CONSUMER PREFERENCE AND WILLINGNESS TO PAY(WTP) FOR FDA CERTIFIED CBD OIL: EVIDENCE FROM CHOICE EXPERIMENT

by

MOUNATA DAHAL

(Under the Direction of Benjamin Campbell)

ABSTRACT

Cannabidiol (CBD) oil is becoming popular after implementing the 2014 and 2018 Farm Bills in the United States, although not entirely regulated by the Food and Drug Administration (FDA) because of its safety concerns. This paper, via a choice experiment, examines consumer preference and willingness to pay (WTP) for various certification labels (FDA, third party, and no-label) of CBD oil with different concentrations: high, medium, low, and none using random parameter logit model (RPLM). We find that FDA certification has a significant role in purchasing CBD oil by non-users in all but low concentration. In contrast, non-users have negative utility for third-party certified oil in all strengths. Users prefer FDA-certified oil in none and high concentration. Overall, we find a significant impact of FDA labels in all except low concentration. We also examine how other attributes like price, location of purchase, production method, and origin impact the WTP of CBD oil.

INDEX WORDS: FDA certified, CBD oil, concentration, choice experiment.

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TABLE OF CONTENTS

Page

LIST OF TABLES

Page

LIST OF FIGURES

Page

CHAPTER 1

INTRODUCTION

Consumer behavior is a broad topic with economic and cognitive levels; it is more than just buying a product. According to Hoyer, MacInnis, and Pieters (2012), "Consumer behavior reflects the total process of consumer decision making concerning acquisition, consumption, and disposition of goods, services, experiences, and ideas by people (decision-making units)". Based on research and analysis, a consumer uses five decision-making stages while buying low-cost and high-cost products (Qazzafi, 2019). The stages are: 1) need identification, 2) information hunt, 3) evaluation of choices, 4) purchase decision 5) post-purchase decision (Qazzafi, 2019). Various forces influence consumer decision-making. According to Chand (2014), consumer behavior is influenced by marketing factors such as product characteristics like product design, price, promotion, packaging, and labeling information; personal factors such as age, gender, educational status, and other; psychological factors like buying motives, product perception, consumer attitudes and social and cultural factors such as social status, religion, race, etc. Consumers are presented with a myriad of choices in the market, out of which they need to choose the best option given their constraints like budget, status, culture, etc. Their preferences and utility drive the decision-making process of consumers. Since consumers are heterogeneous, their choices do not precisely overlap. In addition, consumer behavior is not static; the things we prefer now might not be preferred tomorrow. It is tough to determine the consumer demand for a particular product in such a scenario. Knowledge of consumer demand/behavior enables the marketers and processors to make appropriate marketing and advertising decisions considering the factors. CBD oil is an

emerging subject where limited research is conducted. Thus, evaluating a consumer preference for CBD oil will be helpful for the farmers, processors, and policymakers.

Consumer preference influences the supply chain from producers to consumers. The information label acts as one of the aspects of product differentiation and affects consumer demand (Alfnes, Chen, & Rickertsen, 2018). Accurate and illuminating product labels inform and direct consumers to make wise decisions among products according to their attitudes and preferences (Corroon, MacKay, & Dolphin, 2020). According to Alfnes et al. (2018), there are three kinds of regulation labels: government certification, third-party certification, and private certification. Our study only analyzes the effect of government regulation and third-party regulation on consumer purchasing decisions. The Food and Drug Administration (FDA) is the federal regulatory body working to protect and promote public health. Public safety is crucial in food products, and the citizens of the country have a higher willingness to pay for improved food safety regulations (Alphonce, Alfnes, & Sharma, 2014). The safety of consumption of hemp products like CBD has not been well known; the recommended dosage, whether it is safe for pregnant, lactating women, or children, and the side effects of the CBD are also not adequately known (Food and Drug Administration, 2019). That is why FDA certification is becoming a requirement for the marketing of drugs for therapeutic and other purposes (Abernethy, 2019). According to Corroon et al. (2020), FDA certification is essential for protecting consumers and making wise decisions.

Consumers generally prefer certified products over uncertified ones when it comes to consumption. Certification labels act as a guarantee for the consumers. Consistent with much of the research and intuition, we hypothesize (H1) that FDA certification will be preferred over non-certified CBD oil. Consumers will be willing to pay (WTP) premium prices for FDA-certified CBD oil. We also look at other attributes like the location of purchase, origin, and production

method. We hypothesize (H2) that the consumers will prefer CBD oil produced in their state and have WTP over CBD oil with no proper origin label. Our following hypothesis(H3) would be that consumers will prefer organic labeled CBD oil over non-labeled CBD oil and non-genetically modified (NGM) CBD oil is preferred to genetically modified (GM) CBD oil (H4). In addition, our fifth hypothesis is that consumers will exhibit a stronger preference to buy CBD oil from pharmacies and dispensaries rather than from internet/online sources (H5). We also look at the interaction effect of the CBD use with certification label and location of purchase.

Background Information

Industrial hemp (Cannabis sativa L.) is an emerging plant of the Cannabaceae family. It is burgeoning as a specialty crop and sustainable product alternative in the USA. Hemp is a golden plant with various industrial benefits such as medicine, insulation, textiles, paper products, personal care products, building materials, etc. Industrial hemp acts as the best soil contaminant cleanser and a phytoremediator (Rehman et al., 2021). This plant also helps in soil and water conservation. Its popularity is greatly heightened because of multiple potential applications of industrial hemp in the fiber, cosmetic, food & medical industries. This statement is supported by a nearly fourfold increase in licensed growers between 2018 and 2020 and a 3-fold increase in licensed hemp acreage between 2018 and 2020 (Vote Hemp, 2020). However, it is slightly reduced compared to 2019 (Vote Hemp, 2020), which might be due to the Covid-19 outbreak. Industrial hemp was illegal in the USA for almost 77 years until the 2014 Farm bill, which allowed pilot programs to study the hemp for limited research purposes. Agriculture Improvement Act of 2018(Farm Bill) is more liberal and allows the extensive cultivation of industrial hemp (Hudak, 2018), removing it from Schedule I of the Controlled Substance Act. However, it is not restrictions-

free. People cannot grow hemp, and its product is entirely free whenever and wherever they want. They have multiple restrictions. Despite this, this law allows the transfer of hemp and hemp-derived products like hemp oil, hemp containing personal care products, fibers, etc., across states for commercial and other purposes, which has created many hemp loopholes (Leas, 2021). If the products are produced as per the law, there will be no restrictions on the products' sale, transport, and consumption. Still, there are restrictions on the consumption and interstate commerce of food and beverages containing CBD. It is not legal to use CBD and its products for medicinal and therapeutic purposes except for one CBD-containing drug and three CBD-derived drugs (Food and Drug Administration, 2019). The FDA is sending warning letters to those illegally trying to manipulate people by falsely advertising CBD products as a miracle drug for curing severe illnesses like cancer. That is why consumers are in the phase of dilemma to consume hemp-derived and CBD products without government certification labels.

