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Derived psychoactive cannabis products and 4/20 specials: An assessment of popular brands and retail price discounts in Fort Worth, Texas, 2023

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ABSTRACT

Background: Retail sales of derived psychoactive cannabis products (DPCPs) have increased in the U.S. since passing the 2018 Farm Bill and is unregulated in most states. This study investigated the types and commonly sold brands of DPCPs as well as promotional pricing on April 20th, a day associated with cannabis use.
Methods: On April 19–20, 2023, investigators conducted telephone surveys with 98 retail stores that sold DPCPs in Fort Worth, Texas (where the market was largely unregulated).
Results: Delta-8, Delta-9, and Delta-10 THC products were widely available, with 97%, 72%, and 82% of stores selling each type, respectively. Fifteen additional DPCPs were identified, and selling blends containing multiple types of THC was common. Frequently sold brands included Cake, Medusa/Modus, Torch, Urb, Kik, Tyson, 3Chi, Casper, Hidden Hills, Esco Bars, Happi, Hometown Hero, STNR, Bomb Bars, Baked, Hi On Nature, Looper, and Space God. Overall, 45% reported having 4/20 specials discounting prices on DPCPs, smoking devices/accessories, or everything in the store. Several stores also sponsored 4/20 promotional events including free THC gummies and "live delta demos where people can test cartridges and try smoking flower in the store."
Conclusions: Findings highlight the growing complexity of the DPCP market, including numerous different intoxicating compounds and blends. Policymakers, researchers, and public health professionals should consider these complexities, as well as the commonly sold brands, when developing strategies to regulate DPCPs and protect consumer safety. Pricing policies may be an especially important form of harm reduction during events associated with heavy cannabis use, including 4/20.

1. Introduction

The 2018 Federal Agricultural Improvement Act (AKA U.S. Farm Bill) defined hemp as products containing ≤0.3% Delta-9 tetrahydrocannabinol (THC) by dry weight, because Delta-9 THC is the primary psychoactive compound in the cannabis plant (LoParco et al., 2023). The bill inadvertently created a legal loophole that led to a federally unregulated retail market of derived psychoactive cannabis products (DPCPs) (Rossheim et al., 2023). DPCPs are derived using various methods and come in a variety of forms including edibles, flower/bud, electronic cigarettes/vapes, and wax/concentrate (LoParco et al., 2023; Rossheim et al., 2023).

States have instituted a patchwork of legislation that either regulate, ban, or largely ignore the distribution and/or retail sale of DPCPs (LoParco et al., 2023). Legislative efforts to regulate these products have been slow and challenging to enforce for a host of reasons, from rapidly

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evolving technology, strong lobbying campaigns from consumers and industry advocates, state and federal policies that privilege hemp over cannabis, and persistent illicit markets (Rossheim et al., 2023). In Texas, the state Supreme Court upheld the 2019 updates to the Health and Safety Code that prohibited "*processing or manufacturing* of a consumable hemp product for smoking" (Texas Department of State Health Services, 2023; Health and Safety Code, 2023). Despite this, other modalities remain legal *to produce*, and the *distribution and retail sale* of DPCPs continues as of December 2023 (Texas Department of State Health Services, 2023).

To date, most research on DPCPs has focused on Delta-8 THC (LoParco et al., 2023), because it was the first to enter the market and was initially the most popular (Livingston et al., 2022). For example, a 2021 study conducted among a large convenience sample of adults who use cannabis found that one-in-six were currently using Delta-8 THC (Livne et al., 2022). The retail availability of DPCPs has not been well studied, though a 2021 study identified 133 retailers selling Delta-8 THC in the city of Fort Worth, Texas (Rossheim et al., 2022) which has a population of 961,885 (World Population, 2023).

This retail assessment documented numerous concerning business practices including low retail prices, disproportionately greater retail availability in areas with more socioeconomic deprivation, and retailers who would sometimes compare Delta-8 THC to non-intoxicating drugs such as CBD (Rossheim et al., 2022; LoParco et al., 2022). While the types of DPCPs appear to be rapidly expanding, there is little evidence regarding the variety of products available at retail stores (Rossheim et al., 2023). Whereas Delta-8 THC may be less potent than Delta-9 THC (Tagen et al., 2022), other new derivatives such as Delta-9-O, THC-O, and THC-P are alleged to be more potent than Delta-9 THC (High Times, 2022; Secret Nature CBD, 2023). Given that the acute and long-term health effects of using these more potent DPCPs is largely unknown, a better understanding of the retail market for DPCPs is critically important.

