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Effects of Two Cannabidiol Oil Products on Self-Reported Stress Relief: A Quasi-Experimental Study

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Releaf · Cannabinoid · Anxiety · Distress · Cannabis

Abstract

Introduction: Estimated rates of past-month cannabidiol (CBD) use in the general public are 13–26% and emerging research examines CBD as a potential adjunct treatment for several medical conditions, including stress-related disorders (e.g., depression, anxiety, and chronic pain). However, little is known about the effects of different CBD products on self-reported stress. The present study compared the effects of two delta-9-tetrahydrocannabinol (THC)-free CBD tincture products – (1) an isolate CBD oil and (2) a broad spectrum CBD oil – on self-ratings of effectiveness of the product and ability to manage stress. ***Methods:*** This quasi-experimental study reports on a total of 374 participants who completed either a 30- or 60-day regimen. Participants were instructed to use a 1,000 mg CBD isolate product at will, and then switch over to a 1,000 mg broad spectrum product for the remainder of the regimen (i.e., next 15 or 30 days). Self-reported effectiveness of the product and its ability to help manage stress was compared between the isolate and broad spectrum products. We also examined overall impression, quality, taste, and adverse effects of each product. ***Results:*** Overall, both products were rated to be highly effective and able to assist with stress management. Participants reported that the broad spectrum product's effectiveness ($p < 0.001$) and ability to reduce stress ($p < 0.001$) as greater than the isolate product across both regimens. However, participants preferred the taste of the isolate product over that of the broad spectrum across regimens ($p < 0.05$). For the 30-day regimen, participants reported a more positive overall impression of the isolate as compared to the broad spectrum ($p < 0.001$); however, overall impression did not differ between the products in the 60-day regimen. There was no difference in adverse effects or quality between the products, across both regimens. ***Conclusion:*** These results fit with prior studies suggesting anti-stress effects of CBD. Ratings were higher for the broad spectrum as compared to the isolate product, which is consistent with prior data suggesting that cannabinoids can work synergistically to maximize benefits. Nonetheless, more controlled studies are needed to explore these effects in nonclinical and clinical populations.

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Introduction

The use of cannabinoids such as cannabidiol (CBD), a constituent of the cannabis plant (*Cannabis sativa* L.), has increased over the past decade, including for medical use [1]. CBD in the form of Epidiolex is currently an FDA-approved medication for treatment of three severe childhood seizure disorders [2]. In addition to reducing seizures, recent studies suggest that CBD may be effective for reducing stress, anxiety, pain, sleep problems, arthritis, depression, migraines, and headaches [1, 3, 4], and several clinical trials are underway for these indications and others [5].

Stress is a significant public health problem that can precipitate physical and mental disorders, including major depressive disorder, chronic pain, and cardiovascular disease [6, 7]. Stress-related disorders are extremely common and often debilitating, with approximately 8.4% of US adults experiencing at least one major depressive episode in 2020, 20.5% suffering from chronic pain in 2019, and 7.2% from cardiovascular disease between 2015 and 2018 [8–10]. The key role of stress in common, debilitating physical and mental disorders highlights the importance of preventing and managing stress [7].

Recent studies suggest that CBD may have anti-anxiety and anti-stress effects. Indeed, previous observational studies have demonstrated lower reported anxiety and stress following consumption of cannabis flower – particularly strains with higher CBD concentrations [11]. However, a recent meta-analysis of cannabinoids for the treatment of mental disorders suggests a paucity of research on CBD alone, in particular, and scant evidence for beneficial effects of other cannabinoids such as Δ-9-tetrahydrocannabinol (THC) [12]. Therefore, more studies are needed to evaluate whether CBD alone is effective for reducing stress and anxiety, or whether CBD is a useful adjunct treatment or preventive intervention for stress-related disorders. Further, there are different types of CBD products. For example, isolate products are a pure form of CBD that contain little-to-no other compounds found in the cannabis plant (e.g., other cannabinoids or terpenes) [13]. Broad spectrum products, in contrast, can contain multiple cannabis plant extracts, including essential oils, terpenes, cannabigerol (CBG), cannabinol, trace levels of THC, or other cannabinoids [14]. More research on the effects of CBD on stress, as well as different CBD products, is needed.

THC exerts its actions on various targets, including cannabinoid type 1 (CB1) and 2 (CB2) receptors found throughout the central nervous system and the peripheral immune system [15, 16]. CBD, in contrast, is not thought to bind strongly to CB1 receptors [17]. In the presence of THC, CBD may serve as a negative allosteric modulator of CB receptors and may counteract the agonist effects of THC [17]. CBD may, however, increase CB1 signaling by enhancing levels of endocannabinoids, which act as an agonist to CB1 [18]. Studies have demonstrated CBD activity on various other receptors including TNF-alpha, serotonin, and adenosine A2A [19]. CBD is also thought to reduce the anxiogenic and psychotropic side effects of THC by inhibiting hepatic metabolism to its psychoactive form [19]. CBD may also reduce inflammation and blood pressure [15]. In summary, CBD has diverse biological and physiological effects which may impact stress.