The cannabis plant consists of more than 400 compounds, of which eighty are biologically active (Meissner & Cascella, 2020). Among them, the most important compounds are tetrahydrocannabinol (THC) and Cannabidiol (CBD) (Meissner & Cascella, 2020). THC has psychoactive properties, which are responsible for making people high. In contrast, CBD has therapeutic properties and is considered a boon in the medical industry (Meissner & Cascella, 2020). CBD has been demonstrated as a unique prospective treatment for psychotic disorders (Davies & Bhattacharyya, 2019), epilepsy & neurodegenerative diseases (Li et al., 2020), Dravet syndrome (Lattanzi et al., 2020), multiple substance abuse, social depression & anxiety (Laczkovics, Kothgassner, Felnhofer, & Klier, 2021), Alzheimer's Disease (Watt & Karl, 2017) and many others. However, it has concentration-related adverse impacts as well (Meissner & Cascella, 2020). Consumers often confuse them with marijuana, a psychoactive cannabis plant

belonging to the same species of industrial hemp. Unlike marijuana, hemp and its derivatives do not make people high. Both THC and CBD are in industrial hemp and marijuana plants, but the main difference is in their concentration. As noted, cannabis plant containing more than 0.3% THC by dry weight is psychoactive marijuana, and those containing less than 0.3%THC by dry weight is industrial hemp (Hudak, 2018). Morphologically, it is challenging to tell the difference between two plants (Mark et al., 2020).

The economic viability of the industrial hemp industry is uncertain as data and information for this industry are new and under process. The research is limited. The heightened interest in hemp and hemp-derived products among farmers and processors has primarily enhanced their supply chain. In contrast, consumer demand for hemp products is not fully known. Researchers are expecting an increase in the demand for hemp products. However, they are also wary of the anticipation of price volatility due to the unbalanced supply and demand of hemp products (Mark et al., 2020). Legal regulation, risks, global competitiveness, etc., are the main factors for this uncertainty. However, it has excellent potential and the opportunity to develop as a distinctive crop due to the enormous benefits associated with this.

The global cannabidiol market in 2021 is USD 4.9 billion, which is expected to reach a value of USD 47.22 billion in 2028 with a compound annual growth rate (CAGR) of 21.3% (Vantage Market Research, 2022). According to Leas et al. (2019), internet searches have shown an increase in CBD products' demand and are highly accelerating. Similarly, Mark et al. (2020) argue that the demand for hemp products like fiber, paper, etc., is accelerating, but the primary source of demand growth is due to CBD oil. According to Bonn-Miller et al. (2017), CBD's demand is increasing because of its therapeutic properties and medicinal benefits associated with it. CBD oil is trendy among consumers though highly restricted. The federal authorization has limited the supply of

CBD products for consumption as food and beverages, which has created bottlenecks in the supply chains. Because of this, several CBD companies are requesting FDA for their regulatory authorization for CBD products. They have claimed this un-regulatory behavior from the federal has impacted the demand for the products and increased the number of unauthorized products in the market, which might be harmful to the consumers. According to Bonn-Miller et al. (2017), discrepancies between federal and state government has caused inadequacy in regulation and oversight, which has flourished this type of unauthorized products in the market. In their research, they found inaccurate labeling of the CBD products: under-labeling and over-labeling of CBD extracts than they claim it contains. These all things suggest there is a need for regulation from the federal and state levels to ensure these critical products' label accuracy. We are still figuring out consumers' choices regarding the FDA labeling of CBD products. Thus, this study's research objective is to understand better the consumer demand for the FDA labeling of CBD products, particularly CBD oil, along with other attributes.

CHAPTER 2

DATA AND METHODOLOGY

2.1. MATERIALS AND METHODS

Various researchers widely use discrete choice experiments for measuring consumer preferences and WTP (Katz, Campbell, & Liu, 2019; Ryan, Bate, Eastmond, & Ludbrook, 2001; Shi, Cao, Shang, & Pacula, 2019). It is a potentially useful tool to elicit preferences in behavioral economics (Ryan et al., 2001). Discrete choice experiments are broadly used in food marketing, health, transportation, economics, etc., to measure the consumer preferences and WTP (Cho & Choi, 2019). This study uses a discrete choice experiment to understand the consumer preferences and WTP for three different strengths of CBD oil e.g., High(60mg/ml), Medium(30mg/ml), Low(15mg/ml) and control (None) so altogether 4 different treatments.

Table 1:Choice attributes and levels

Attributes	Levels
price	
	$36
	$108
	$180
location of purchase	
	dispensary
	pharmacy
	internet
certification	
	FDA certified
	third party certified
	not certified
origin	
	USA
	own state(local)
	no origin
production method	

	organic non-GMO no label

The design for each concentration and 'none' consists of 5 attributes such as price, location of purchase, certification, origin, and production method (Table *1*). For certification attribute, three levels (FDA certified, third-party certified, and not certified) were used to denote whether the product, i.e., CBD oil, is certified or not. The attribute location of purchase also had three levels (Dispensary, pharmacy, and internet) to identify where the product was purchased. Attribute 'production method' had three levels: organic, non-GMO, and no label. Respondents were provided with the simulated choice conditions and some demographic and use questions. Other supplemental information regarding the definition of organic and non-GMO however were not provided. Respondents were asked to complete the survey as if they were purchasing in an actual situation keeping in mind their budget constraints to eliminate the hypothesis bias. The price attribute had three levels determined by examining the rate found in retail markets and pharmacy stores and in conjunction with team members of the HEMP project funded by USDA.

