biosynthesis and biotechnological applications, allergenicity to cannabis and methods to assess personal exposure, genomics and molecular markers, micropropagation, hairy root culture as a biotechnological tool, cannabis endophytes and their application in breeding and fitness, and contaminants of concern in cannabis. The reader can achieve a purer view of cannabis science.

Aside from the botanical and biotechnology aspects of the plant, the book ends with a chapter on product safety and contaminants. While academia and industry seem to be hitting their stride with the plant, there has been serious issues due to sloppy, unethical, dubious and unscrupulous operators in the cannabis space. The book shows a number of surprising lessons the global cannabis industry has hopefully learned from. While the plant is innocuous and non-toxic, humans find an endless combination of ways to make it less safe, as with any mass-produced commodity. Such as spraying plants with fertilizers made from human dungs (Europe) or untreated manure (North America), or a company that was caught repackaging a product targeted to cannabis growers as “Guardian” as “100% Natural,” when it was an illegal pesticides. The impact of these behaviors leads to costly fines, recalls, and influences policy and regulatory decisions for cannabis science.

The book also discusses aspects of cultivation to enhance or inhibit different aspects of the plant. Not only genetics and nutrients, but the microbeome, the friendly bacteria and fungus the plant needs to either be a great hemp or a potent medicinal plant. If you are growing the plant for cannabidiol (CBD), you shouldn’t be growing it for fiber, and there are many reasons. Hemp appears across 22 genera of plants, it is a name bestowed to plants used to make textiles like rope, and contamination. Kim’s per- mission, as it is tested for purity and contamination. Kim had received it illicitly. Kim tried medical cannabis. However, at her next session, she reported that she had procured “some marijuana from her friend’s son” who had received it illicitly. Kim was told that her state’s program would be able to provide safer cannabinoid-based medical cannabis, as it is tested for purity and contamination. Kim’s primary care physician was unable to sign a recommendation as the provider’s health system strictly prohibited it. Thus, I strongly encouraged Kim to call a state-approved doctor who is certified to recommend medical cannabis. Kim was assisted with securing an appointment with a certified physician at the only functional cannabis dispensary in the northern part of the state, and in obtaining a legal medical cannabis card. At the appointment, Kim obtained both flower- and vape cartridge-based cannabis derived from a strain that has shown positive results (according to the manufacturer) in people with sleeplessness, hypervigilance, and depression.

The book’s chapters clarify every botanical aspect to concrete the organizational family of cannabis. This is important as hemp plants are grown differently from medicinal plants, in most respects to improve fiber production over resin production. The tools and resources exist to improve cannabis agriculture, but we need the academics and the industry to work closer together to leverage the knowledge base to truly create a resurgence of cannabis’ place in the global economy.

This book is useful because it combines basic sciences such as botany, with applied sciences such as biotechnology. This combination of curiosity and outcome driven research has proven powerful enough to have solved many issues, such as how to decontaminate dried flower tops or apply genetic testing to breed specific drug chemovars (chemical varieties; dominant for a specific cannabinoid). But also identified a number of research projects the could truly make cannabis have a significant economic resurgence as a hemp or medicinal plant. The book is also useful for the student looking for a project to keep her busy for years, or the industry entrepreneur trying to earn licenses or increase funding opportunities by utilizing innovative research technology. Personally, the book has been a useful guide for my partners in the cannabis industry to help choose and focus on projects at various cultivation operations.

My recommendation is to read this book and to work with agricultural specialists, biochemists, and analytical chemists to make possible a consistent and global supply of standardized medical cannabis for patients and researchers. This book will be of considerable importance not only in summarizing present day knowledge, but also in advancing innovations in the cultivation and use of cannabis.

Reference
1. The Rohrabacher-Farr amendment (also known as the Rohrabacher-Blumenauer amendment) is legislation first introduced by U.S. Rep. Maurice Hinchey in 2001, prohibiting the Justice Department from spending funds to interfere with the implementation of state medical cannabis laws. It passed the House in May 2014 after six previously failed attempts, becoming law in December 2014 as part of an omnibus spending bill. The amendment does not change the legal status of cannabis, however, and must be renewed each fiscal year in order to remain in effect.
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Kim began taking both formulations and reported that she was immediately sleeping better and felt less agitated. She noticed that she felt “less angry around others” and was able to return to playing golf—one of her favorite pastimes—with her friends. Over time, Kim’s quality of life began to improve with the medicinal use of cannabinoids. Her feelings of hypervigilance eased, she was immediately sleeping better and felt less agitated, and the legal and regulated cannabis market led her to make inadvertently risky decisions concerning her own health. Additionally, issues regarding insufficient medication. Additionally, issues regarding insufficient state supplies of safe and standardized cannabinoids are of vital concern to anyone using cannabis medicinally. Notably, I had called a local dispensary asking for the same variety of cannabis that Kim had previously used. After a few months, the dispensary began stocking the same variety of cannabis that Kim had previously used. She began to use cannabis daily in low dosages with similar improvement in symptoms. Kim reported that cannabis administration assisted in improving the quality of her sleep, reduced the severity and frequency of her flashbacks, improved her motivation, and elevated her mood. She began “re-engaging in the world” and working on her cognitive understanding of the traumatic event that brought her to therapy originally. It has been 3 years now since her husband’s death, and Kim is finally starting to feel like herself again. Her quality of life has returned to normal.