The present study leveraged self-reported data on stress from a quasi-experimental study on volunteers as they started on two THC-free, CBD tincture products: (1) an isolate oil and (2) a broad spectrum oil. First, we compared effects of the isolate versus broad spectrum CBD oil on self-reported effectiveness and ability to manage stress. We hypothesized that the broad spectrum product would be associated with better self-reported management of stress as compared to the isolate product. This hypothesis is based on recent data regarding the "entourage effect," which suggest that certain cannabinoids work together to amplify therapeutic effects [20]. We also compared overall perceived impression, quality, taste, and adverse effects associated with each product.

Materials and Methods

Participants

Participants who reported experiencing significant stress and wanted to try a CBD-based product for stress management were recruited via digital advertisements (e.g., newsletters, blogs, social media postings). All interested participants were invited to complete a brief eligibility survey for a marketing campaign for two products from CBDistillery™. Individuals were considered eligible if they were at least 18 years of age, resided in the USA, were willing to use both the isolate and broad spectrum CBD tinctures, and self-identified as desiring to use these products for stress management. All eligible participants were invited to complete either a 30- or 60-day CBD regimen, called the "Stress Pathfinder Mission™." The two regimens were run at different times; therefore, participation in the 30- versus 60-day regimen was determined by time of sign-up. The regimens were identical except for the duration of the regimen and the frequency in which participants were asked about their product use. The regimens were run from April 2021 to July 2021. This was a remote/decentralized campaign; thus, there were no sites or clinics. Individuals participated via a smartphone and completed an agreement prior to participation. Language regarding consent to participate in research studies is covered in the privacy policy that was linked to every survey question in Penzai. See https://releafapp.com/privacy-policy/ for more details. Participants were sent two complimentary CBD products to use over

the course of 30 or 60 days, while they answered questions about their use and experience with each product as described below. Data collection was performed by Penzai, a customizable study/survey software developed by MoreBetter, Ltd. The research team at Wayne State University received de-identified data through a Memorandum of Understanding with MoreBetter, Ltd. Therefore written informed consent was not required. The study protocol follows ethics guidelines in accordance with the World Medical Association Declaration of Helsinki and was reviewed and granted an exemption by the Wayne State University Institutional Review Board. Participants who completed the Pathfinder Mission™ received a 40% discount on their next CBDistillery™ purchase.

CBD Products

Eligible participants received two complimentary THC-free CBDistillery™ products: a 1,000 mg Isolate CBD Oil and a 1,000 mg broad spectrum CBD oil. The isolate product consisted of 3.73% total cannabinoids (total CBD: 3.73%, other cannabinoids: none detected [i.e., below the limit of quantification, 0.001%]). The broad spectrum product consisted of 4.009% total cannabinoids (total CBD: 3.884%, total CBG: 0.094%, other cannabinoids: 0.031%) as well as 0.381% total terpenes (alpha-terpinene: 0.224%, pulegone: 0.084%, (R)-(+)-limonene: 0.073%). Third-party test results (i.e., certificates of analysis) for each product are publicly available (isolate: https://www.thecbdistillery.com/product/thc-free-pure-cbd-oil-tincture-1000mg-30ml/#view-lab-results; broad spectrum: https://www.thecbdistillery.com/product/broad-spectrum-cbd-oil-tincture-1000mg-30ml-0-thc/#view-lab-results), and also provided in online supplementary information (for all online suppl. material, see https://doi.org/10.1159/000531886). The isolate product consisted of fractionated coconut oil (MCT) and CBD from hemp extract (aerial parts). The broad spectrum product consisted of fractionated coconut oil (MCT), broad spectrum CBD hemp extract (aerial parts), and natural terpenes.

The shipment of product was triggered after participants signed up and survey/study questions were sent via text messages. After receiving the product, participants were instructed to scan a QR code included in the package or to respond to a text message asking if they received their product. This receipt response triggered the survey questions. Participants were provided with the following instructions for suggested use provided by the manufacturer: "Take 1 serving (1 mL) orally. Hold under the tongue for 15–20 s prior to swallowing. Adjust dosage as needed. Individual results may vary." See online supplementary information. No other instructions were provided.