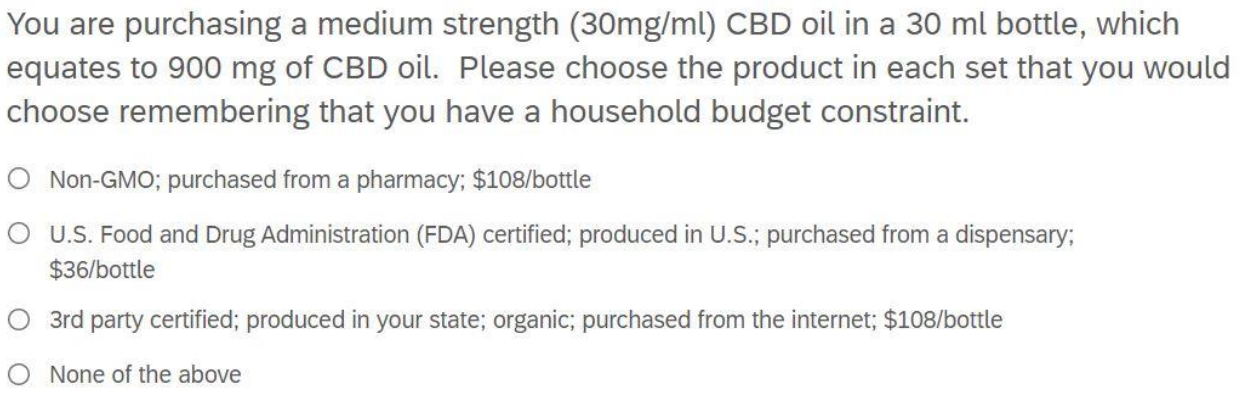

Figure 1: a sample choice question set

The combination of five attributes, each with three levels, represented a 3^5 design. The possible product combinations we obtained with these levels and attributes is 36, which may create fatigue with boredom when provided to the respondents. The efficiency and reliability of the research experiment may be retarded. We use a D-efficiency criterion to determine a final choice design like that of Kuhfeld (2010). D-efficiency is one of the measures of design efficiency to compare the orthogonal balanced design with design efficiency. A total of nine choice sets were presented to the participants, including three product profiles and one 'none' option, in a total of four options in one set of choice questions. An example of a choice set is shown in Figure *1*. There were not any figures, different font styles, colors, etc., in the questions. The questions were provided only in text format. The choice sets were randomized to minimize the order bias. Our assumption is consumers will choose a product that maximizes their utility, keeping in mind their constraints.

2.2 DATA COLLECTION

To better understand the consumer preference for CBD oil and to determine the interactions of CBD oil use with the location of purchase and certification, an online discrete choice experiment/survey was conducted using Qualtrics software. The survey was conducted in the early spring of 2021/2022. Since we have four different concentration of CBD oil, for a low concentration of CBD oil, the survey was conducted in February 2022; for a medium concentration of CBD oil, data was collected in December 2021. For a high concentration of CBD oil, data was collected in January 2022, and for control or none, the survey was conducted in March 2022. Respondents comprised whole USA consumers except Puerto Rico and Hawaii within the Toluna Co. database panel who are 18 years or older. Toluna allows the researchers to set the desired criteria and then sample the respondents who fit those criteria. Consumers who fit the survey were

emailed an invitation and a link to the survey. Those respondents who agreed to participate in the survey were directed to the survey. Altogether there were 1007 respondents for medium concentration and 1010 respondents for a high concentration, 1003 respondents for low concentration, and 1002 respondents for 'none' concentration of CBD oil who completed the survey. Data on demographics, including age, gender, education level, income, etc., were also collected.

Demographics on each concentration are presented in Table *2*. The median age for the none, low, medium, and high concentration were 41, 41, 42, and 40, respectively, which is pretty close to the median age in the USA of 38.5 years. The median household income of none, low, medium, and high concentration samples are $54999.5. The percentage of white consumers are 68% in none, 77% in low concentration, 77% in the medium concentration, and 74% in the high concentration. US census data reported the percentage of white is 75% which is very close to our sample. Similarly, African American consumers are 20%, 12%, 15%, and 17%, respectively, in the none, low, medium, and high concentration, which is close to the US census data of 14.2% of African Americans in the USA. Males in our sample are 48% in none, 46% in low concentration, 46% in medium, and 48 % in high concentration of CBD oil.

The average number of children per household is 0.89 in none, 0.68 in low concentration, 0.75 in the medium concentration, and 0.72 in high concentration sample. The US census data also reported that the number of children per household is 0.59, which is close to our sample. The average number of adults per household is 2.16 in none, 2.19 in low, 2.13 in medium, and 2.21 in high concentration of CBD oil. Our sample can be representative of the US as the US census reported the number of adults per household is 2.01, which is pretty close to our sample. The educational demographics are also very close to the US census survey data, as we can see from the

table (Table *2*). Table *2* also shows that, on average, 42.8% of consumers have tried CBD in their life, so our research could be worth conducting to understand the preferences of consumers towards CBD oil.

Table 2:Descriptive statistics of respondents

Conc. / Variables	None		Low		Medium		High		US* census estimates , mean
	Mean	SD	Mean	SD	Mean	SD	Mean	SD	
Mean income($)	74884.05	58568.49	70309.2	52992.04	75691.74	59237.4	73563.87	58064.86	91,547
Median income($)			54999.5		54999.5		54999.5		64994
Children per household	0.89	1.55	0.68	1.16	0.75	1.26	0.72	1.21	0.59
Adult per household	2.16	1.39	2.19	1.20	2.13	1.10	2.21	1.18	2.01
Age (Mean)	47.14	23.67	45.07	20.46	45.54	20.29	43.94	19.91	
Median	41		41		42		40		38.2(median)
Male	0.48	0.50	0.46	0.50	0.46	0.50	0.48	0.50	49.2%
Race									
White	0.68	0.47	0.77	0.42	0.77	0.42	0.74	0.44	75.1%
African American	0.20	0.40	0.12	0.33	0.15	0.35	0.17	0.37	14.2%
American Indian	0.01	0.11	0.02	0.13	0.01	0.08	0.01	0.08	1.8%
Asian	0.06	0.23	0.04	0.21	0.04	0.19	0.04	0.19	6.8%

