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The Role of Water Activity in Cannabis Quality and Safety

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Abstract

Water activity is recognized for the safety it provides by preventing microbial contamination. Cannabis buds that are not dried to water activity levels below 0.70 a_w can support mold growth during storage and transport, leading to the subsequent potential for inhalation of mold spores or mycotoxins. Water activity is correlated to additional critical product quality attributes that are associated with shelf life such as the rate of decarboxylation that can lead to breakdown of THC.

Introduction

Cannabis-based products for both medicinal and recreational use are gaining in popularity and acceptance. However, if not handled properly, these products can pose a safety issue for consumers. Dried buds, extracted oils, or processed edibles with microbial contamination can result in allergic reactions, respiratory complications, or foodborne illnesses. From a quality standpoint, changes in efficacy and potency due to chemical reactions or structural loss can also result in poor product and lost revenue.

Water activity is utilized as an effective tool in the food and pharmaceutical industries to maximize microbial, chemical, and physical stability. It provides this same safety and control to the cannabis market and it is important that cultivators and processors understand water activity and how to maximize its usefulness. Safety regulations for the cultivation and processing of cannabis-based products is currently handled at the state level, resulting in inconsistent recommendations. As a result, not all states currently require water activity testing of cannabis. However, based on its established relationship with common safety and quality modes of failure, it should be one of the most important analytical test run by anyone in the cannabis market.

Materials and Methods

- Dried Cannabis flower for water activity testing was obtained from a local dispensary
- Water activity testing was conducted using the LabMaster NEO instrument from Novasina using an electrolytic sensor with no filters.
- Modes of failure for different water activity ranges was adapted from Carter 2018
- Moisture sorption profile for Cannabis was obtained using a dynamic isotherm method (Carter and Schmidt 2012)
- Trichome images were adapted with permission from Charlie Rutherford

References

- Carter, B.P. 2018. Shelf Life Simplified. IFT 2018 Short Course: Water, Water Activity, & Moisture Sorption: Characterization and Challenges for Low Moisture Foods. July 14, 2018. Chicago Il.
- Carter, B.P and S.J. Schmidt. 2012. Developments in glass transition determination in foods using moisture sorption isotherms. Food Chemistry 132:1693-1698.

Results

Table 1. The most likely modes of failure for the important water activity ranges for Cannabis

Water Activity Range	Most Likely Product Failure
> 0.850	Microbial Spoilage
0.70-0.85	Microbial Spoilage Chemical Instability
0.40-0.70	Chemical Instability Texture Changes Moisture Migration
0.20-0.40	Texture Changes Caking and Clumping
<0.20	Chemical Instability

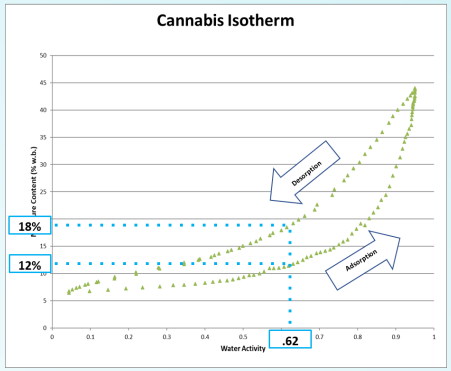

Figure 1. Moisture sorption profile for dried Cannabis showing hysteresis and its impact on the moisture content associated with a safe 0.62 water activity

Table 2. The ideal water activity and moisture content for Cannabis compared to other common products.

MATERIAL	a_w	MC %
Cannabis	0.55 to 0.65	10 to 12
Raisins*	0.51 to 0.53	10.3 to 12.6
Snack Sausage*	0.66 to 0.87	10.6 to 29
Black Pepper*	0.72	10.3
Vanilla Icing*	0.80	15
Beans*	0.47	10.1
Fruit Roll Up*	0.52	9.3

Figure 2. Trichome structure loss due to over drying Cannabis flower to water activities less than 0.55 a_w

Discussion

- The expected mode of failure for Cannabis can be hypothesized based on the water activity range (Table 1)
- At a water activity than 0.70 a_w, mold and other microorganisms will not grow on dried Cannabis flower (Table 1)
- At a water activity less than 0.55 a_w, dried Cannabis flower will begin to lose structure resulting in the loss of terpenes and cannabinoids. (Table 1 and Figure 2)
- The ideal water activity range for dried Cannabis is 0.55 a_w to 0.65 a_w (Table 1)
- The moisture content associated with the ideal water activity range for Cannabis is different than the moisture content at that water activity for other products, indicating the moisture content cannot be used in place of water activity (Table 2).
- Moisture sorption profile for Cannabis was obtained using a dynamic isotherm method (Carter and Schmidt 2012)
- Due to hysteresis, the moisture content associated with a water activity in the ideal range for dried Cannabis, such as 0.62 a_w, will vary depending on whether the cannabis dried or wetted to that point, so water activity should always be directly measured and never replaced with moisture content.

Conclusion

Water activity plays a key role in ensuring the safety of cannabis products and maximizing shelf life. Water activity may be a new concept to many in the cannabis industry, and those familiar with water activity may only know of its ability to control microbial growth. However, in many cases, microbial spoilage is not the most likely mode of failure for the shelf life of cannabis products. Water activity is related to all common modes of failure and consequently may be the most important test that can be run on everything from harvested biomass to edibles. Moisture content should never be used in place of water activity due to hysteresis.

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