The U.S. cannabis industry comprised $30 billion in sales in 2022 alone (Reiman et al., 2023), underscoring the vast potential for market leaders to reap financial gain. While the Delta-9 THC industry is currently conceptualized as a small-scale, decentralized "cottage industry," the tobacco industry has been strategizing how to dominate and compete with legal cannabis sales for over 50 years (Barry et al., 2014). Delta-9 brands are likely localized because the patchwork of state laws governing the sale of Delta-9 THC limits interstate commerce (Mikos et al., 2021). However, DPCPs that are not explicitly illegal federally may have a more expansive reach. Also, market concentration facilitates industry interference with passing and implementing evidence-based policies. Thus, understanding 'key players' in the DPCP industry may provide useful insights into industry practices including marketing and lobbying, which could help in passing and enforcing future laws designed for harm reduction.

Brand-level research has been instrumental in identifying problematic alcohol and tobacco products. For example, 25 alcohol brands comprise nearly one-half of the alcohol consumed by underage youth in the U.S. (Siegel et al., 2013), and the first tobacco brand that youth smoke typically becomes their preferred brand (DiFranza et al., 1992). These brand-related insights have been crucial in crafting targeted public health campaigns and policy measures aimed at curbing use among vulnerable populations. Identifying popular DPCP brands may facilitate future brand-level consumption research that unpacks how the DPCP industry structure, profit motives, targeted marketing, consumption patterns, and public health harms intersect. These insights could help inform the development of laws, public health campaigns, and counter-advertising initiatives that reduce use and prevent youth initiation.

The formulation of these prevention and control strategies could be further enhanced by gaining insights into specific instances when retail practices might promote excessive use. For example, April 20th, colloquially known as 4/20, is an unofficial holiday associated with cannabis use. Historically 4/20 was affiliated with a counterculture movement to protest criminalization of cannabis as well as wars, corruption, and other aspects of the U.S. political system (Lopez, 2023). However, 4/20 now appears to be more of a commercialized holiday, with noted rises in cannabis flower sales and use (Meier et al., 2023; Bravo et al., 2017; Walukevich-Dienst et al., 2019; Cannabis Business Times, 2023), and a potential increase in fatal traffic crashes, though there is mixed evidence (Staples and Redelmeier, 2018; Harper and Palayew, 2019).

There is little evidence regarding the potential role of retail markets in encouraging cannabis use on 4/20. According to economic theory, an increased demand for cannabis products on 4/20 could result in stores raising prices. However, in a competitive market, businesses may temporarily sell cannabis products at lower prices, to retain and grow their customer base. Such price reductions would be expected to further increase quantity demanded. Considering that prices and price promotions are a major determinant of use and can be regulated (Amlung et al., 2019; Berg et al., 2023), research is needed to examine the retail promotional practices on 4/20, especially for DPCPs which are already sold for relatively inexpensive prices (Rossheim et al., 2022).

In this study, we aimed to document the types and brands of DPCPs and the presence of 4/20 specials in brick-and-mortar stores. Our research centered on Fort Worth, Texas because it is a large city with an existing database of DPCP retailers. Moreover, similar to most states, non-medical cannabis is not legal and there are minimal regulations on the retail sale of DPCPs in Texas (Oracle, 2023a; Texas Department of State Health Services, 2023). Thus, study findings may serve as a starting point for further research on DPCP availability and marketing in other regions, contributing to a more comprehensive understanding of the DPCP landscape across the U.S. and informing the development of evidence-based regulations and public health initiatives.

2. Material and methods

2.1. Sample

In a previous telephone assessment conducted from September 8 to October 14, 2021, among 1223 establishments with retail alcohol, tobacco, or consumable hemp licenses in Fort Worth, Texas, 133 retail stores reported selling Delta-8 THC (Rossheim et al., 2022). A second wave of this study in July 2022 identified 25 additional stores that reported selling Delta-8 THC products (LoParco et al., under review). Google search results for "smoke shop fort worth" in April 2023 identified 26 additional stores.

