 2-undecanone



# Discovery

- Trypsin modulating oostatic factor (TMOF) (Vanderherchen et al. 2005)
  - Terminates synthesis of digestive enzyme
- TMOF chemical analogs synthesized
- Similar to tridecanone and 2-undecanone



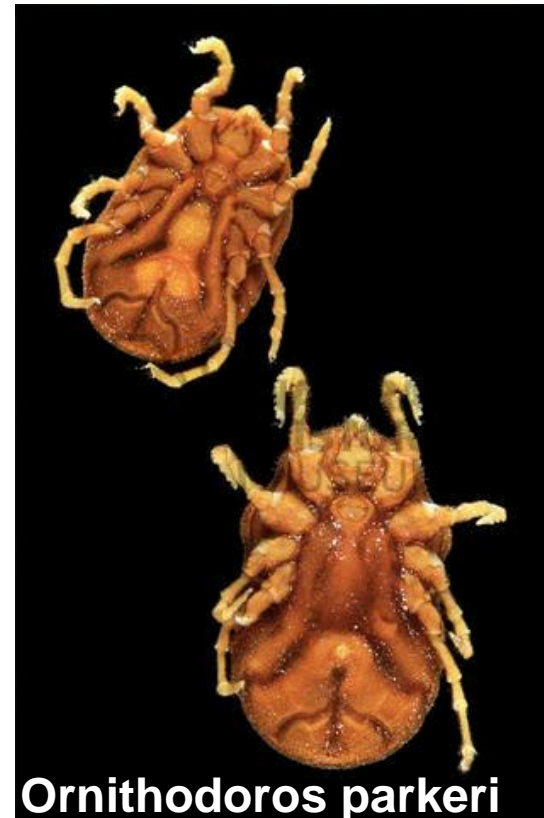
# Discovery

- Aha! moment - Repellent action?
- 2-undecanone chosen
  - Known safety record
  - Used as a dog & cat repellent
  - Cosmetic and flavoring additive



# Preliminary Trials

- Effective against mosquitoes & ticks
- Highly volatile



# Corporate Partnering

- BioUD<sup>®</sup> (7.75% 2-Undecanone) HOMS, LLC
- Proprietary emulsion technology



# Next Steps

- Patented
- Toxicity trials
  - Category IV
- Efficacy trials
- EPA registration
  - 2007



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# Repellency of BioUD<sup>®</sup>

- NCSU IRB
- Field trials
  - Mosquitoes (NC and Ontario)
- Laboratory trials
  - *Aedes aegypti*, *Ae. albopictus*
  - *Dermacentor variabilis*
    - Skin, filter paper, cotton cloth



# Repellency of BioUD<sup>®</sup>

- Field trails
- Howell Woods, Smithfield
- 9 volunteers on 3 evenings
- 1 ml/600 cm<sup>2</sup>
- BioUD<sup>®</sup> (7.75% 2-Undecanone),  
25% DEET, control
- Landing counts



# Repellency of BioUD<sup>®</sup>

- Field trails
- Guelph, Ontario Canada
- 4 volunteers on 3 evenings
- 1 ml/600 cm<sup>2</sup>
- BioUD<sup>®</sup> (7.75% 2-Undecanone),  
30% DEET, control
- Biting counts



# Mean ( $\pm$ SE) Percent Repellency Field Studies

	Time (h)	BioUD <sup>®</sup>	DEET <sup>1</sup>
<b>North Carolina<sup>1</sup></b>			
(N=9)	3	98.4 $\pm$ 8.2a	100.0 $\pm$ 8.2a
	4	94.2 $\pm$ 8.2a	99.0 $\pm$ 8.2a
	5	92.2 $\pm$ 8.2a	99.7 $\pm$ 8.2a
	6	79.0 $\pm$ 8.2a	95.8 $\pm$ 8.2a
-----			
<b>Ontario<sup>2</sup></b>			
(N=4)	4	95.5 $\pm$ 2.0a	96.7 $\pm$ 1.2a
	6	95.6 $\pm$ 3.0a	72.2 $\pm$ 5.2b

25% DEET used in NC trials, 30% DEET used in Ontario trials. <sup>1</sup>( $P = 0.05$ , repeated measures ANOVA, means separated by LSD); <sup>2</sup>( $P = 0.05$ , ANOVA, Duncan's multiple range test).