Study Design and Measures

During the first half (i.e., 15 or 30 days of the 30- or 60-day regimen, respectively) of the regimen, participants were instructed to use the isolate product at will, and then switch over to the broad spectrum product at will for the remaining of the regimen (i.e., next 15 or 30 days). Self-reported frequency and dose of use, satisfaction, stress, anger, irritation, and annoyance were collected after the broad spectrum and isolate product use periods were complete. Baseline stress was rated on a 0–10 Likert-style scale: "On a scale of 0–10, with 10 being the most extreme, how severe was your stress?". Product effectiveness and ability to manage stress were rated on 1–10 scales: "How would you rate the effectiveness of the CBDistillery™ (isolate or broad spectrum) tincture on a scale of 1–10? (with 10 being the best) and "How would you rate the CBDistillery™ (isolate or broad spectrum) tincture's ability to manage your stress? (with 10 being the best)." Participants were asked to rate their overall impression of each product on a scale from 1–5: "How would you describe your overall impression of the CBDistillery™ (isolate or broad spectrum) tincture? (1) Extremely favorable, (2) very favorable, (3) somewhat favorable, (4) neither favorable nor unfavorable, (5) unfavorable." Quality of each product was rated on a scale from 1–10: "How would you rate the quality of the CBDistillery™ (isolate or broad spectrum)? (with 10 being the best quality)." Participants were also asked whether they experienced adverse effects with each product ("Did you experience any negative side effects from the CBDistillery™ [isolate or broad spectrum] Tincture?" (1) yes (2) no), and to rate each product's taste: "How would you rate the CBDistillery (isolate or broad spectrum) tincture's taste? (with 5 being the best tasting)." Additionally, baseline demographic data were collected, including gender, age, state of residency, baseline stress, primary sources of stress. Participants were asked whether they previously used cannabis or other cannabinoids to manage stress and if they used over the counter or prescribed medications to manage stress. Participants were also asked periodically to report their use for the past 3 days and asked to report on any adverse effects manually at the end of the 30- or 60-day regimen.

Statistical Analyses

Statistical analyses were performed in SPSS version 27 (IBM Corp.). Data quality checks were done to assess missing data, distribution of variables of interest, and test for potential outliers. Missing values (NA's) were excluded from analyses. Paired samples *t* tests were used to compare ratings of effectiveness for managing stress, overall impression, quality, adverse effects, and taste at the end of the isolate product phase versus the end of the broad spectrum product phase. Results of each regimen (30- vs. 60-day) were assessed separately and considered significant at a p value of <0.05 (two-tailed). To reduce bias, we emphasize results that were consistent between the two regimens; caution is warranted when interpreting inconsistent results.

Results

A total of 6,781 individuals completed the screening process to participate in a CBDistillery™ study. Of the 540 who met eligibility criteria, 480 enrolled and were sent two complimentary CBD products and the surveys. Participants who did not complete the final surveys or who used the broad spectrum product rather the isolate product first were excluded from analyses ($n = 106$). Therefore, here, we report on a final sample of 374 participants who completed either the 30- ($n = 175$) or 60-day ($n = 199$) regimen. During the 30-day and 60-day regimens, there were 2,327 and 3,582 survey responses, respectively, reporting on

Table 1. Participant baseline characteristics for each regimen (30- and 60-day)

Variable	30-day regimen	60-day regimen	Comparison
	N = 175 (47%)	*N* = 199 (53%)	*p* value
Age in years, m (SD)			0.053
18–29	32 (18.35)	46 (23.1%)	
30–39	63 (36%)	82 (41.2%)	
40–49	43 (24.6%)	42 (21.1%)	
50–59	27 (15.4%)	20 (10.1%)	
60–69	8 (4.6%)	7 (3.5%)	
79–79	2 (1.1%)	2 (1%)	
Gender, *n* (%)			0.595
Male	35 (20)	45 (22.6)	
Female	136 (78)	146 (73.4)	
Prefer not to identify	0 (0)	1 (0.5)	
Gender fluid or other	4 (2.3)	7 (3.5)	
Baseline reported stress, m (SD)	8.51 (1.2)	8.39 (1.45)	0.347
Baseline sources of stress, *n* (%)*			<0.05
Overwhelmed by too much stress	115 (65.7)	118 (54.4)	
Lack of sleep	96 (54.9)	98 (45.2)	
Change or shifts in personal life	88 (50.3)	92 (42.4)	
Fear/uncertainty of the future state of the USA	68 (38.9)	80 (36.9)	
Emotional instability	76 (43.4)	76 (39.4)	
Physical pain	76 (43.4)	69 (31.8)	
Lack of sense of purpose	64 (36.6)	69 (31.8)	
Unhappy at work	53 (30.3)	66 (30.4)	
Unexpected financial responsibilities	49 (28)	58 (26.7)	
Traumatic event	49 (28)	55 (25.3)	
Difficulty maintaining relationships	42 (24)	42 (19.4)	
Chronic illness	44 (25.1)	40 (18.4)	
Relocating/moving	33 (18.9)	36 (16.6)	
Death of a loved one	44 (25.1)	34 (15.7)	

