Social Media Discourse on Cannabis: Global Influence of Legalization

Consuelo Toledo, Carolina Donat-Vargas, María Montero-Torres, Francisco J Lara-Abelenda, Fernando Mora, Melchor Alvarez-Mon, Javier Quintero, Miguel Ángel Álvarez-Mon

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Abstract

Background: Cannabis is the third most consumed drug worldwide, with its use linked to a high number of substance use disorders, particularly among young men. Associated mortality causes include traffic accidents and cardiovascular diseases. The global expansion of cannabis legalization has sparked debates about its impact on risk perception, which has decreased in countries with permissive laws. Social media analysis, such as on X, is a useful tool for studying these perceptions and how they vary by geographic region.

Objective: This study aims to analyze Twitter users' perceptions of cannabis use and legalization, taking into account the geographic location of the tweets.

Methods: A mixed-methods approach was used to analyze cannabis-related tweets on Twitter, using keywords such as "cannabis," "marijuana," "hachís," and "hashish." Tweets were collected from January 1, 2018, to April 30, 2022, in English and Spanish, and included those with at least 10 retweets. The content analysis involved an inductive-deductive approach, resulting in the classification of tweets into thematic categories, including discussions on legalization.

Results: The tweet analysis showed that in America, Europe, and Asia, political discussions about cannabis were the most common topic, while personal testimonies dominated in Oceania and Africa. In all continents, personal experiences with cannabis use were mostly positive, with Oceania recording the highest percentage (60.93%). Regarding legalization, Oceania also led with the highest percentage of tweets in favor (68.13%), followed by America and Africa, while support in Europe and Asia was slightly lower, with about half of the tweets in favor.

Conclusions: The analysis of tweets shows that America leads cannabis discussions, with political debates predominating in America, Europe, and Asia, and personal testimonies in Oceania and Africa. In all regions, positive experiences with cannabis outweigh negative ones, especially in Oceania. Legalization decreases risk perception and increases use, as seen in America. Europe reflects a divided debate on legalization. The need to accompany legalization with awareness campaigns on the risks of cannabis is highlighted.

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"Social Media Discourse on Cannabis: Global Influence of Legalization "

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ABSTRACT

Background: Cannabis is the third most consumed drug worldwide, with its use linked to a high number of substance use disorders, particularly among young men. Associated mortality causes include traffic accidents and cardiovascular diseases. The global expansion of cannabis legalization has sparked debates about its impact on risk perception, which has decreased in countries with permissive laws. Social media analysis, such as on X, is a useful tool for studying these perceptions and how they vary by geographic region.

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Results: The tweet analysis showed that in America, Europe, and Asia, political discussions about cannabis were the most common topic, while personal testimonies dominated in Oceania and Africa. In all continents, personal experiences with cannabis use were mostly positive, with Oceania recording the highest percentage (60.93%). Regarding legalization, Oceania also led with the highest percentage of tweets in favor (68.13%), followed by America and Africa, while support in Europe and Asia was slightly lower, with about half of the tweets in favor.

Discussion/Conclusions: The analysis of tweets shows that America leads cannabis discussions, with political debates predominating in America, Europe, and Asia, and personal testimonies in Oceania and Africa. In all regions, positive experiences with cannabis outweigh negative ones, especially in Oceania. Legalization decreases risk perception and increases use, as seen in America. Europe reflects a divided debate on legalization. The need to accompany legalization with awareness campaigns on the risks of cannabis is highlighted.

Keywords: Cannabis, Twitter, social perception, infodemiology, drug use/abuse, geolocalization

INTRODUCTION

Cannabis is the third most consumed drug worldwide, only behind alcohol and tobacco. It is estimated that 219 million people used cannabis in 2021, which corresponds to 4% of the global population. In 2021, approximately 46% of countries reported that cannabis was the drug linked to the highest number of substance use disorders (1).