Otherrace	0.06	0.23	0.05	0.21	0.03	0.18	0.05	0.22	3.9%
Location									
Metro	0.23	0.42	0.25	0.43	0.19	0.39	0.18	0.39	
Suburban	0.46	0.50	0.43	0.50	0.41	0.49	0.43	0.50	
Rural	0.31	0.46	0.32	0.47	0.41	0.49	0.38	0.49	
Education									
High school or less	0.27	0.45	0.29	0.46	0.30	0.46	0.31	0.46	38.3%
Some college	0.32	0.47	0.33	0.47	0.30	0.46	0.30	0.46	28.6%
Bachelor's Degree	0.21	0.40	0.23	0.42	0.20	0.39	0.18	0.38	20.3%
Greater than Bachelors	0.20	0.40	0.15	0.35	0.20	0.40	0.22	0.41	12.8%
tryCBD	0.39	0.49	0.41	0.49	0.48	0.49	0.43	0.50	-
No of respondents	1002		1003		1007		1010		

'*' denotes 2020 ACS 5-year estimates extracted from the United States Census Bureau

2.3 MODEL: Random Parameter Logit Model

Our analysis of the choice experiments is based on two theoretical concepts (Otieno & Ogutu, 2020). First, the Lancaster Model was given by Kevin Lancaster in 1966 through his book, which states that consumers' preference of goods/services is their preferences for characteristics/properties of that goods/services. For example, consumers are not interested in one pound of apple, he/she is interested in the properties like minerals, vitamins, water, etc., they get from that pound of apple (Thomsen, 2021). Hence, we assume that the product consumers choose to buy is their preferences for the features of that product like origin, location, price, etc. Second, choice analysis can be performed by random utility theory (Otieno & Ogutu, 2020), which states that respondents choose from the alternatives which provide them the maximum satisfaction/utility.

In order to account for preference heterogeneity, the Random Parameter Logit model (RPLM) is used in our study. This paper studies the consumer behavior of buying CBD oil under simulated choice conditions and willingness to pay (WTP) by using RPLM. It is often called the mixed logit model and is widely used to analyze discrete choice experiments of behavioral economics (Daly, Hess, & Train, 2012). It is better than the logit model as it allows random variations in preferences and accounts for correlation for unobserved factors over time (Merritt, Delong, Griffith, & Jensen, 2018).

Train (2009) provided the derivation of the mixed logit probability from utility-maximizing behavior, which he described as the most straightforward and widely used method. According to him, the decision-maker faces a choice among ‘J’ alternatives. The utility of person ‘n’ from alternative j is specified as,

$$U_{nj} = \beta_n x_{nj} + \varepsilon_{nj} \quad (1)$$

where x_{nj} are explanatory variables related to the alternative 'j' and decision-maker 'n', β_n is a vector of coefficients of these variables for person 'n', which represents a person's tastes and preferences, and ε_{nj} is a random error term that is independently and identically distributed. The error terms are assumed to be normally distributed. The coefficients for each person vary from person to person in the population with density f(β). This density is a function of parameters 'θ' that represent the distribution of parameters like mean and variance in the population. This is the same as standard logit, except the parameters or 'β' varies over respondents rather than being fixed.

The decision-maker chooses alternative 'i' if and only if the utility of one alternative "U_{ni}" > utility of another alternative "U_{nj}" where all $j \neq i$.

By incorporating the CBD oil attributes, the utility function in equation 1 can be extended as,

$$\begin{aligned} U_{nj} = {} & \beta_0 + \beta_1 none + \beta_2 Pharmacy + \beta_3 Dispensary + \beta_4 FDA \\ & + \beta_5 ThirdParty + \beta_6 Organic + \beta_7 NonGMO + \beta_8 USA \\ & + \beta_9 Ownstate + \beta_{10} CBDuse * FDA + \beta_{11} CBDuse \\ & * Thirdparty + \beta_{12} CBDuse * Pharmacy + \beta_{13} CBDuse \\ & * Dispensary + \beta_{14} Price + \varepsilon_{nj} \end{aligned} \quad (2)$$

where none represents the dummy variable for the fourth alternative, which is equal to 1 if respondents chose none of the above options and 0 otherwise. Pharmacy is a dummy variable which is 1 if CBD oil is purchased from a pharmacy and 0 otherwise. The dispensary is also a dummy variable which is equal to 1 if CBD oil was purchased from the dispensary and 0 if it was not. Similarly, FDA and third-party are the dummy variables for the certification label. FDA is 1

if CBD oil is FDA-certified and 0 if it is not; third-party is equal to 1 if the oil is third-party certified and 0 otherwise. USA represents the dummy variable equal to 1 if the CBD oil is labeled as the USA grown and 0 otherwise. Own state is also a dummy variable which is 1 if CBD oil is produced in the own state of the respondents and 0 otherwise. Organic is the dummy variable which is 1 if the CBD oil is organically grown and 0 otherwise. Non-GMO is 1 if the oil is produced from GMO-free hemp plant and 0 otherwise. CBDuse*pharmacy and CBDuse*dispensary are the dummy variables for the interaction of use of CBD oil and the location of the purchase. CBDuse*pharmacy is equal to 1 if the user of CBD purchased oil from a pharmacy and 0 otherwise. CBDuse*dispensary is equal to 1 if CBD user purchased oil from dispensary and 0 otherwise. CBDuse*FDA is equal to 1 if a CBD user bought FDA-certified CBD oil and 0 otherwise. CBDuse*thirdparty is equal to 1 if CBD user purchased third-party certified CBD oil and 0 otherwise. The 'Price' represents the continuous variable of CBD oil price. β_1 to β_{14} represent the utility and disutility of the respective attributes of CBD oil.

The distribution of β's was assumed to have normal independent distributions for the estimated model (Merritt et al., 2018). The price coefficient was fixed across all individuals. Hence, the distribution of non-price attributes' WTP was also assumed to have normal and independent distributions like the variable's parameter. The RPL estimates were obtained using Nlogit software employing 500 Halton draws.

2.4 WILLINGNESS TO PAY (WTP)

Using the estimates from the RPL model, we measure the WTP values for each significant attribute. We use the following equation to calculate WTP for non-interaction terms,

$$WTP_{single} = \frac{\beta_s}{-\beta_{14}} \qquad 3$$

where β_s is the coefficient of the specific attribute where s =2, 3, 4…...,9 and β_{14} is the coefficient of the price attribute.