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# Repellency of BioUD<sup>®</sup>

- Lab trials
- *Ae. aegypti* & *Ae. albopictus*
- 4 volunteers
- 1 ml/600 cm<sup>2</sup>
- BioUD<sup>®</sup>, 7 and 15% DEET



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	2	86.7 $\pm$ 3.9a	88.7 $\pm$ 3.9a	99.5 $\pm$ 3.4b
	3	81.7 $\pm$ 3.7a	88.0 $\pm$ 3.7a	100.0 $\pm$ 3.7b
	4	79.5 $\pm$ 5.0a	73.0 $\pm$ 5.0a	96.1 $\pm$ 5.0b
	5	70.1 $\pm$ 7.8a	74.7 $\pm$ 7.8a	95.2 $\pm$ 8.0b
	6	68.2 $\pm$ 8.7a	58.4 $\pm$ 8.7b	89.4 $\pm$ 8.7a
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<i>Aedes albopictus</i>				
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Means within the same row followed by the same letter are not significantly different ( $P = 0.05$ , LS means), N = 6. <sup>1</sup>Cutter Skinsations; <sup>2</sup>ethanolic formulation

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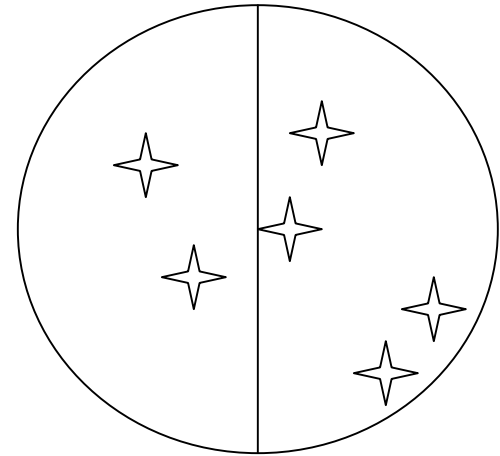
# Summary