It is estimated that 22.1 million people worldwide had a cannabis use disorder (2), which is more common in men than in women. A study conducted in Australia, Europe, and the United States revealed that the average age at which cannabis use disorder manifests is 22 years (3). The most frequent causes of mortality associated with cannabis use are traffic accidents, suicide, and cardiovascular and pulmonary diseases. (4,5) A study conducted in New Zealand concluded that the risks of driving under the influence of cannabis could be greater than the risks of driving under the influence of alcohol (6).

The increasing global legalization of cannabis is generating significant political and social debate. It is necessary to study the impact of legislative changes on the public's perception of risk. Studies have shown that in countries where cannabis use has been legalized, the perception of risk has decreased (7). According to the ESTUDES survey conducted in Spain in 2023, 12.9% of respondents stated that the legalization of cannabis would encourage them to try it (8).

In this context, analyzing social media posts is a useful tool for understanding public opinion, which can help to identify factors that influence cannabis use. Social media platforms are increasingly being used by researchers to monitor public health (9), as they capture more sincere and spontaneous opinions than conventional opinion studies conducted in hospital settings (10,11). A systematic review that analyzed the advantages and disadvantages of using Twitter (now called X) in public health research concluded that it is a valuable tool for identifying social concerns and information needs on a given topic. (12,13). Previous studies have demonstrated the effectiveness of content analysis as a public health tool for analyzing and studying issues related to drugs (14–17).

In this study, we aim to understand how attitudes toward cannabis and its legalization vary by geographic region through the analysis of posts made on X. Our hypothesis is that in countries with more permissive cannabis use and purchase laws, the perception of risk decreases.

METHODS

1. Search Strategy and Data Collection on Twitter.

This mixed-method analysis, both quantitative and qualitative, focused on the content of tweets related to cannabis posted on the social network Twitter. We collected all tweets using the following keywords: cannabis, marijuana, marijuana, hashish, hashis. We included those tweets that met the

following inclusion criteria: (1) Public tweets; (2) Tweets containing any of the aforementioned keywords in the text; (3) Published between January 1, 2018, and April 30, 2022; (4) Written in English or Spanish; (5) Having received at least 10 retweets. The inclusion criteria were selected to capture a broad and representative social media discussion on the topic.

The tool we used to collect the tweets is Tweet Binder, which has been widely used in previous research and can access 100% of public tweets. In addition to the tweet text, this tool provides the number of retweets and likes for each tweet, as well as the date they were published, a link to the tweet in its context, the user description, and geolocation. The number of retweets and likes each tweet received is an indicator of the interest generated by the corresponding content among users.

2. Content Analysis Process

Using the previously mentioned search criteria, we collected 69,033 tweets in Spanish and 181,217 tweets in English. Next, the remaining tweets were analyzed using a mixed inductive-deductive approach to develop a codebook to classify the tweets based on key thematic categories. A small subset of tweets (n = 300) was manually classified by two members of the research team. After discussing discrepancies and adjusting the codebook by consensus, 2,000 more tweets were analyzed. Finally, an automated and computerized classification of the remaining larger subset of tweets (n = 250,250) was performed.

Tweets were classified as classifiable or non-classifiable. A tweet was considered non-classifiable when its content was unrelated to the objectives of the present work, if the content was insufficient to contain relevant information, or if it was written in a way that made its meaning uncertain. For each classifiable tweet, the content was analyzed according to the following topics: 1) Tweet theme; 2) Personal experience with the drug; 3) Legalization. The classification criteria and examples of tweets are shown in Table 1.

Table 1. Category, definitions and examples of classification. Usernames and personal names were removed.

Category	Examples
Topic • Political discussion *(Refers to both police/social/political complaint/ claim (for or against))* • General information *(Refers to when talking about more scientific issues).* • Sale / advertising *(Cannabis is advertised).* • Testimonials *(Regarding consumption, experience, more from the opinion of drug users or families/friends).*	• On July 1 2021 the New Jersey Supreme Court announced procedures for automatic vacation dismissal and expungement of certain marijuana- and hashish-related cases. • "Podemos" (communism) is always against progress and freedoms and against health. It calls for the legalization of cannabis, which destroys neurons and willpower. It causes memory and learning problems, dependency, anxiety, depression, lung diseases, cancer, arrhythmia, and psychosis... • The Assad regime has transformed into one of the world's leading narcotics enterprises. Hashish is