We attempted to contact these 184 stores on April 19th and 20th, 2023. Phone numbers were identified using Google. We called each establishment a maximum of three times. Among the 184 stores called, 127 (69%) answered the phone, and 124 provided data (67%). Among these 124, the 98 stores that reported selling DPCPs (79%) comprised the study sample. The Institutional Review Board (IRB) Office determined this project does not meet the definition of human subject research under the purview of the IRB according to federal regulations.

2.2. Measures

2.2.1. Types and brands of DPCPs

Retailers were asked "What types of THC products do you sell?" Retailers were specifically probed about whether they sold any Delta-8 THC, Delta-9 THC, and Delta-10 THC, as well as any blends. Blends are a mix of two or more intoxicating compounds, often marketed as providing a more enjoyable/balanced or extreme/intense high than using a singular THC product (Koi, 2023). Any other types of DPCPs they mentioned were also recorded. Retailers were also asked, "What are some of the most popular brands you sell?".

2.2.2. 4/20 Specials

Retailers were asked, "Do you have any 4/20 specials going on

tomorrow [asked on 4/19] /today [asked on 4/20]?" Those who responded "yes" were asked, "What's the special?" Specials were categorized into discounts on: (a) everything in the store, (b) THC products, or (c) smoking devices and accessories – often referred to by retailers as "glass" – such as water pipes/bongs, hand/small pipes, dab rigs, or nectar collectors.

2.2.3. Store types

We differentiated store types based on store names. Stores were classified as "smoke shops" if their names contained any variation of the following descriptors: smoke, vape, cloud, fumes, puff, pipe, cannabis, delta, hemp, hookah, tobacco, cigarette, or cigar. Stores were classified as convenience stores if their names did not include any smoke shop descriptors. The names of these convenience stores each included some variation of at least one of the following words: convenience, alcohol, food, mart, market, stop, or store.

2.3. Analyses

During each call, we recorded detailed notes in Microsoft Excel. Using these notes, we engaged in extensive data management processes including: (a) creating dichotomous variables for each identified brand and product type, (b) categorizing the various types of 4/20 specials, and (c) analyzing narratives related to the study's primary aims as well as for emergent themes including product descriptions, blends, and 4/20 events. This data management enabled us to use frequencies and percentages to concisely summarize the number and proportions of retailers as well as narratives to provide details and context. Bivariate tests (an independent sample t-test and chi-squared tests) were used to examine whether differences between smoke shops and convenience stores were statistically significant. Analyses were conducted using Stata SE 17.0.

3. Results

Among the 98 stores selling DPCPs, 78% were smoke shops and 22% were convenience stores. Table 1 displays the retail sales practices – including types of DPCPs, 4/20 price promotions, and popular brands – for the overall sample, as well as by store type.

3.1. Types of DPCPs

During a small number of calls, retailers did not say whether the store sold Delta-9 (n=3) or Delta-10 THC (n=4). Among those without missing data, 97% of stores reported selling Delta-8 THC (n=95), 72% reported selling Delta-9 THC (n=68), and 82% reported selling Delta-10 THC products (n=77). Compared to convenience stores, a significantly greater proportion of smoke shops sold each of these substances (see Table 1).

Beyond Delta-8, −9, and −10 THC, retailers reported selling 15 other types of intoxicating compounds including: Delta-6 THC, Delta-11 THC, 11-Hydroxy-THC, HHC, HHC-P, HXC, PHC, THC-A, THC-H, THC-JD, THC-M, THC-O, THC-P, THC-V, and THC-X. Some retailers reported "we have everything", and others explained selling "basically the whole darn alphabet".

Retailers reported vastly differing practices regarding the sale of THC-O, which the DEA stated was a controlled substance (i.e., federally illegal) on February 23, 2023 (Kight, 2023). One retailer that sold PHC, stated that "PHC is the new THC-O". Some reported not having THC-O because it was illegal. However, 18 stores reported selling THC-O. Moreover, one store reported having a standing price discount on THC-O products (buy-one-get-one 50% off) to eliminate inventory because it was no longer legal.