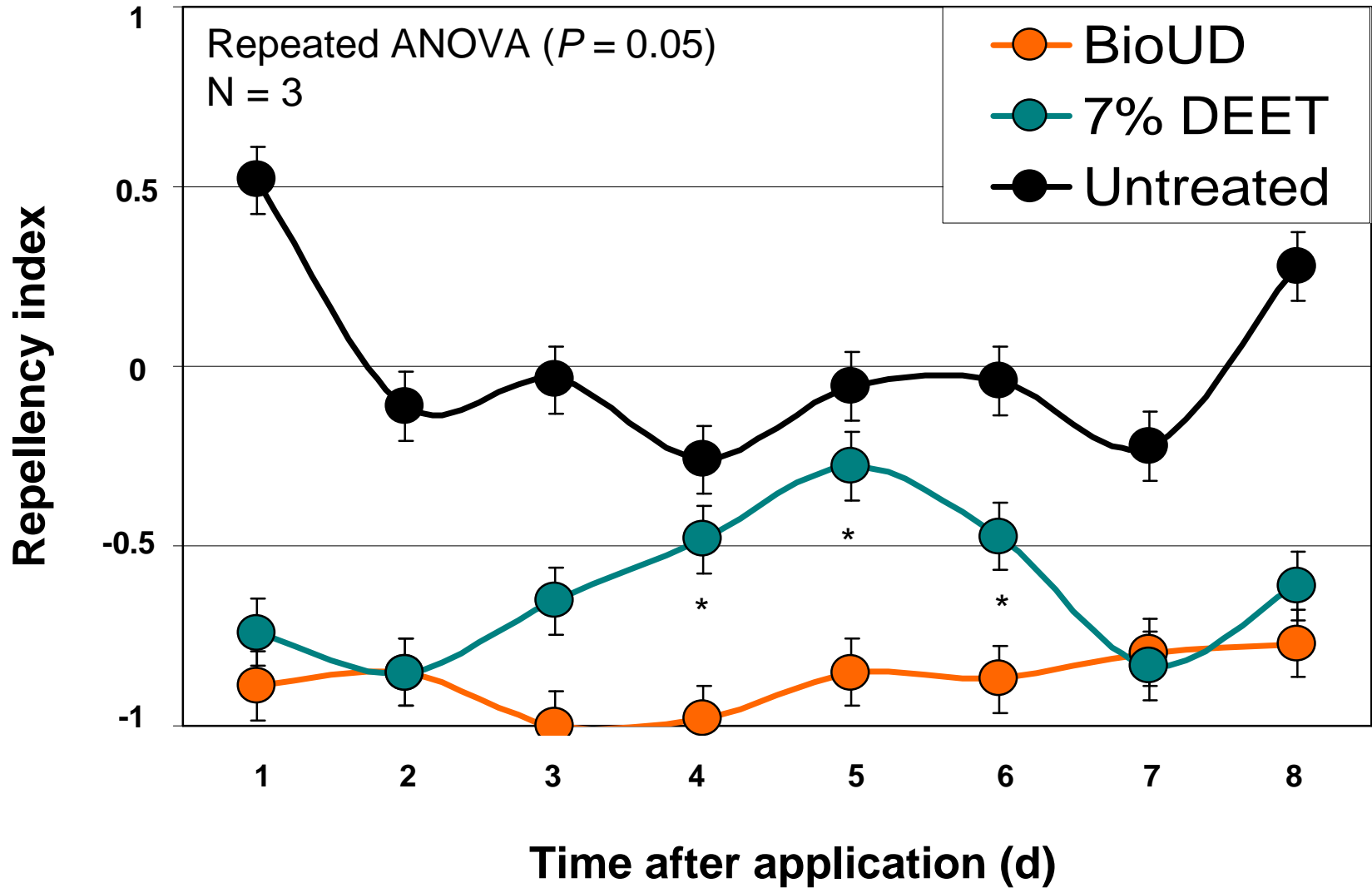
- Field trials
  - BioUD<sup>®</sup> as effective as 25% DEET
  - BioUD<sup>®</sup> more effective than 30% DEET at 6hr
- Lab trials
  - *Ae. aegypti* BioUD<sup>®</sup> as effective as 7% DEET
  - *Ae. albopictus* BioUD<sup>®</sup> as effective as 7 & 15% DEET