• Trivialization. *(Minimization of the consequences of consumption, stigmatization, humorous tweets)*	among its major drug exports but the most lucrative is captagon a mild stimulant pill consumed recreationally throughout the Middle East • Second-Hand Smoke Has Never Been Funnier'-Reporter: "Burning behind me is 8 1/2 tons of heroin opium hashish & other narcotics… (uncontrollable giggling)"-This is what happens when you stand too close to a pile of burning drugs. It's like taking a toke from a HUGE joint. • This Lebanese town's residents rely on hashish to survive. The problem? It is all illegal
Personal experience with cannabis. *(Personal experience with cannabis, whether through acquaintances, friends, family members, or personal use, or related to social events associated with its consumption.)*	• The professor MUST 1st have to answer:WHAT KIND OF ENVIRONMENT PRODUCES VIOLENT YOUTHS AND FANATICALHASHISH SMOKING TERRORISTSlacking enterprise and ingenuity for growth?It takes a special breed of people to persevere with leeches...I commend all Biafransincluding Igbos.
Legalization • No mention (or agains) • In favor of legalization	• Finally Morocco legalises it most famous export. They've been growing marijuana in the mountains for centuries and Moroccan hashish is cherished in Europe. This week parliament is debating a cannabis legalisation bill for "medicinal use" (☺)

3. Ethical Considerations

This study was conducted in accordance with the ethical research principles outlined in the Declaration of Helsinki (seventh revision, 2013) and received approval from the Ethics Committee of the University of Alcalá (CEID/2023/6/118). Additionally, it did not directly involve human subjects or include any interventions. Only publicly available tweets were used (subject to universal access via the Internet in accordance with the Terms of Service that all users agree to on Twitter). In any case, we have taken care not to disclose any usernames directly in this work and have avoided citing information that could identify specific individuals.

4. Machine-learning classifier

The methodology followed in this project has been validated in prior research studies (18,19). First, a preprocessing of the Database should be executed. This preprocessing involves a translation of the non-English tweets to English using Google Translator and a normalization of the tweets by removing special characters, splitting negative contractions, and removing repetitions. Then, we employ a pre-trained network called BERTWEET, trained on 850 million English tweets (20), to classify cannabis-related tweets. Since BERTWEET was not initially designed for the specific classification categories, fine-tuning was performed. Manually classified tweets were randomly

divided into an 80% training subset and a 20% testing subset. The training subset was used to fine-tune the network, while the testing subset was used to validate its performance. Additionally, to address some imbalanced categories (where certain options had a higher number of tweets compared to others), text augmentation was performed using the library called textattack (21).

5. Statistical analysis

The results were presented in tables or figures, showing the percentage of tweets in each category. To compare the proportions of tweets between categories, Pearson's chi-square test was utilized, yielding a p-value indicating statistical significance.

Choropleth maps were generated as a visualization tool to depict the global distribution of tweets. Additionally, these maps were used to illustrate the geographic distribution of tweets expressing support for the legislation and exhibiting a sentiment favorable to cannabis.

The statistical analyses were performed using the software packages STATA v16 (StataCorp) and MS Excel.

RESULTS

Out of the total number of classifiable tweets (206,526), 68.81% (142,139/206,526) had geolocation data. The continent with the highest number of tweets is America, accounting for 54.23% (112,004/142,139) of the total, followed by Europe with 9.21% (19,024/142,139), Asia with 2.39% (4,946/142,139), Africa with 1.68% (3,470/142,139), and Oceania with 1.3% (2,696/142,139).