WTP estimates for the interaction term were calculated using the following equation:

$$WTP_{interaction} = \frac{\beta_{is}}{-\beta_{14}} \quad 4$$

Where β_{is} is the coefficient of the interaction attribute where is= 10, 11, 12, and 13.

We also calculate the total effect of the single and interaction effect. We use the following equation for the calculation.

$$WTP_{total} = -\left(\frac{\beta_{is} + \beta_s}{\beta_{14}}\right) \quad 5$$

CHAPTER 3

RESULTS AND DISCUSSION

3.1 Results from Random Parameter Logit (RPL) model

The results from the RPL model are presented in Table *3*. Price has a significant negative impact on the purchasing decision of CBD oil in all of the given concentration, including control, low concentration(15mg/ml), medium concentration(30mg/ml), and high concentration(60mg/ml). Consumers prefer lower-priced CBD oil to higher-priced CBD oil.

Table 3: Random Parameter Logit (RPL) Model results

Variables	None		Low		Medium		High	
	RPLcoefficient	**p-value**	**RPLcoefficient**	**p-value**	**RPLcoefficient**	**p-value**	**RPLcoefficient**	**p-value**
Means of the random parameters in the utility function								
None	**-0.41695*** **	0.0018	-0.10705	0.5329	**-2.52265*** **	0.0000	**-2.20795*** **	0.0000
Location of purchase								
Dispensary	**0.25533*** **	0.0007	**0.31938** **	0.0228	**0.20378** **	0.0109	**0.14859***	0.0685
Pharmacy	**0.24814*** **	0.0009	0.20751	0.1390	**0.33267*** **	0.0001	**0.28173*** **	0.0006
internet	-		-		-	-	-	-
Certification								
FDA certified	**0.28356*** **	0.0003	0.21896	0.1108	**0.36704*** **	0.0000	**0.19313** **	0.0254
Third party certified	**-0.23963*** **	0.0030	**-0.45805*** **	0.0043	**-0.21204** **	0.0155	**-0.25078*** **	0.0016
Not certified	-				-	-		
Origin								
US	**0.15278** **	0.0213	**0.37932*** **	0.0074	0.07861	0.2281	**0.18772*** **	0.0061
Ownstate	0.03960	0.5135	**0.26078** **	0.0266	**0.09316***	0.0823	0.07223	0.2305
No origin	-				-	-		
Production method								
Organic	0.10658	0.1035	**0.32087** **	0.0192	0.04897	0.4324	0.07916	0.2378
Non-GMO	-0.02546	0.7109	**0.26311***	0.0674	-0.07003	0.2713	-0.01104	0.8760
No label	-				-	-		
Nonrandom parameter in utility function								
Price	**-0.00803*** **	0.0000	**-0.01076*** **	0.0000	**-0.00793*** **	0.0000	**-.00723*** **	0.0000
Interaction of CBDuse with certification								
CBDuse*FDA	**0.28581** **	0.0138	-0.17566	0.4021	0.00052	0.9968	**.28033** **	0.0222
CBDuse*thirdparty	**0.49467*** **	0.0000	-0.27451	0.2422	**0.21426***	0.0798	**.28649** **	0.0144
Interaction of CBDuse with location								
CBDuse*pharmacy	0.14015	0.2262	-0.10546	0.6138	-0.02237	0.8477	-0.14106	0.2407
CBDuse*dispensary	**0.20610***	0.0740	-0.10135	0.6146	0.17862	0.1270	0.08883	0.4394
Standard deviations of parameter distributions								
None	4.45987***	0.0000	1.63509***	0.0000	8.69689***	0.0000	8.96060***	0.0000

Pharmacy	0.21652**	0.0288	0.14729	0.3295	0.37545***	0.0024	.17519	0.1509
Dispensary	0.24214**	0.0360	0.09708	0.4749	0.27173***	0.0077	.17096	0.1563
FDAcertified	0.60460***	0.0000	0.69889***	0.0024	0.65772***	0.0000	.53465***	0.0000
Thirdparty certified	0.39125***	0.0001	0.57880***	0.0010	0.23567**	0.0366	.16405	0.1392
US	0.41915***	0.0000	0.60002***	0.0001	0.43435***	0.0000	.27868***	0.0002
Ownstate	0.48028***	0.0000	0.42587***	0.0041	0.14600*	0.0505	.20293***	0.0010
Organic	0.29947***	0.0002	0.64565***	0.0000	0.44192***	0.0000	.30922***	0.0000
Non-GMO	0.31066***	0.0000	0.83671***	0.0000	0.37323***	0.0002	.31019***	0.0007
CBDuse*FDA	0.93952***	0.0000	0.41818*	0.0760	0.94713***	0.0000	.89749***	0.0000
CBDuse*thirdparty	0.72318***	0.0000	0.73278***	0.0033	0.44417***	0.0015	.52432***	0.0000
CBDuse*pharmacy	0.52393***	0.0000	0.63911***	0.0064	0.44222***	0.0029	.40403***	0.0000
CBDuse*dispensary	0.64638***	0.0000	0.86753***	0.0001	0.47515***	0.0004	.50865***	0.0001
Loglikelihood function:	-8334.52892		-1697.17776		-8304.66111		-8306.86124	
Chi-squared:	7524.55135		856.02337		9367.06153		9262.84806	
Significance level:	0.00000		0.00000		0.00000		0.00000	
McFadden Pseudo R-square	0.3110140		0.2013993		0.3605991		0.3579627	
Number of respondents	1002		1003		1007		1010	

Bold text indicate significance.

*, **, *** indicates significant at 10%, 5% and 1% respectively.

- denotes the base category of variable.

3.1.1 RPL results of "none"

The results from Table *3* show that purchase location has a significant impact on the purchasing decision of CBD oil. Respondents are more likely to purchase CBD oil from dispensaries and pharmacies than from internet sources/online. Certification, our variable of interest, also has a significant role in consumers' buying behavior. We find CBD oil with FDA certification is preferred over CBD oil without any certification labels. Food safety is an emerging concept nowadays, and based on Castro, Pabuayon, Catelo, and Camacho Jr (2021) study on Philippines consumers, consumers have a strong preference for FDA/HCCPA certified fish products than other food safety attributes like sustainability practice information, traceability, etc.