3.2. Descriptions of DPCPs

DPCPs were often described based on their potency and compared to each other. For example, one retailer described having "strong" 30 mg gummies that were "straight Delta-9." Next, they described having a 250 mg gummy that was a blend of Delta-8 THC, THC-P, and THC-X. Finally, they stated that they had a cookie that was "even stronger than that." Another retailer describing a specific brand stated, "take two and the next one and a half hours will be the best trip of your life". Some products were promoted as having "lots of resin" or live resin: concentrated extracted from fresh flower to enhance potency and flavor. Some retailers selling THC-JD did not know what it was. One reported it to be "an enriching agent used to boost flavor and the overall high… it's a stronger cannabinoid". Another stated that "JD is similar to THC-P but about 30% stronger". HXC was described as close to HHC, which was described as similar to THC.

3.2.1. Blends

Many stores sold blends of various DPCPs (51 smoke shops and 2 convenience stores). Smoke shops often reported having more blends than "stuff on its own", with one retailer reporting selling 50 different options of blends for vapes and hundreds of different blends for edibles. Several retailers specifically mentioned carrying Delta-11 THC (n=17) and THC-P (n=32), each often as part of a blended product. As many as 6 different types of DPCPs were said to have been blended into a single product.

Table 1
Retailer Sales Practices for Derived Psychoactive Cannabis Products (DPCPs).

	Smoke Shops N = 76	Convenience Stores N = 22	Overall Sample N = 98	Bivariate Tests
Products				
Delta-8 THC	100%	86%	97%	$X^2 = 10.7$ $p = 0.001$
Delta-9 THC	85%	27%	72%	$X^2 = 27.6$ $p < 0.001$
Delta-10 THC	92%	48%	82%	$X^2 = 21.5$ $p < 0.001$
Promotions				
4/20 Specials	58%	0%	45%	$X^2 = 23.1$ $p < 0.001$
Brands				
Average # of Brands Reported as Popular (SE)	4.0 (0.3)	1.5 (0.2)	3.5 (0.2)	$t = 4.6$ $p < 0.001$
Popular Brands (Frequencies)	Medusa/Modus (35) Torch (22) Urb (22) Cake (19) Kik (18)	Cake (17) Kik (2) Tyson (2)	Cake (36) Medusa/Modus (35) Torch (22) Urb (22) Kik (20)	

3.3. Popular Brands

The most popular brands were: Cake (n=36), Medusa/Modus (n=35), Torch (n=22), Urb (n=22), Kik (n=20), "Tyson" (i.e., Mike Bites; n=9), 3Chi (n=8), Casper (n=8), Hidden Hills (n=7), Esco Bars (n=6), Happi (n=6), Hometown Hero (n=6), STNR (n=6), Bomb Bars (n=5), Baked (n=4), Hi On Nature (n=4), Looper (n=4), and Space God (n=4). The number of brands stores listed ranged from 0 to 12 (median=3). There were significantly more popular brands listed by smoke shop retailers than at convenience stores (Table 1). Convenience stores tended to have fewer brand options, with 27% only selling Cake brand Delta-8 or Delta-10 THC vapes and no other THC products. Some brands were purportedly popular because of the variety of available flavors or that, "unlike other brands, the flavors actually taste like the ones listed on the box".

3.4. 4/20 specials

None of the 22 convenience stores that sold DPCPs had 4/20 sales promotions, whereas 58% of smoke shops did. An additional 11 stores (11%) reported currently having sales promotions on THC products not affiliated with 4/20 or that they would offer "good discounts" on their listed prices. Among the 44 smoke shops with 4/20 specials, 2 did not provide details about the special.

The most common 4/20 specials included sales on DPCPs (69%), glass (43%), and everything in the store (26%). Most specials were a fixed percent off, ranging from 10% to 30% off everything in the store, and up to 50% off DPCPs and 75% off glass. Other specials were a fixed amount off (i.e., from $5 to $10 off), buy-two-get-one free, buy-one-get-one (BOGO) free, or BOGO half-off. Seven stores offered giveaways, most often for smoking devices/accessories.