Regarding the distribution of tweets by theme, in America, Europe, and Asia, the most common theme is political discussion, while in Oceania and Africa, the most frequent theme is personal testimonies (Figure 1).
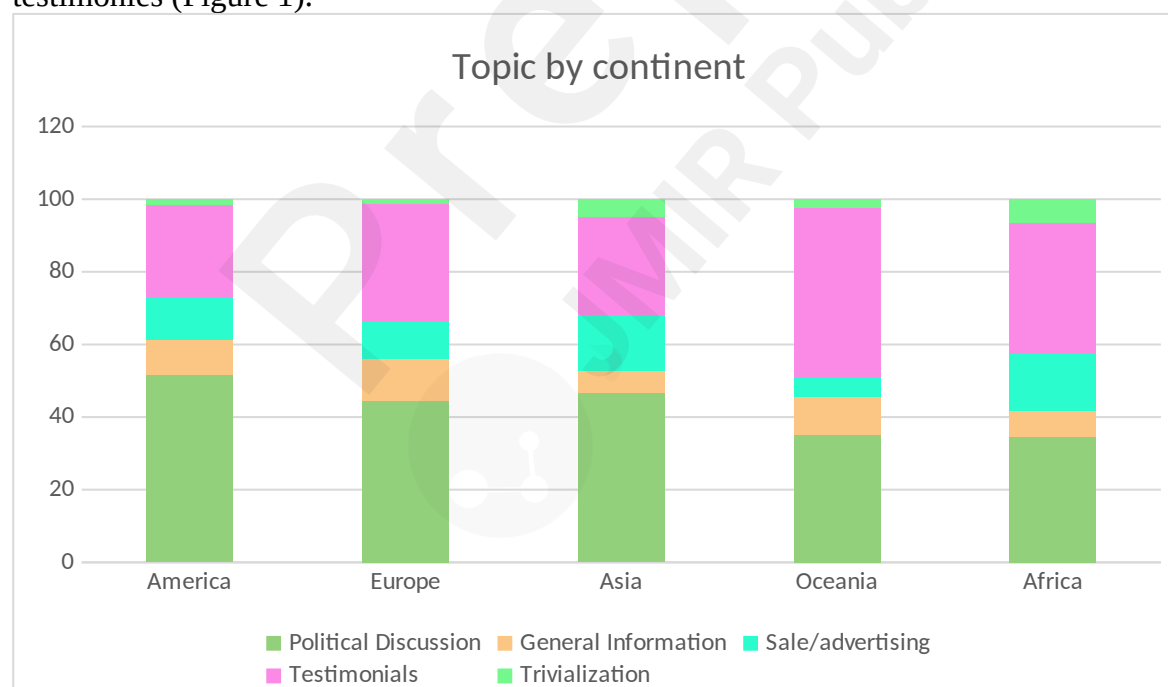

Figure 1: Thematic distribution by continent.

Regarding personal experiences related to cannabis consumption, on all continents, there are more tweets describing positive experiences than negative ones, with Oceania having the highest percentage of such tweets. Specifically, in Oceania, we found that 60.93% of the posts described a

positive experience, while only 9.09% described a negative experience (with 29.98% of posts not expressing any opinion on the matter). In Africa, 50.63% of posts described a positive experience and 10.81% a negative one; in Europe, 40.49% described a positive experience and 10.19% a negative one; in America, 40.03% described a positive experience and 8.16% a negative one; and in Asia, 34.07% described a positive experience and 11.89% a negative one (Figure 2).

Figure 2: Personal experience with cannabis by continent.

Lastly, regarding cannabis legalization, Oceania has the highest percentage of tweets in favor legalization, with more than double the number of tweets supporting legalization (68.13%) compared to those against it (31.87%). In America and Africa, the percentage of tweets in favor is also higher than those expressing opposition to legalization, with 59.21% and 53.54% of tweets in favor, respectively. In Europe and Asia, the proportion of tweets supporting legalization is slightly lower, with 48.26% in Europe and 47.21% in Asia (Figure 3).

Figure 3: Percentage of tweets in favor of legalization. In darker blue are the countries where the most tweets in favor of cannabis legalization have been found, and as the blue gets lighter, the number of tweets decreases. In grey are the countries where there are no tweets in this category.