In contrast, third-party certification is negatively preferred over non-certified 'none' CBD oil. Consumers would be more likely to buy non-certified CBD oil than third-party certified CBD oil. We have found an interesting result regarding the origin of CBD oil. People are more likely to prefer CBD oil extracted from USA-grown hemp plants than CBD oil with no information about its origin. In contrast, we find non-significant results regarding the variable 'own state'. It is positive but non-significant. Both variables of the production method are non-significant. From our study, we find positive and significant effects of the interaction variable, CBD use with certification. Those who have already tried CBD or used CBD oil would be more likely to purchase FDA-certified CBD oil than non-certified ones. Similar is the case with third-party certification. Compared to non-users, users would be more likely to purchase third-party certified CBD oil over not-certified CBD oils. Although non-users have a positive and significant role in pharmacy while buying CBD oil, users do not care whether the CBD oil is from a pharmacy or internet sources. They just need CBD oil for their use. However, users would be more likely to buy CBD oil from dispensaries than online sources.

3.1.2 RPL results of low concentration

In the case of low concentration, like none, the dispensary variable is significant, but unlike none, pharmacy is not significant. It shows that non-users are more likely to buy CBD oil from dispensaries compared to online sources. FDA certification is insignificant, but it is close to significant (p-value = 11%), but third-party certification is negatively significant. Non-users are less likely to purchase third-party certified CBD oil compared to CBD oil with no certification. We find significant results for both origin and production method variables. Non-users are more likely to prefer US-grown CBD oil and own state-grown (local) CBD oil compared to CBD oil with no information about its origin. Organic and non-GMO CBD oil is preferred to CBD oil without information about its production method. All the interaction variables are not significant indicating users are neutral regarding purchasing decisions of location and certification labels of CBD oil.

3.1.3 RPL results of medium concentration

The results show that purchase location plays a significant role in the purchasing decision of CBD oil. Consumers are more likely to purchase CBD oil from dispensaries compared to internet/online sources. Similarly, non-users would like to purchase from a pharmacy rather than on the internet. In addition, certification also plays a crucial role in buying CBD oil as FDA-certified CBD oil is more likely to be purchased by consumers rather than not certified oil. Our study finds that non-users have negative utility in purchasing CBD oil certified from a third party rather than purchasing not certified CBD oil. However, consumers who have tried CBD or have used CBD previously (users) are more likely to buy third-party certified CBD oil from the interaction effect. Surprisingly, we do not see a significant effect of the interaction of FDA certification with the use of CBD oil. Respondents subject to a medium concentration choice experiment would prefer CBD

oil extracted from plants grown in their state compared to CBD oil with no information about its origin. This result is expected as several studies have shown that consumers usually choose local products over products with no information (Katz et al., 2019). We do not see any significant differences in the interaction of use of CBD with the location of purchase. That means users are neutral about the location of purchase.

3.1.4 RPL results of High concentration

The consumers' purchase decision is affected by the location of buying goods, as indicated by our results in Table *3* which show that purchasing from the dispensary is significant compared to internet sources. People would prefer to buy CBD oil from pharmacies compared to online sources. In the case of certification, consumers would be more likely to purchase FDA-certified CBD oil than non-certified. In contrast, respondents were less likely to purchase third-party certified CBD oil compared to those not certified. No certification is preferred over third-party certification like that of medium concentration. High-concentration respondents were more likely to purchase CBD oil which is US-grown, compared to CBD oil with no information about origin.

Additionally, production methods like organic, GMO and non-GMO are not much of a concern to CBD oil consumers. Interaction of certification levels with the use of CBD also shows significant importance. Consumers who have used CBD prefer CBD oil with both FDA certification and third-party certification. An insignificant difference is seen in the interaction of CBD use with the location.

3.2 Willingness to pay (WTP) from the RPL model

The willingness to pay for different concentration is different. Several attributes show statistically significant WTP values. WTP values are given in Table *4*.

3.2.1 WTP for 'none'

Table *4* suggests that non-users are willing to pay $30.89 to purchase CBD oil from a pharmacy than from the internet. Similarly, they are willing to pay $ 31.78 to purchase CBD oil from a dispensary than from online sources. Respondents are highly willing to buy FDA-certified CBD oil paying $35.3 more than not certified CBD oil. Non-users have discounted willingness to pay for third-party certified CBD oil compared to not-certified CBD oil. They want a discount of $29.83 to purchase the third-party certified CBD oil compared to not certified CBD oil. People are willing to pay the premium price of $19.02 to purchase USA-grown labeled CBD oils compared to unlabeled CBD oils.

3.2.2 WTP for low concentration

Non-users are willing to pay a $29.69 premium price to purchase CBD oil from a dispensary rather than from the internet. FDA certification is surprisingly not significant but close to it at an 89% significance level. Non-users are less likely to buy third-party certified CBD oil than not certified CBD oils and are willing to get a discount of $42.58 to purchase third-party certified CBD oil. The variables origin and production method are significant in a low CBD oil concentration. People are willing to pay $35.26 to purchase USA-grown labeled CBD oil compared to not labeled CBD oil. Respondents are willing to purchase locally labeled CBD oil compared to not labeled CBD oil and are ready to pay the premium price of $24.24. Non-users are willing to pay $29.83 to purchase low-concentration organic CBD oil compared to not labeled low-concentration CBD oil. Similarly, they are willing to purchase GMO-free low concentration CBD oil by paying $24.46 more than that non-labeled low concentration CBD oil.

3.2.3 WTP for medium concentration

As we can see from Table *4*, consumers are willing to pay $41.94 to purchase medium-concentration CBD oil from a pharmacy than from the internet. Similarly, consumers are willing to pay $25.69 more to purchase CBD oil from a dispensary than from online sources. Respondents have a higher willingness to pay for FDA-certified CBD oil which is $46.27 more than the not certified CBD oil. CBD oil with third-party certification experience a $26.73 discount in WTP compared to not certified CBD oil. People are willing to pay the premium price of $11.74 for medium-concentration CBD oil produced in their state compared to the CBD oil with no details of their production area.

3.2.4 WTP for high concentration

Table *4* suggests that consumers are willing to pay $38.98 premium prices to buy CBD oil from pharmacies compared to the internet. Similarly, they are willing to pay $20.56 to purchase CBD oil from dispensaries compared to online sources. Respondents are willing to pay $26.72 for FDA-certified CBD oil rather than not certified CBD oil. In contrast, consumers want a discount of $34.7 to purchase CBD oil certified from a third party compared to no certification. Consumers are willing to pay the premium price of $25.97 to purchase USA-produced CBD oil compared to CBD oil with no information about origin.