Some stores also sponsored promotional events for 4/20. In addition to offering 20% off THC products, a "poke and smoke" shop offered $40 tattoo outlines on 4/20, with numerous tattoo designs related to 4/20 and cannabis. Another retail store held an event that included food trucks and a DJ. Finally, one store offered free THC gummies and "live delta demos where people can test cartridges and try smoking flower in the store," to experiment with large pipes before purchasing them.

4. Discussion

This study was the first to describe the types and popular brands of DPCPs, as well as the prevalence of 4/20 price specials (Rossheim et al., 2022; Meier et al., 2023; Berg et al., 2023). Our findings reveal an extensive range of products and promotional events, highlighting the diversity of the DPCP market and the complexity of the current regulatory landscape. Nearly one-half of the stores included in the study reported having 4/20 sales promotions, including price discounts and giveaways. Whereas 4/20 is traditionally a holiday associated with smoking cannabis flower (Cannabis Business Times, 2023), study findings related to 4/20 promotional events suggest a growing interest in the consumer experience surrounding DPCPs and the normalization of its use. Given the high prevalence of price discounts that likely promote heavier consumption, our findings suggest the need for pricing policies such as taxes, minimum unit pricing, and restrictions on price promotions.

The normalization of cannabis sales may also explain why some retailers willingly reported selling products that may be federally illegal. Some stores reported selling Delta-9 flower and vapes/carts. It is possible that these retailers meant Delta-9-O THC, or that it was included in blends where the amount of Delta-9 THC was below the legal threshold. However, it is also possible that these stores were selling illegal Delta-9 THC products due to the perceived low likelihood of being detected or penalized for non-compliance. The U.S. Food and Drug Administration (FDA) has issued several warnings to companies that have been selling CBD and Delta-8 THC products illegally, with violations including marketing unapproved new drugs, misbranding, and adding Delta-8 THC to food products (FDA, 2022). Given the widespread availability of legally questionable products and serious adverse events reported by some users (Leas et al., 2023), even states without legalized cannabis sales need some regulatory infrastructure to ensure compliance with state and federal laws.

Similarly, 18 stores reported selling THC-O, despite it being a Schedule I drug and the DEA advising stores to remove it from shelves in February 2023 (Kight, 2023). Findings from the current study suggest that the DEA letter may have had little impact on the retail availability of these products in the following months. The DEA took similar actions against Delta-8 THC in 2021 (U.S. Drug Enforcement Agency, 2023), though it remains in the retail market. One reason why both products likely remain in the retail marketplace is because the recategorization of these products was not accompanied by funds to support compliance monitoring. However, the merit of THC-O's legal status may differ from Delta-8 THC, because it does not naturally exist in cannabis plants (Kight, 2023). The rapidly expanding array of DPCPs underscores the ongoing challenge of regulating these products and ensuring consumer safety. New compounds are created as replacements faster than problematic substances can be banned. Thus, policies should be broad enough to encompass substances that are similar in chemical composition or effect, while being specific enough to be upheld in the courts.

Blends containing multiple types of intoxicating compounds were common, further complicating the regulatory landscape. The popularity of blends suggests a demand for products with diverse and potentially enhanced effects. These blends may pose additional risks to consumers due to unknown interactions between various intoxicating compounds. The rapid rate of discovery and utilization of new cannabinoid compounds occurs at a pace that makes it difficult to assess potential side effects or contraindications. Although cannabis plants naturally contain most of the THC compounds used in blends, the concentration of these compounds is substantially higher in DPCPs than in the plants themselves (LoParco et al., 2023; Rossheim et al., 2023). Further, some of the intoxicating compounds included in blends are often marketed as being much more potent than Delta-9 THC (e.g., THC-O, Delta-11 THC, THC-H, THC-P, HHC-P, THC-JD), whereas others are marketed as less potent (e.g., Delta-8 THC, Delta-10 THC, HHC) (CBD Mall, 2023; High Times, 2023; Oracle, 2023b). Thus, it is largely unclear how use of these DPCPs impacts consumer health.