DISCUSSION

In this analysis conducted on platform X, 68.81% of the posts were geolocated. The study reveals that America is the continent with the most tweets about cannabis (54.23%), followed by Europe

(9.21%) and Asia (2.39%). Political discussion is the most common topic in America, Europe, and Asia, while personal testimonials dominate in Oceania and Africa. Across all continents, tweets about positive experiences with cannabis outnumber negative ones, with Oceania showing the highest percentage of positive experiences (60.93%). Oceania also leads in support for cannabis legalization (68.13%), followed by America (59.21%) and Africa (53.54%).

Currently, over 40 countries have enacted laws allowing cannabis use for medicinal or recreational purposes, with significant legislative variability among them. Some countries permit both recreational and medicinal use, others allow only medicinal use, some have decriminalized possession and use for profit, while others maintain it as illegal (22). The global debate on cannabis legalization is a multifaceted issue involving social, economic, medical, and legal aspects. Proponents of legalization argue that it allows for market regulation, which can lead to a reduction in criminal activity and associated costs, as well as positive economic impacts (23). Arguments against cannabis legalization include its potential negative impact on public health (24), effects on the brain development of young people (25) and the potential increase in cases of driving under the influence of cannabis (26). A study conducted in the U.S. to evaluate the impact of legalization found that it led to decreased prices and increased availability, which may have contributed to higher cannabis consumption among adults. Additionally, there was an observed increase in emergency room visits and hospitalizations related to cannabis use (27). A systematic review indicated that recreational legalization might be associated with an increase in traffic fatalities (28). Furthermore, states in the U.S. where recreational cannabis use was legalized saw rises in self-harm and assault rates (29).

Among the five continents, America has the highest number of countries with both recreational and medicinal cannabis legalization, with a longer historical background, particularly in countries like the United States and Canada. This is reflected in the high volume of tweets and the prevalence of political discussions, as these countries have been at the center of debates on legalization. The greater experience and acceptance of cannabis use in these countries may explain the high proportion of tweets with positive experiences. Regarding the perception of risk related to health and cannabis consumption, legalization has been found to not only increase consumption rates but also reduce the perception of harm and decrease treatment rates for cannabis use disorders (24). A study conducted in the U.S. found that in states where medicinal use is legalized, there is a higher prevalence of daily use and cannabis use disorders (30).

Europe shows a greater inclination towards political discussion, reflecting the complexities and variations in legalization among its countries. The near parity in tweets both in favor of and against legalization in Europe suggests an active and diverse debate environment, with divided and evolving opinions. Indeed, during the time period covered by this study, no country had legalized recreational use, although countries like the Netherlands and Portugal had decriminalized it and approved medicinal use. Additionally, this debate aligns with the three proposed laws to legalize recreational cannabis use in Spain in 2021 (31).

Finally, the low awareness of risk found is concerning. Legalization may be influencing this perception. It seems necessary that debates about legalization and cannabis regulation are accompanied by public awareness campaigns with accurate information. The legalization of cannabis is a complex issue that involves not only medical aspects but also the need to convey to the public that its legalization does not make it less harmful. The effects of cannabis on health vary based on multiple factors such as the amount consumed, frequency of use, potency of the substance, and age, with younger individuals being the most susceptible (25). Frequent cannabis use is associated with substance use disorders, such as those involving alcohol, tobacco, or cocaine (32), and poses a higher risk of developing depression (33), and suicidal behaviors (34,35). A meta-analysis published in JAMA Psychiatry demonstrates that cannabis use during adolescence is associated with an increased risk of developing depression in adulthood and a higher risk of suicides (36,37). Lastly, cannabis use, especially in high doses or among individuals with a genetic predisposition, can increase the risk of developing psychotic disorders, such as schizophrenia (38). Other substances, like tobacco, while

legal and socially accepted, are objectively harmful to health.

LIMITATIONS

This study has several limitations. Firstly, the social, economic, and demographic characteristics of Twitter users do not accurately reflect the broader population. Users of this social network tend to be younger adults with higher education levels, and it is more popular in North America, Europe, and Asia. Secondly, the design of the coding book and the analysis of tweets involve some subjectivity, which is common in qualitative studies. However, this methodology is consistent with previous medical research studies. Thirdly, certain colloquial terms for cannabis, such as "dope" or "maría," had to be excluded as keywords due to their multiple meanings, potentially resulting in lost sample data and information on the topic. Finally, the limitation of using tweets published only in English or Spanish may explain why continents like Africa or Asia are underrepresented. Future work should consider including more widely spoken languages in these continents.