*Baseline sources of stress do not add up to 100% as volunteers could report >1 source of stress. Baseline stress was reported on a 0–10 Likert-style scale, with 10 corresponding to the most severe stress.

periodic use. This averages to about 1 survey response per participant every 13.29 or 18 days for 30- or 60-day regimen, respectively. Baseline demographics and reported sources of stress for the final sample are provided in Table 1, by regimen (30- vs. 60-day). Of note, the two regimens did not differ in demographic variables or baseline stress. Average reported baseline stress was high across regimens (8.51 and 8.39 out of 10 for 30- and 60-day regimens, respectively; see Table 1). Participant locations (US states) for each regimen are provided in Figure 1. At baseline, 78.3% and 50.3% of participants in the 30- and 60-day regimens, respectively, reported using other stress aids. The most commonly reported aids were other sources of CBD (19.6% and 22.1% for the 30- and 60-day regimens, respectively), antidepressants (11.7% and 12.6%), melatonin (8.9% and 7%), benzodiazapines (6.1% and 9%), anti-inflammatory medications or supplements (2.2% and 6%), and oil diffusers (2.8% and 2.5%).

Frequency and Dose

For the 30-day regimen, 52% reported using the isolate CBD product once a day, 41% twice a day, 6% three times a day, and 1% four times a day. For average CBD dosage (mg) in the 30-day regimen using the isolate product, 55% used 15–35 mg of CBD, 35% used 36–70 mg, 8% used 71–100 mg, and 2% used 100 mg or more. For the broad spectrum product, 52% reported using the broad spectrum product once per day, 41% twice a day, 6% three times a day, and 1% four times a day. For average CBD dosage (mg), 55% used between 15–35 mg of CBD, 35% used 36–70 mg, 8% used 71–100 mg, and 2% used 100 mg