# Repellency of BioUD<sup>®</sup>

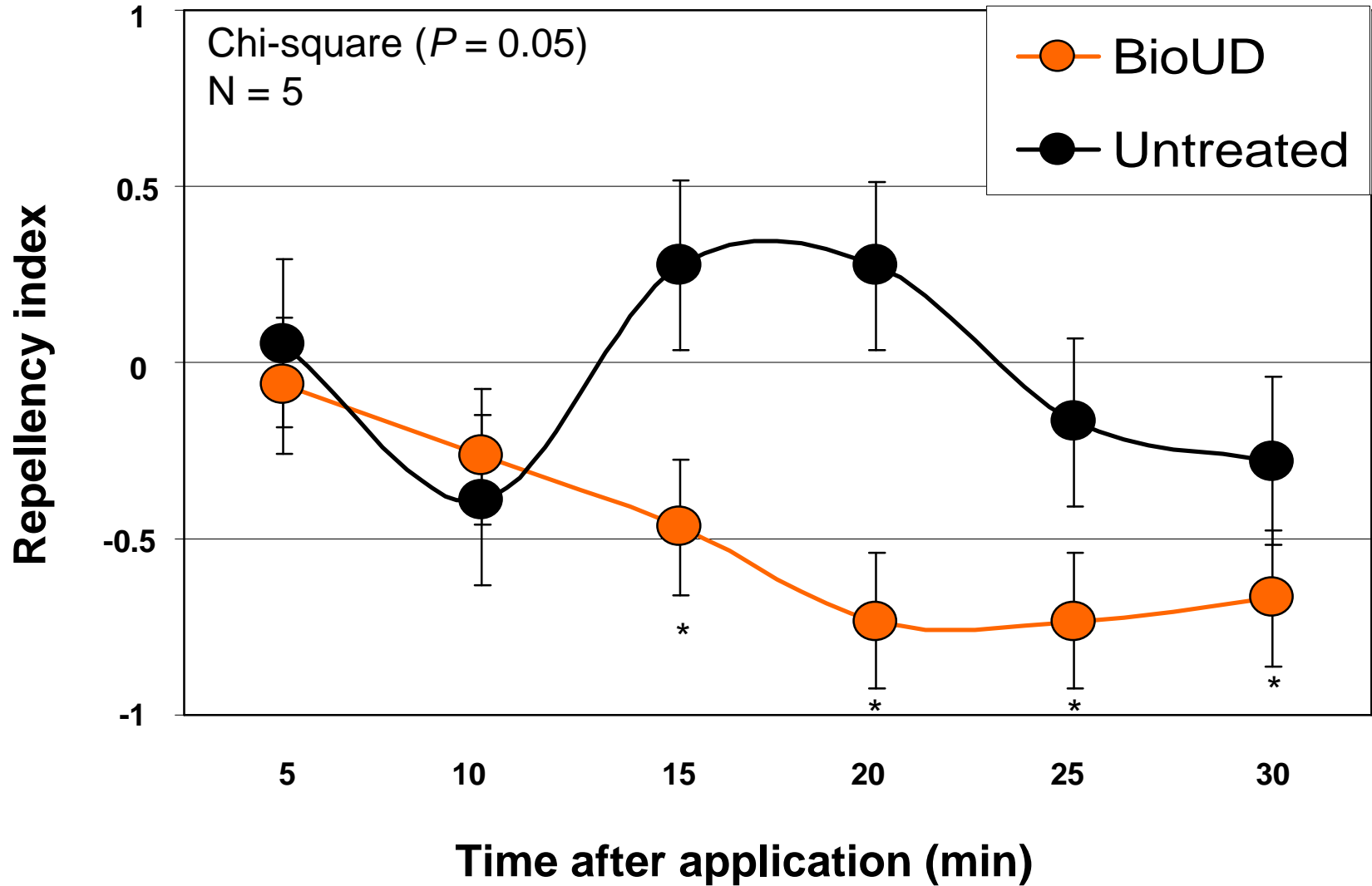
- *D. variabilis*
- Two-choice bioassays
  - Cloth (8 days)
  - Filter paper (30 min)
  - Skin (30 min)
- Repellency index
  - (untreated – treated / untreated + treated)
  - -1 highly repellent, 1 highly attractive, 0 neutral