CONCLUSIONS

Perceptions and discussions about cannabis consumption and its legalization vary significantly by region, influenced by the timing and scope of legalization policies. Europe and Africa, although at different stages of legalization, reflect active political debates and increasing support for legalization. America, with the U.S. and Canada leading, tops in both medicinal and recreational legalization, as reflected in a high volume of tweets and shared experiences. The risk perception in these countries suggests that legalization reduces treatment rates for substance use disorders, though it increases daily consumption prevalence.

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CONFLICTS OF INTEREST

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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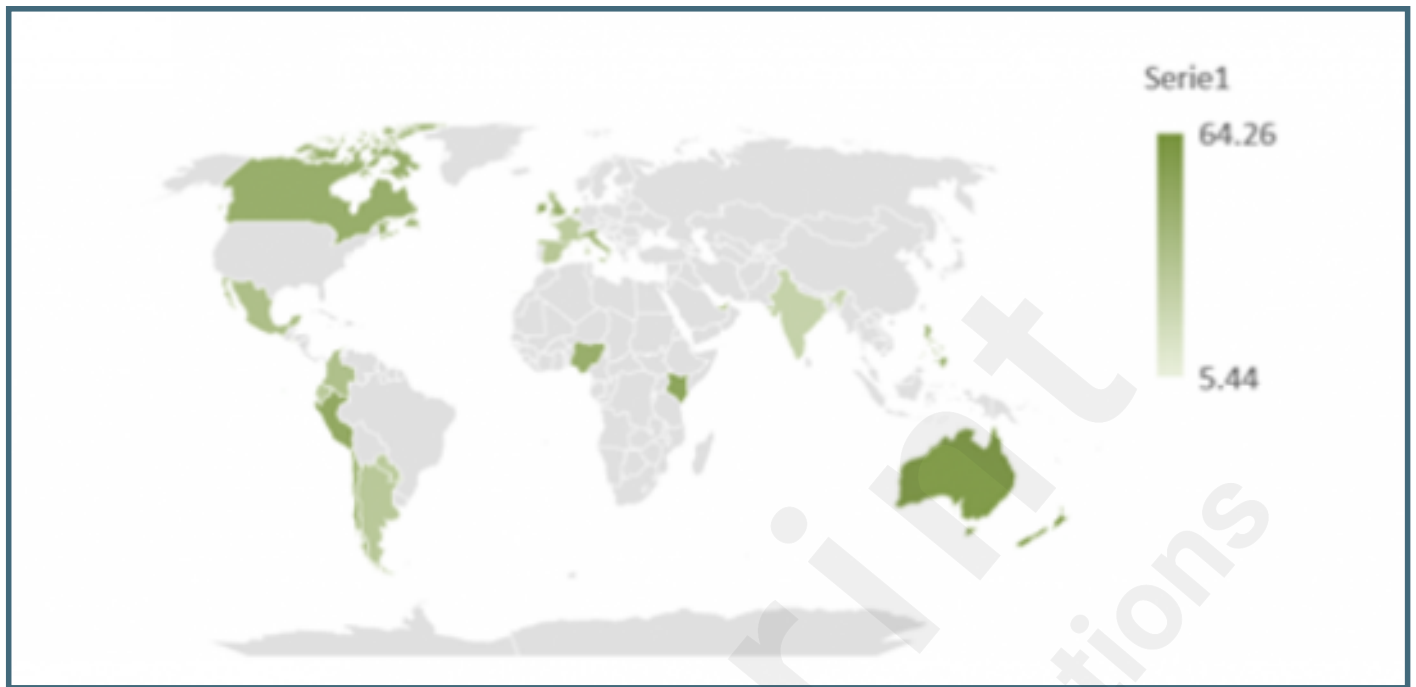
Supplementary Files