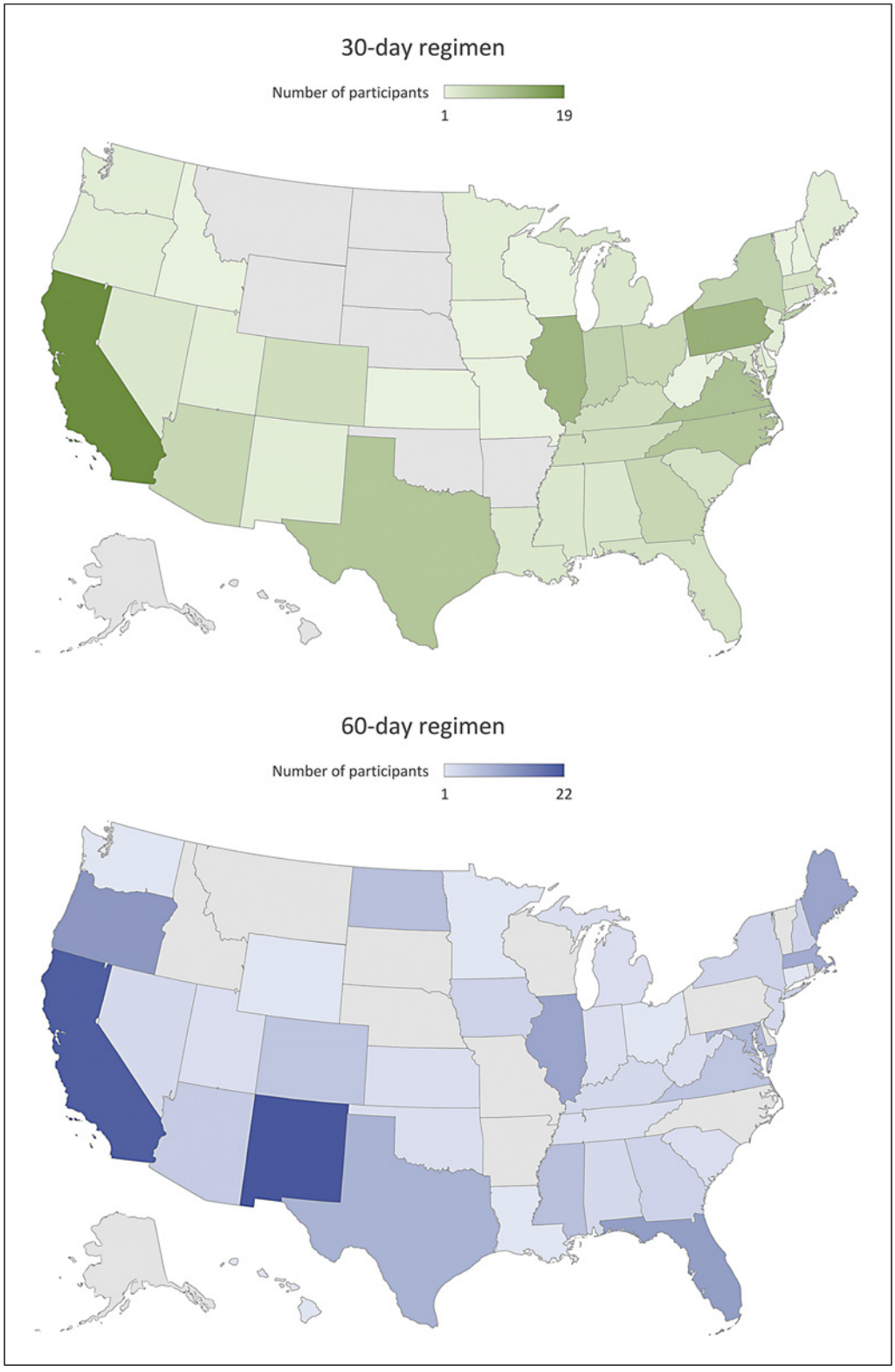

Fig. 1. Participant locations based on US state of reported residence. Top = 30-day regimen. Bottom = 60-day regimen. Images created with Bing, © GeoNames, Microsoft, TomTom.

or more. Similar rates were observed in the 60-day regimen. Sixty-five percent of participants reported using the isolate product once a day, 30% twice a day, 4% three times a day, and 1% four times a day. For average CBD dosage (mg) in the 60-day regimen using the isolate product, 60% used between 15 and 35 mg of CBD, 32% used 36–70 mg, 6% used 71–100 mg, and 2% used 100 mg or more. For the broad spectrum product, 65% participants reported using the broad spectrum product once a day, 30% twice a day, 4% three times a day, and 1% four times a day. For average CBD dosage (mg) in the 60-day regimen using the broad spectrum product, 60% used between 15–35 mg of CBD, 32% used 36–70 mg, 6% used 71–100 mg, and 2% used 100 mg or more.

Perceived Effectiveness and Ability to Manage Stress

Across the two regimens, participants reported both products to be highly effective and to be helpful for managing stress (Fig. 2, 3). However, across regimens, participants reported the broad spectrum product to be significantly more effective (30-day: M ± SD effectiveness of broad spectrum = 7.83 ± 2.023, isolate = 7.14 ± 2.181, $t(117) = 42.06$, $p < 0.001$; 60-day: M ± SD effectiveness of broad spectrum = 7.88 ± 2.065, isolate = 6.64 ± 2.896, $t(100) = 38.35$ $p < 0.001$; see Fig. 2) and better able to manage stress (30-day: M ± SD ability of broad spectrum to manage stress = 7.71 ± 1.63, isolate = 6.89 ± 2.22, $t(100) = 3.79$, $p < 0.001$; 60-day: M ± SD ability of broad spectrum to manage stress = 7.58 ± 2.43, isolate = 6.36 ± 2.76, $t(88) = 5.08$ $p < 0.001$; see Fig. 3) than the isolate product.

Overall Impression and Quality

For the 30-day regimen, participants' overall impression of the isolate product was more positive than for the broad spectrum product, $t(100) = 5.2$, $p < 0.001$. Indeed, 100% of participants reported their overall impression of the isolate product as "extremely favorable," whereas 75% of participants reported their overall impression of the broad spectrum product as "extremely favorable," 18% as "very favorable," 6% as "somewhat favorable," and 1% as "neither favorable nor unfavorable." For the 60-day regimen, however, 100% of participants rated both products as "extremely favorable." Across both regimens, there was no significant difference in reported quality between the isolate and broad spectrum products (30-day: M ± SD effectiveness of broad spectrum = 8.53 ± 1.54, isolate = 8.16 ± 2.25, $t(100) = 0.904$, $p = 0.368$; 60-day: M ± SD effectiveness of broad spectrum = 8.52 ± 1.73, isolate = 8.08 ± 2.55, $t(88) = 1.93$ $p = 0.056$).

Adverse Effects and Taste

There were no differences in adverse effect ratings for the isolate versus broad spectrum product in both the 60- and 30-day regimens ($p = 0.483$ and $p = 0.417$, respectively). The most common adverse effects reported across both regimens included lethargy ($n = 4$), nausea ($n = 2$), and increased appetite ($n = 2$). Less commonly reported adverse effects included irritability, headaches, feeling "spacey," visual disturbances, light sensitivity, cough, scratchy throat, bad dreams, upset stomach, loose stools, and tachycardia ($n = 1$ each). These qualitative reports of adverse effects were reported across both regimens ($n = 10$ and $n = 7$ reported manually entered adverse effects in the 30- and 60-day regimens, respectively) and were not attributed to a specific product.