Commentary
As a clinician, it is my job to advocate for my clients. Kim is a typical example of one of the fastest growing patient demographics in the United States (ie, the older population). Kim’s lack of understanding about the differences between the illicit “marijuana” market and the legal and regulated cannabis market led her to make inadvertently risky decisions concerning her own health. Additionally, issues regarding insufficient state supplies of safe and standardized cannabinoids are of vital concern to anyone using cannabis medicinally. Notably, I had called a local dispensary asking for a detailed account of what products were in stock.

Regrettably, the staff refused to provide information to me until I informed them that I, too, was a state medical cannabis cardholder. After verifying my personal information, the dispensary staff provided information on that day’s available cannabis varieties (aka “strains”). This enabled me to identify the variety that might have the most significant effect on Kim’s symptoms of sleeplessness, hypervigilance, and depression. Thus, health care professionals without a medical cannabis card may have difficulties when calling dispensaries on their patient’s behalf to determine which cannabis strains are in stock and in order to recommend a strain that may best treat their symptoms.

As has been demonstrated in similar preclinical trials, Kim’s use of cannabis seemed to help reduce both her startle reflex and flashbacks. In this particular case, Kim’s use of cannabis provided significantly less adverse reactions than were reported from zolpidem use. In light of these findings—as a clinician, cannabis researcher, and educator—I believe that far more funding needs to go toward rigorous research so that we might truly determine if the various cultivars of cannabis are as promising as they seem in the treatment of mood disorders. The apparent correlation between Kim’s cannabis therapy cessation and her increased PTSD symptoms appears to provide provocative anecdotal evidence that merits further study.

References

Dr. Roberts has no financial disclosures to disclose.
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Kim began taking both formulations and reported that she was immediately sleeping better and felt less agitated. She noticed that she felt “less angry around others” and was able to return to playing golf—one of her favorite pastimes—with her friends. Over time, Kim’s quality of life began to improve with the medicinal use of cannabinoids. Her feelings of hyper vigilance eased, she started feeling motivated to spend more time with her friends, and her mood significantly improved. Kim also reported that she was experiencing fewer nightmares, and flashbacks of the event were reduced considerably. Kim was stable and, eventually, became motivated enough for us to begin working on her traumatic experience. We were able to look at both her cognition and behaviors, to reframe and rework her thoughts concerning the event, and remodel her behaviors in the absence of prior anxiety.

Effects of Cannabis Cessation

Kim made significant progress until issues arose with supply at the providing dispensary. The primary dispensary suffered shortages in production, negatively affecting their ability to meet patient demands. The particular variety of cannabis flower (and extracted oil) that Kim had used was no longer available, and other similar varieties also were unavailable. As a result, Kim was no longer able to procure the cannabis that had successfully and significantly reduced her symptoms of PTSD. Slowly, the same difficulties with sleeping and arousal states eventually returned at the same level of severity, increasing the frequency of flashbacks of the event, and finally resulting in a pronounced dysthymia. There was an apparent correlation between the reduction of Kim’s cannabis use (due to the unavailability of a specific variety) and the increase in her PTSD-derived symptoms.

At this point, Kim’s primary care physician prescribed zolpidem, which she eventually stopped taking because of significant side effects. Psychotherapy had to revert to more basic therapeutic work centered around ensuring safety and support.

Resumption of Cannabis Use and Follow-Up

After a few months, the dispensary began stocking the same variety of cannabis that Kim had previously used. She began to use cannabis daily in low dosages with similar improvement in symptoms. Kim reported that cannabis administration assisted in improving the quality of her sleep, reduced the severity and frequency of her flashbacks, improved her motivation, and elevated her mood. She began “re-engaging in the world” and working on her cognitive understanding of the traumatic event that brought her to therapy originally. It has been 3 years now since her husband’s death, and Kim is finally starting to feel like herself again. Her quality of life has returned.

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