Figures

Thematic distribution by continent.
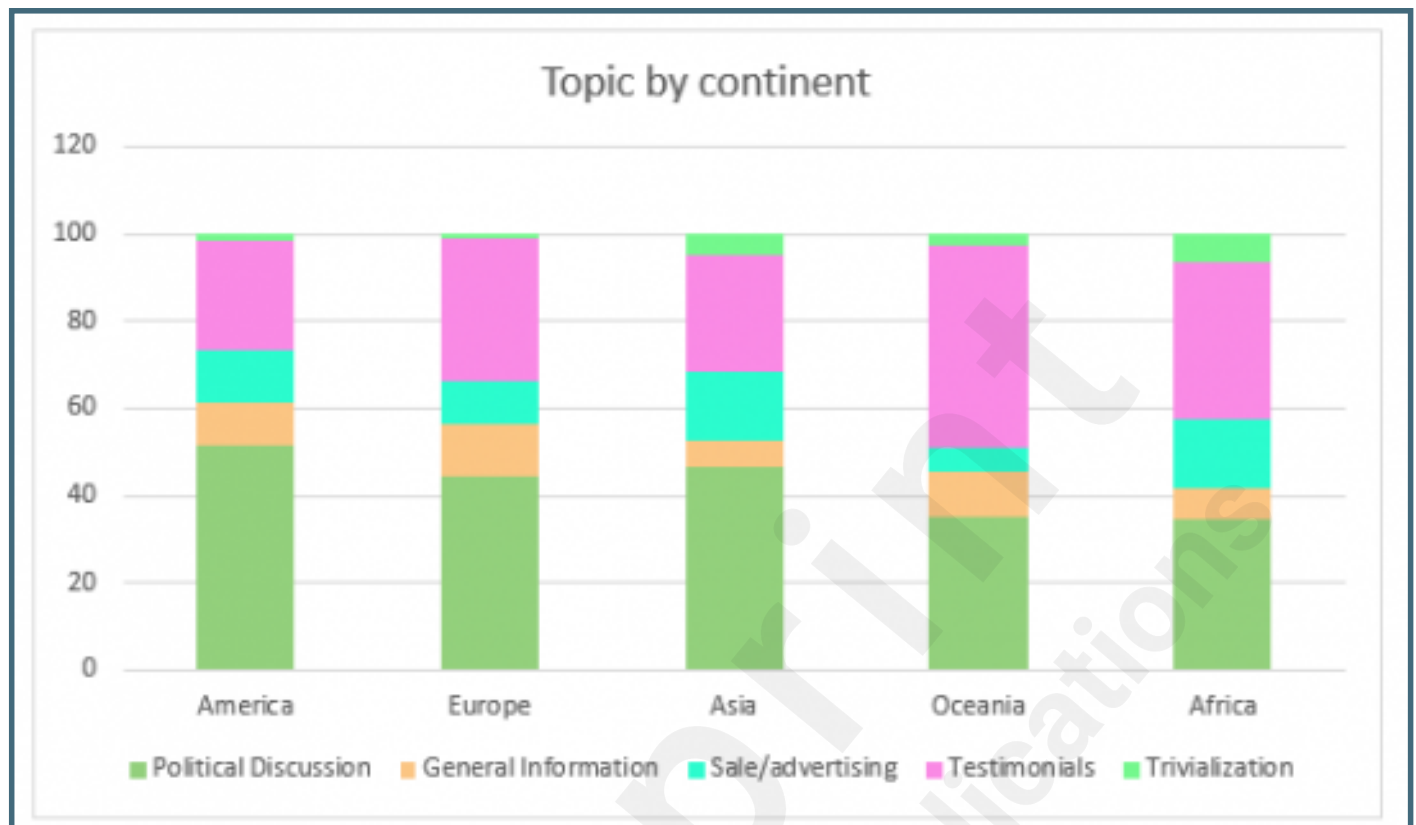
Personal experience with cannabis by continent.

Percentage of tweets in favor of legalization. In darker blue are the countries where the most tweets in favor of cannabis legalization have been found, and as the blue gets lighter, the number of tweets decreases. In grey are the countries where there are no tweets in this category.