Participants preferred the taste of the isolate product over the broad spectrum product across both regimens (30-day: $p = 0.011$; 60-day: $p = 0.007$). Indeed, for the 30-day regimen, average rating for the isolate's product taste was 3.92 out of 5 (SD = 1.2), compared to an average of 3.58 (SD = 1.25) for the broad spectrum. A minority of participants rated the products as 1, corresponding to the worst tasting (7.6% and 8.5% for the isolate and broad spectrum, respectively), and 44.1% and 31.4% rated the products as 5, corresponding with the best tasting. For the 60-day regimen, average rating for the isolate's product taste was 4.3 out of 5 (SD = 0.9), compared to an average of 4.02 (SD = 0.94) for the broad spectrum product. A minority of participants rated the products as 1, corresponding to the worst tasting (4.2% and 3% for the isolate and broad spectrum, respectively), and 50% and 36.6% rated the products as 5, corresponding with the best tasting.

Discussion

The overall purpose of this quasi-experimental study was to assess and compare the self-reported effectiveness of two THC-free CBD products – an isolate and a broad spectrum – across two independent regimens (30- and 60-day) for stress reduction. Participants reported the broad spectrum product's effectiveness and ability to reduce stress as greater than the isolate across both regimens. However, participants preferred the taste of the isolate as compared to the broad spectrum product across regimens. There were no differences in reported adverse effects or quality between the products, regardless of regimens. Participants reported a more positive overall impression of the isolate product than the broad spectrum product, but only within the 30-day regimen.

