INTERVIEW REGARDING

D-limonene Impact on THC-induced Anxiety Effects

This interview was conducted by CBD Oracle via email in June 2024 and is provided here for full transparency. Learn more about CBD Oracle's Editorial Policy.

Ethan Russo

Founder and CEO
CReDO Science

Ethan Russo, MD, is a board-certified neurologist, psychopharmacology researcher, and author. He is the Founder and CEO of credo-science.com and the creator of the course Foundations of Cannabis Therapeutics with Ethan Russo, MD: An Evidence-Based Medical Cannabis Education Course.

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CBD Oracle: What would you say is the most important result of your study?

Ethan: Debate has raged in the scientific community for decades between those that have claimed that effects of cannabis are solely attributable to THC, or more recently, perhaps CBD, versus those that have recognized cannabis as a true botanical medicine with many components that act in concert to produce the overall pharmacological benefits. This study supports the botanical concept, commonly known as "the entourage effect," as first proposed by Professors Mechoulam and Ben-Shabat a generation ago.

CBD Oracle: Does the fact that d-limonene had no effect on anxiety alone but did in combination with THC offer evidence for the entourage effect?

Ethan: Yes, it does. At inhaled low doses, the effect of limonene was too subtle to show statistical significance between groups. However, in combination with THC, the changes were clear. This is part of the definition of synergy of ingredients, wherein the whole (plant) is greater than the sum of its parts (single isolated compounds).

CBD Oracle: You note that there is a big difference between your test mixture and full spectrum or "whole plant" products - how would you expect the results to change in that case? What is the "real world" significance of the study in that sense?

Ethan: Cannabis contains upwards of 500 different chemical compounds. It becomes very difficult to demonstrate salient differences in the face of so many variables. Certainly, cannabis consumers recognize unique varieties, and their preferences in selection relate to the attributes of various chemovars according to their composition and resulting effects. The scientific approach here called for what I like to call a "deconstruction/reconstruction process," by which we can parse the effects of more simple combinations to demonstrate synergy.

CBD Oracle: What would you say was a major limitation of the study?

Ethan: It would be nice to test larger groups, but with 9 or 10 sessions per study participant, it makes for a long and expensive process.

We pointed out a possible criticism that most cannabis consumers may not encounter cannabis in dispensaries that conforms to the ratios of THC and limonene that were utilized, but these chemovars certainly do exist, and selective breeding for limonene can make this a reality now that we have demonstrated the effect and therapeutic benefit of reducing THC-induced anxiety by selecting for limonene content and that of other useful components.

CBD Oracle: What's the next step for research into d-limonene and the entourage effect more broadly?

Ethan: We'd like to test whether the benefit of limonene on anxiety extends to oral preparations, and not just inhalation. Similar studies are planned for other THC/terpenoid combinations. ▮