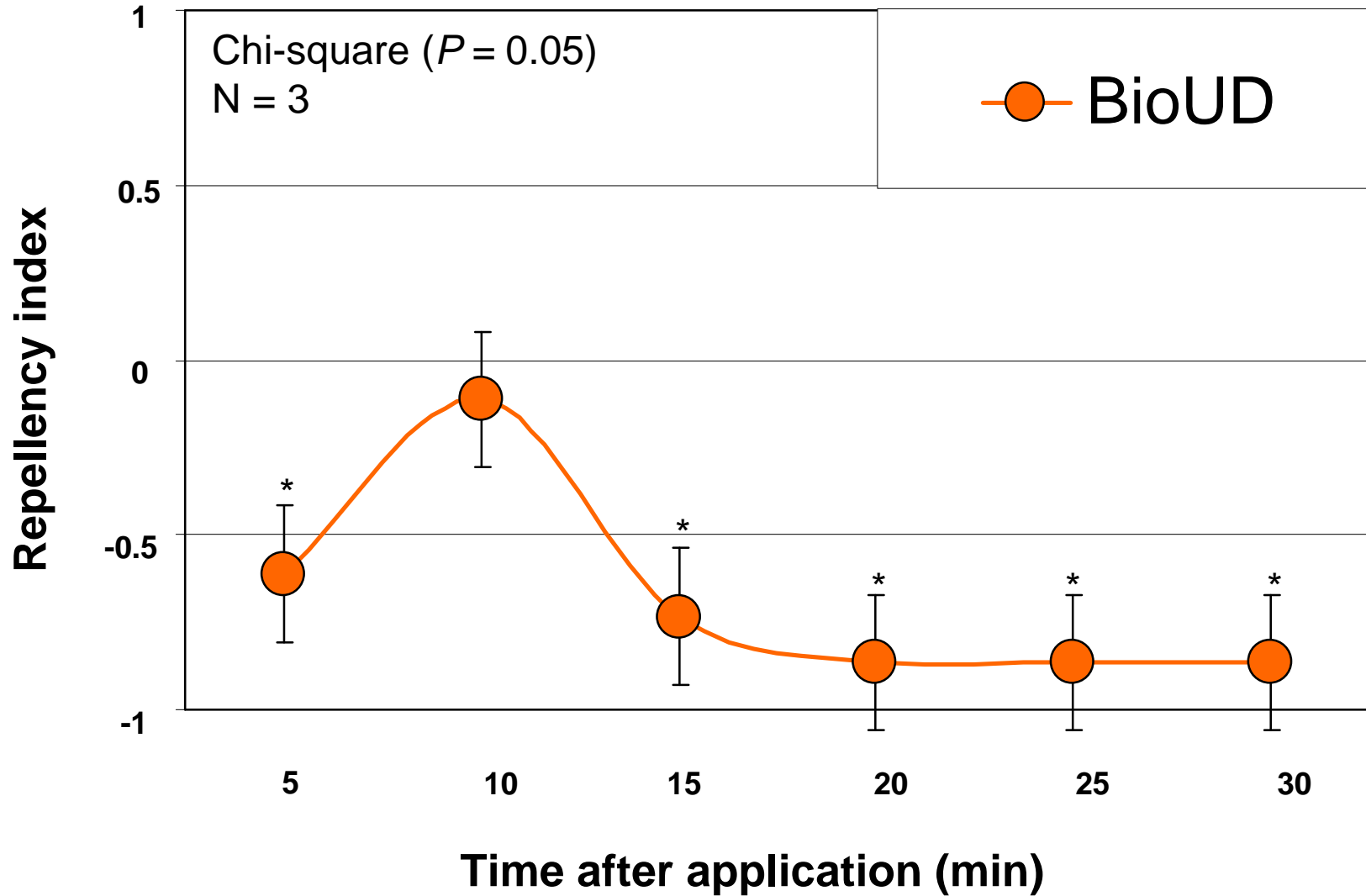
# Ticks on Cotton Cloth



# Ticks on Skin



# Ticks on Filter Paper



# Summary



- Cloth
  - BioUD<sup>®</sup> as or more effective than 7% DEET
- Skin
  - BioUD<sup>®</sup> highly repellent
- Head-to-head
  - BioUD<sup>®</sup> more repellent than 15% DEET

# Conclusions

- BioUD<sup>®</sup> is a viable alternative to DEET against mosquitoes & ticks
  - Efficacy
  - Safety
    - Toxicity trials
    - Non-flammable
  - Provides a plant-based repellent for those averse to chemical repellents

# Acknowledgements

- Dr. Charles Apperson
- Dr. Daniel Sonenshine
- Dr. Cavell Brownie
- Dr. Christof Stumpf
- Kevin Donohue