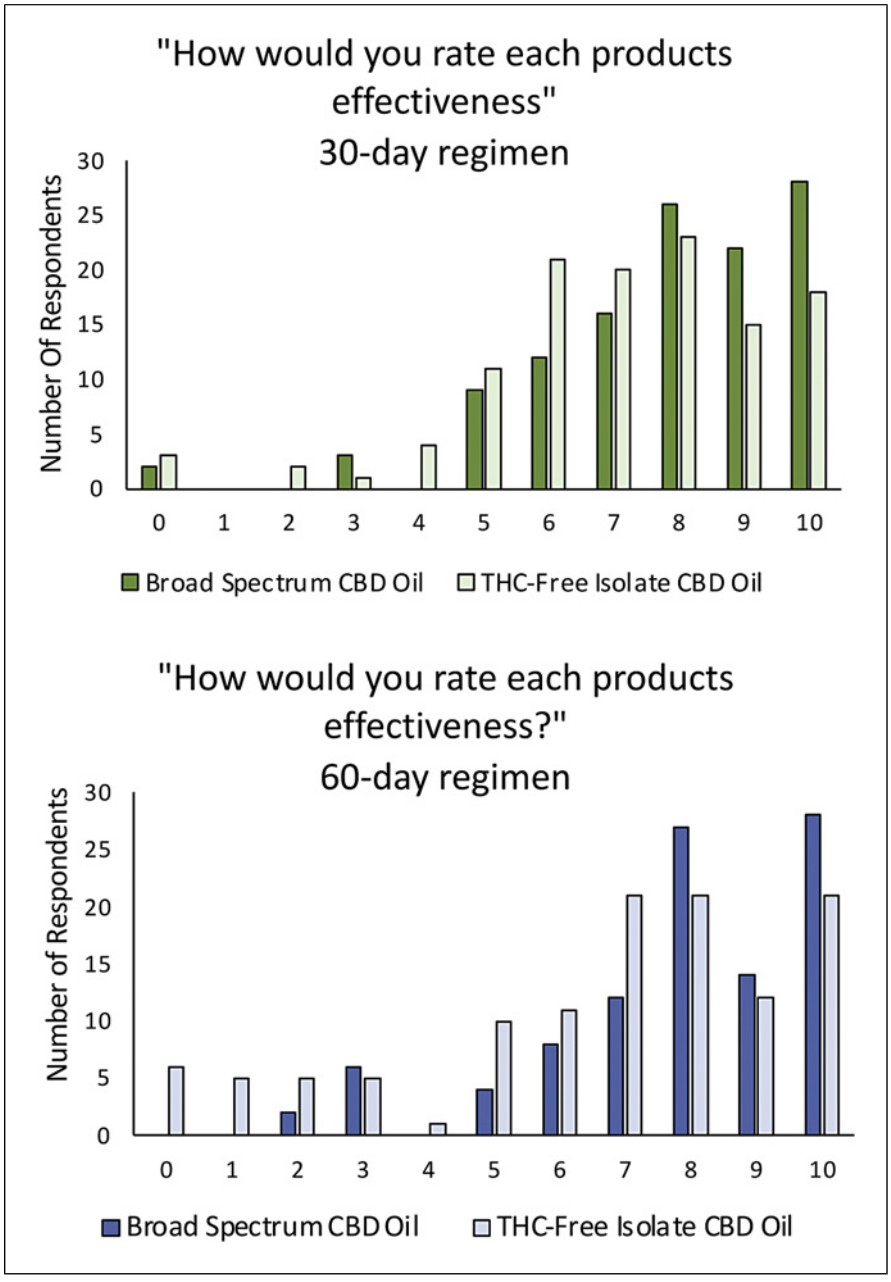

Fig. 2. Participant ratings of perceived effectiveness of the broad spectrum versus THC-free isolate products. Effectiveness ratings were significantly higher for the broad spectrum product as compared to the isolate product, across campaigns. Participants rated the products on a 1–10 Likert-style scale, where 10 is the most effective. Top = 30-day regimen. Bottom = 60-day regimen.

Overall, these data are consistent with the so-called "entourage effect," suggesting that broad spectrum products containing multiple cannabinoids and other compounds (e.g., terpenes) may be more effective than isolate products [20].

Overall, participants perceived both CBD products to be effective and helpful for stress management. This finding is consistent with previous studies, demonstrating the benefits of CBD in managing stress, anxiety, and sleep problems [21]. Further, participants reported that the broad spectrum product provided more positive effects on stress management than the isolate product. Our results support the notion that cannabinoids may have synergistic effects on therapeutic outcomes [22, 23]. Indeed, prior research in patients treated for refractory epilepsy suggests that full or broad spectrum products may be superior to isolate CBD products for managing symptoms [23]. Preclinical studies have also provided some support for the entourage effect [24], but relatively few studies have been conducted in humans. In addition,