3.3 WTP for total effects

3.3.1 Total effects WTP for 'none'

We can see from Table *5* that FDA certification alone, with interaction and in total, has a positive and significant effect on the purchase willingness of the 'none' concentration CBD oil. Users and non-users are willing to pay $70.88 to purchase CBD oil compared to non-certified CBD oil. As we can see, third-party certification alone has discounted effect on buying behavior of the non-

users(single) but has a positive and significant role in interaction and total effect. Consumers are willing to pay $31.75 to buy third certified 'none' CBD oil. Pharmacy and dispensaries have highly significant total effects on the purchase willingness of CBD oil. Consumers, in total, are willing to pay $48.34 more to purchase CBD oil from a pharmacy rather than from the internet. Similarly, respondents are willing to pay $57.44 more in total to buy CBD oil from a dispensary than from the internet.

3.3.2 Total Effects WTP for low concentration

The results in Table *5* show that FDA certification's single, interaction and total effects are non-significant. That means the consumers equally perceive FDA-certified and non-certified low-concentration CBD oil. Third-party certification is not significant in total; however, it is negatively significant in a single effect. A similar case is observed in the dispensary. It has a significant value in a single effect but, in total, has a non-significant value. Pharmacy has also insignificant results in all the cases like single, interaction, and total.

3.3.3 Total effects WTP for medium concentration

We can see from Table *4* and Table *5* that FDA certification alone has premium effects on the purchase of CBD oil but is not significant in interaction with CBD use. However, in total, FDA-certified CBD oil will fetch $46.33 more than that of not-certified CBD oil (Table *5*). Furthermore, third-party certified CBD oil has discounted role in single effect but has a significant positive role in interaction effect. However, in total effect, third-party has some positive value but are not significant. Pharmacy and dispensaries have highly significant total effects on the purchase willingness of medium concentration CBD oil. Consumers, in total, are willing to pay $39.12 more to purchase CBD oil from a pharmacy rather than from the internet. Similarly, respondents are willing to pay $48.2 more in total to buy CBD oil from a dispensary than from the internet.

3.3.4 Total effects of WTP for high concentration

In the high concentration sample, in total effects, people prefer the FDA-certified CBD oil and are willing to give $65.50 more than the non-certified ones. Third-party certification, in total, is not significant though it was significant in single and interaction effects. A similar case is in pharmacy, where it is not significant in total. In contrast, the dispensary shows a huge willingness of the people to buy CBD oil in total. Although, in interaction effect, it is not significant. Overall, both users and non-users are willing to provide $32.85 more to buy CBD oil from a dispensary than from the internet. These all results can be seen in Table *5*.

Table 4:Willingness to pay (WTP) estimates calculated from RPL model

Strengths / Variables	None				Low				Medium				High			
	WTP	p-value	CI lower	CI upper	WTP	p-value	CI lower	CI upper	WTP	p-value	CI lower	CI upper	WTP	p-value	CI lower	CI upper
Location																
Pharmacy	**30.89*** **	0.000	12.58	49.20	19.29	0.14	-6.33	44.91	**41.94*** **	0.000	21.09	61.78	**38.98*** **	0.000	16.55	61.41
Dispensary	**31.78*** **	0.000	13.30	50.27	**29.69** **	0.023	4.04	55.34	**25.69** **	0.011	5.85	45.53	**20.56***	0.069	-1.60	42.71
internet	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Certification																
FDA	**35.30*** **	0.000	16.25	54.35	20.36	0.113	-4.84	45.56	**46.27*** **	0.000	23.82	68.71	**26.72** **	0.026	3.19	50.25
Third Party	**-29.83*** **	0.003	-49.52	-10.14	**-42.58*** **	0.004	-71.78	-13.38	**-26.73** **	0.016	-48.38	-5.08	**-34.70*** **	0.002	-56.31	-13.08
No certified origin	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
USA	**19.02** **	0.019	3.03	35.01	**35.26*** **	0.005	10.49	60.03	9.91	0.226	-6.13	25.95	**25.97*** **	0.006	7.56	44.38
Own state	4.93	0.513	-9.84	19.70	**24.24** **	0.024	3.132	45.36	**11.74***	0.083	-1.52	25.01	9.99	0.231	-6.36	26.34
No origin production	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Organic	13.27	0.101	-2.59	29.13	**29.83** **	0.015	5.727	53.93	6.17	0.431	-9.19	21.53	10.95	0.236	-7.16	29.06
Non-GMO	-3.17	0.712	-19.97	13.63	**24.46***	0.056	-0.898	49.82	-8.83	0.274	-24.66	7.00	-1.53	0.876	-20.74	17.68
No label	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Bold text indicate significance.

*, **, *** indicates significant at 10%, 5% and 1% respectively.

- denotes the base category of variable.