Popular brands identified in this study may provide insights into the current trends and preferences among consumers. This area of research is critically important for informing targeted public health interventions given the strong relationship between brand-level marketing and brand-specific use of substances among youth (Roberts et al., 2016). DPCP brands could encompass producers/farmers, companies, or strains of flower (Trangenstein et al., 2021). However, most of the reported DPCP brands were for vape companies such as Cake, Torch, and Medusa/-Modus (Modus, 2023) or edibles such as Tyson and 3chi. The popularity of "Cake" brand products is not surprising given that the company boasted $60 million in revenue during a 9-month period, but it may be concerning due to the counterfeit products in the market, which have been the source of litigation (U.S. Court of Appeals, 2022). Major companies and their most popular brands often set industry standards that have significant impacts on consumer behavior. Thus, the identification of prominent DPCP industry players is pivotal for informing regulatory measures aimed at reducing the impact of their marketing strategies on young people. Hence, there is a pressing need for more in-depth research focused on prominent brands. The current study's findings shed light on some popular DPCP brands, along with a diverse range of intoxicating compounds they offer. This information can help guide future research, enabling a more targeted approach in surveys and retail surveillance studies.

Convenience stores carried fewer DPCPs than smoke shops, often only Cake brand vapes, presumably due to more limited shelf space allocated to these products. Moreover, 4/20 price promotions were not

offered at convenience stores in our sample, only smoke shops. These observations suggest the promotional strategies used to sell DPCP's may differ by store type. While most smoke shops restrict their customer base to those 21 and older, anyone may enter convenience stores. These findings highlight the need to further investigate the intersection of retailer types, product types, promotional strategies, and customer bases.

More research is needed to better understand how DPCPs contribute to legal confusion, normative perceptions, and adverse health outcomes. Future studies should prioritize understanding the patterns and preferences in DPCP use, including the impact of promotional events, with a focus on youth and young adults. Policymakers should use these insights to formulate targeted regulations and public health campaigns aimed at reducing the appeal and accessibility of these products to younger populations. When designing future studies and policy interventions, it is crucial to incorporate the lessons learned from the regulation of e-cigarettes, especially regarding marketing practices aimed at young people. For example, restricting flavors, limiting youth-oriented marketing, and implementing pricing policies and age verification are crucial for reducing their appeal to and access by minors (King, 2022; Saloner et al., 2015). However, challenges persist due to the rapid emergence of new brands and products that circumvent existing regulations (Rossheim et al., 2023). Continuous monitoring and adaptation of regulations are necessary to address these ongoing changes.

4.1. Limitations

This study has several limitations. First, the sample is limited to stores in Fort Worth, Texas, which may not be representative of the broader market. However, Texas has a DPCP policy environment similar to several other states (Oracle, 2023). Second, information was reported by retailers via telephone, not observed in stores. The use of phone calls allowed for rapid data collection among numerous locations during a critical time (April 20th), but it was not possible to capture an exhaustive list of all DPCPs. While it is unclear whether some reported sales practices were illegal, previous telephone assessments among vape shops support retailers' honesty about legally questionable retail activities (Berg et al., 2021).

5. Conclusions

This study provides valuable insights into the types and brands of DPCPs available, as well as the prevalence of 4/20 promotions. Findings highlight the complexities of regulating the cannabis market and underscore the need for comprehensive research to better understand the potential risks associated with various products, including blends. Policymakers and public health professionals should consider these complexities when developing regulatory strategies that protect consumer safety. Future studies assessing prevalence of use and associated harms should consider focusing on commonly sold brands. Study findings also suggest that pricing policies, including taxes, minimum unit pricing, and prohibiting price discounts/promotions and giveaways may be especially important forms of harm reduction for events associated with heavy cannabis use, including 4/20 (Meier et al., 2023; Bravo et al., 2017; Walukevich-Dienst et al., 2019; Cannabis Business Times, 2023; Guindon et al., 2022).

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Declaration of Competing Interest

The authors report no declaration of interest.

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Contributors

All authors contributed to conceptualizing the study, interpreting the results, and reviewing and editing manuscript drafts. Matthew E Rossheim conducted data collection, management, and statistical analyses, and drafted the manuscript. All authors read and approved the final manuscript.

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