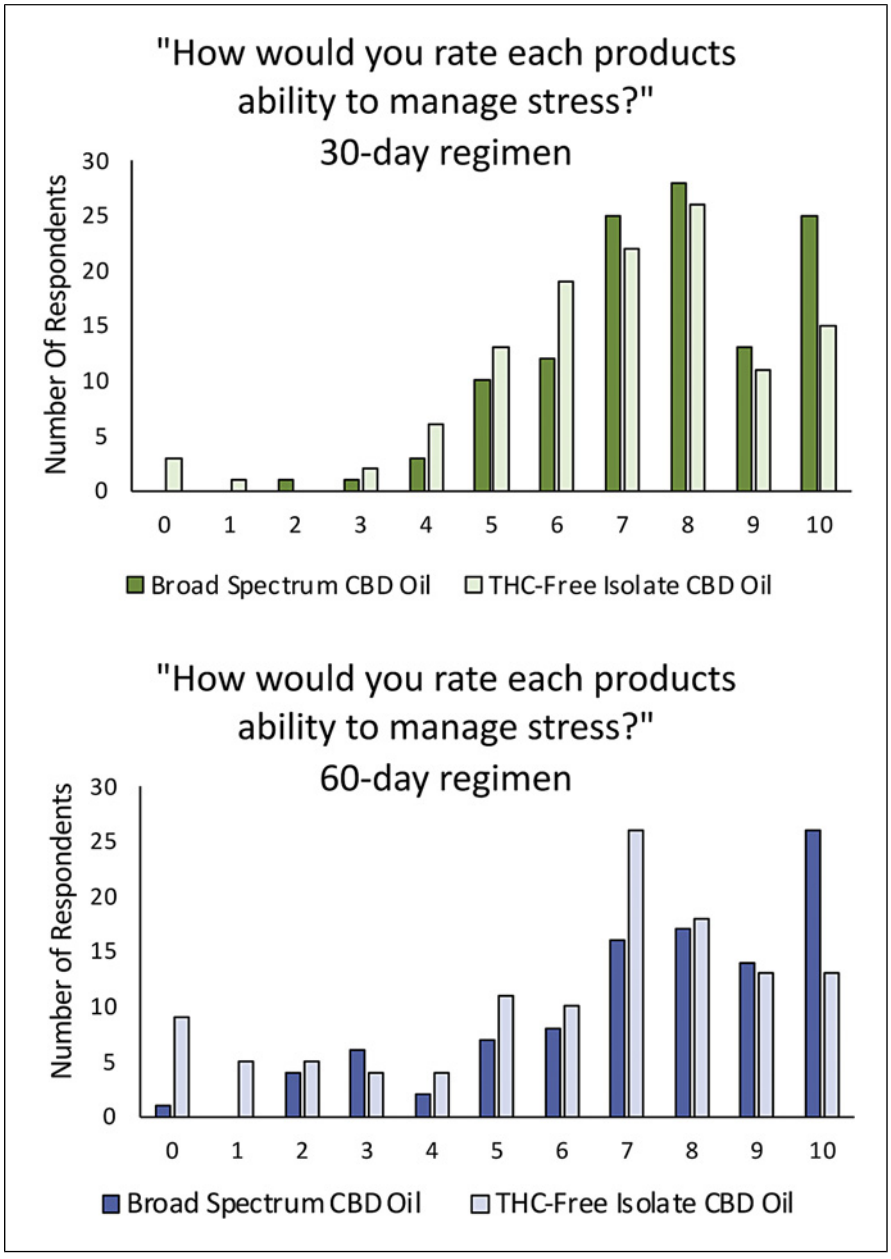

Fig. 3. Participant ratings of effectiveness of the broad spectrum versus THC-free isolate products in managing stress. Ratings were significantly higher for the broad spectrum product as compared to the isolate product, across campaigns. Participants rated the products on a 1–10 Likert-style scale, where 10 is the most effective. Top = 30-day regimen. Bottom = 60-day regimen.

other cannabinoids (e.g., THC, cannabinol, CBG) or terpenes may have significant main effects on stress reduction that could be additive, rather than interactive. Nonetheless, our results extend prior studies, suggesting that CBD may be effective for reducing stress and that cannabinoids have synergistic or additive effects. Controlled clinical studies are needed to confirm if these compounds have anti-stress properties alone or synergistically.

Although participants reported the broad spectrum product's effectiveness and ability to reduce stress as greater than the isolate, they preferred the taste of the *isolate* product across regimens. With the exception of THC extraction, broad spectrum products contain all of the compounds naturally present in the cannabis plant, such as other cannabinoids, flavonoids, and terpenes, which can contribute to the taste/aroma of the plant [25]. Therefore, it is not surprising that participants preferred the taste of the isolate product over the broad spectrum. In addition, prior studies examining CBD for the treatment of epilepsy, for example, have reported that broad spectrum products have a better safety profile (i.e., fewer adverse effects) than isolate products [23];

however, we did not find a difference in adverse effects between products here. However, the number of reported adverse effects was generally low, which could have limited the ability to detect statistically significant differences. Further, adverse effects could not be attributed to a specific product or treatment duration. Future studies are needed to examine potential adverse effects more closely.

Our results should be interpreted in the context of limitations. First, the study sample was self-selected, with participants reporting an average baseline stress level of ~8 out of 10. Therefore, responses are likely to be biased and not representative of all CBD product users. Also, both regimens started with the isolate then transitioned to the broad spectrum product, so order effects may have influenced results. Additionally, it cannot be excluded that a physiological adaptation to CBD exposure occurred over time, or that CBD effects developed from short- to long-term use, which could confound comparison between products. Future studies should incorporate blinding, a randomized controlled design, a longer treatment period, a washout period, a placebo comparator, and post-treatment follow-up assessments. Another limitation of the study was the lack of standardized self-reported measures of stress before and after the regimens. Additionally, reports of positive side effects (e.g., improved sleep, better concentration) were not collected, and participants were not asked to abstain from using other stress aids (e.g., medications, supplements) or other sources of cannabinoids or cannabis during the regimen. Future studies should also collect other demographic data, such as race, ethnicity, socioeconomic status, marital status, body mass index, and education. Nonetheless, participants were from various geographic locations across the USA (see Fig. 1) and consisted of a variety of age groups (18–79 years; see Table 1), which increases generalizability. Further, we completed two separate regimens, which allowed us to treat one as an independent replication study and importantly, our main results replicated across the independent regimens.

Conclusions

This quasi-experimental study of nearly 400 adult volunteers compared self-reported effectiveness of two THC-free CBD products – an isolate and a broad spectrum – for stress reduction. Overall, participants reported both CBD products to be effective and able to assist with stress management, and that ratings were higher for the broad spectrum as compared to the isolate product. However, participants preferred the taste of the isolate product over that of the broad spectrum. Together, these data fit with prior studies, suggesting anti-stress effects of CBD. Nonetheless, more controlled studies are needed to explore these effects in both nonclinical and clinical populations, e.g., individuals with major depressive disorder, chronic pain, and cardiovascular disease.

Statement of Ethics

This study protocol was reviewed and granted an exemption by the Wayne State University Institutional Review Board (protocol: IRB-21-04-3501). Language regarding consent to participate in research studies is covered in the privacy policy that was linked to every survey question in Penzai. See https://releafapp.com/privacy-policy/for more details.

Conflict of Interest Statement

T.D. is the COO of MoreBetter, Ltd. (dba Releaf App).

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Author Contributions

M.F.: data analysis and interpretation, drafting the article, visualization; T.D.: conception or design of the work, data collection, critical revision of the article; L.L.: data analysis and interpretation, critical revision of the article; H.M.: data analysis and interpretation, drafting the article, critical revision of the article, visualization.

Data Availability Statement

Data are not publicly available due to legal reasons. Further inquiries can be directed to the corresponding author.

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