Table 5:Decomposition of WTP based on single, interaction and total effect

Conc. / Variables	None			Low			Medium			High		
	Single	interaction	total	single	interaction	total	single	interaction	total	single	interaction	total
Certification												
FDA	**35.30*** **	**35.58** **	**70.88*** **	20.36	-16.33	4.026	**46.27*** **	0.066	**46.33*** **	**26.72** **	**38.79** **	**65.50*** **
p-value	0.0003	0.0143	0.0000	0.1134	0.4021	0.80	0.000	0.9968	0.000	0.0260	0.0224	0.0000
Lower CI	16.2485	7.0997	48.2966	-4.8442	-54.53	-27.27	23.82	-32.04	24.22	3.19	5.4974	41.5025
Upper CI	54.3473	64.0581	93.4570	45.557	21.87	35.32	68.71	32.167	68.45	50.25	72.0719	89.5074
thirdparty	**-29.83*** **	**61.58*** **	**31.75*** **	**-42.58*** **	25.52	-17.06	**-26.73** **	**27.01** *	0.279	**-34.70*** **	**39.64** **	4.9407
p-value	0.003	0.000	0.0000	0.0043	0.2438	0.32	.0155	.0798	0.979	0.0017	0.0148	0.6847
Lower CI	-49.5165	31.8357	8.6010	-71.79	-17.39	-50.64	-48.3778	-3.2062	-20.98	-56.3099	7.7532	-18.91
Upper CI	-10.1438	91.3200	54.8945	-13.38	68.43	16.51	-5.0811	57.2235	21.54	-13.0831	71.5212	28.79
Location												
Pharmacy	**30.89*** **	17.4458	**48.34*** **	19.29	-9.805	9.487	**41.94*** **	-2.820	**39.12*** **	**38.98*** **	-19.52	19.46
p-value	0.0009	0.2262	0.0000	0.14	0.6139	0.557	0.0001	0.8477	0.0002	0.0007	0.2411	0.1246
Lower CI	12.58	-10.8056	24.9877	-6.33	-47.90	-22.14	21.0928	-31.60	18.82	16.5512	-52.15	-5.38
Upper CI	49.20	45.6973	71.6823	44.92	28.26	41.11	62.7780	25.955	59.41	61.4065	13.11	44.30
Dispensary	**31.78*** **	**25.66** *	**57.44*** **	**29.69** **	-9.422	20.27	**25.69** **	22.517	**48.20*** **	**20.56** *	12.29	**32.85*** **
p-value	0.0008	0.0741	0.0000	0.0233	0.6147	0.199	0.0112	0.1266	0.0000	0.0689	0.4394	0.0059
Lower CI	13.2954	-2.4952	34.2021	4.0421	-46.10	-10.64	5.8485	-6.3697	27.90	-1.5953	-18.87	9.46

Upper CI	50.2724	53.8060	80.6765	55.342	27.26	51.18	45.5265	51.4029	68.51	42.7131	43.45	56.24

Bold text indicate significance.

*, **, *** indicates significant at 10%, 5% and 1% respectively.

CHAPTER 4

CONCLUSION

Our study uses a choice experiment to examine the consumer decision-making process and preferences for three different concentration of CBD oil: high, medium, and low, as well as no concentration or control in the United States. Notably, we want to determine if there is a difference in preference and WTP for FDA certification of CBD oil. We used a random parameter logit model, which accounts for the heterogeneity of consumer preferences. We also see whether consumer buying decision is affected by location, production method, price, and origin. In addition, we observe the interaction effect of the CBD use with two attributes (location and certification). Our focus is to examine the interaction between use and certification labels of CBD oil.

Since CBD oil has become prevalent in the USA for its medicinal and other uses, it is crucial for producers, processors, and retailers to understand the consumer preference and WTP of CBD oil. Price is a determining factor in any decision-making process. As expected, we find price as the most significant factor in CBD oil purchase in all the concentration; none, low, medium, and high concentration. Consumers prefer to buy cheaper CBD oil than expensive CBD oil, regardless of the concentration. Our analysis shows that location of purchase does matter when buying CBD oil, and consumers have a strong preference for purchasing oil from pharmacies over the internet and purchasing from dispensaries over online sources regardless of the concentration. This can be a piece of worthy information for the producers and retailers. Furthermore, we also know that certification label matters for none, medium, and high concentration of CBD oil. However, in low

concentration, we do not see the significant results of the certification attributes, FDA, and third party in total. In gist, we can say people prefer certified products over non-certified ones. Production method like organic and non-GMO does not affect the decision-making process, as we can see from the results of none, medium, and high concentration. In contrast, we find they do impact the purchasing decision of the low-concentration CBD oil. Low-concentration CBD oil buying consumers prefer locally grown, the USA grown, organic and GMO-free characteristics of the oil and are willing to pay premium prices for products with these qualities. This information will help farmers not to focus on the costly production practices which consumers do not prefer for no concentration, medium, and high concentration of the CBD oil. Nevertheless, it also suggests focusing on these things for marketing and selling the low-concentration CBD oil. It will make the production process efficient and cost-effective. We find consumers prefer CBD oil produced in their state in medium concentration. However, we find that people prefer US-produced CBD oil in high concentration. Similarly, for no concentration, we find USA grown CBD oil is preferred over non-labeled one, but in the case of low concentration, both the USA grown, and locally grown CBD oils have a significant role in the consumers' purchase behavior. In addition, organic and non-GMO are also valuable attributes to give attention to while marketing low-concentration CBD oils. This sort of information will be valuable for the retailers and farmers.

Results concerning interaction are less straightforward and present scope for future research. In medium concentration, we find that consumers who have used CBD in their life are more likely to purchase third-party certified CBD oil compared to not certified CBD oil. However, in the case of high concentration, users are more likely to buy FDA-certified CBD oil and third-party CBD oil compared to not certified CBD oil. In contrast, we do not find any significant interaction effect of FDA certification and third-party certification with the CBD use in low concentration. But we find

significant positive interaction of users with FDA as well as third party certification in the case of control/none. This result may be due to the high concentration of CBD in CBD oil which makes the consumer more conscious and need better reliable certification. Alternatively, without the information on the concentration, consumers want more certainty by buying FDA-certified CBD oil as well as third-party certified CBD oil. In total, consumers are willing to pay $71 more for the FDA-certified CBD oil than those not certified for the 'none' concentration. In the case of medium concentration, consumers have a strong preference for FDA certification but are willing to pay only $46, which is less than high concentration and 'none' concentration. Consumers are willing to pay more for high concentration than for medium concentration. This could be due to the side effects associated with a higher concentration of CBD, so it needs reliability. In contrast, in the case of location, consumers are willing to pay fewer dollars for 'none' concentration, high concentration, and medium concentration than for low concentration. Maximum willingness to pay for pharmacy and dispensary can be seen in low concentration with $48.34 and $57.44, respectively. In contrast, minimum willingness to pay is observed in 'no concentration' CBD oil in terms of location. Location is not related to any side effects of CBD oil, which may be the reason for less willingness to pay for no concentration of CBD oil from a dispensary than for a low concentration of the same location, i.e., dispensary. We also observe that the CBD oil without the information regarding its concentration fetch maximum and significant willingness to pay for pharmacy and dispensary location of purchase in total effect. Overall, we can see there is a high willingness to pay for a 'none' concentration of CBD oil for FDA certification and third-party certification. 'None' FDA-certified CBD oil fetch higher premium price than other concentration FDA-certified CBD oil. This could be due to people's trust in the certification label. If there is no other given information, consumers value certification as the most trustworthy attribute to consider

while purchasing the product. Thus, we can conclude that the FDA certification label could provide an additional value to the product and impact the decision-making process of the consumers.

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