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Valuation and differentiation attributes in pulque distillate identified by means of discrete choice experiments

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ABSTRACT

Objective: To identify consumer preferences and willingness to pay by assessing the differentiating attributes of distilled pulque.

Design/methodology/approach: The discrete choice experiments methodology (DCE) was used to estimate the willingness to pay (WTP), based on surveys of pulque distillate consumers. The information analysis was carried out with the XLSTAT 2023 software through logistic regression of the willingness to pay data on a choice response with a confidence interval of 95% and with 207 iterations.

Results: The most valued attributes were a low price (MXN $400), artisanal production, and certification. However, a negative marginal WTP was found for origin (Tlaxcala, Mexico), artisanal production, and certification, indicating that some consumers do not perceive clear benefits from these attributes.

Limitations on study/implications: One of the main limitations was the dissemination of this distilled beverage; the highest participation was observed in the central region of the country.

Findings/conclusions: Affordable pricing is the most influential factor for consumers. It is recommended to develop segmentation and communication strategies that highlight the cultural and identity value of pulque distillate, especially regarding certification and artisanal production.

Keywords: attributes, pulque, distilled beverage, choice experiment.

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INTRODUCTION

Pulque is the quintessence Mexican beverage because it has a long tradition since pre-Hispanic times (Erlwein *et al.*, 2013); it is made from mucilage fermentation, popularly known as aguamiel, which is obtained by scraping from the "heart" of the *Agave salmiana* plant after extraction of the apical meristem and rest of 6 to 12 months. The fermentation process is carried out in establishments called *tinacales*, where the *aguamiel* is poured into containers made of materials that range from plastic to those designed in bovine leather, and it is mixed with the "seed" or *pie de pulque* (initial ferment); from that moment, the

fermentation and transformation of *aguamiel* into pulque begins (SADER, 2015). A range of byproducts are obtained from both *aguamiel* and pulque (Astudillo *et al.*, 2022), one of them being the pulque distillate.

In distilled beverages, certain aspects such as the class of distillate and production process make them a difficult and confusing product for consumers to select (Kallas *et al.*, 2012). Therefore, it is important to understand the relationship between properties and attributes of the pulque distillate and their relationship with the consumer's perception.

Intrinsic signals such as flavor, year of distillation, variety of agave (or varieties), and alcohol content; as well as the place of origin, brand, price, awards obtained, containers, and labels are relevant in the agroindustrial market (Cervantes, 2021). As consequence, the variety of distilled alcoholic beverages available in the market makes consumer choices more complex than those of other food products.

There are tools designed to evaluate the preferences of consumers; one of the multi-attribute valuation methods is that of Choice Experiments (CE). This methodology facilitates a more accurate evaluation of esteem for a product, improving the accuracy with which the economic value is determined that consumers are willing to pay for an article that is characterized by its range of tangible and intangible qualities (Barrera-Rodríguez *et al.*, 2019).

Choice experiments have been used to evaluate the preferences of consumers and the willingness to pay for genetically modified foods (Hu, Veeman, and Adamowicz, 2005; James and Burton, 2003; Burton, Rigby, Young and James, 2001), organic foods (Rousseau and Vranken, 2013), meat (Linhai-Wu, Shuxian-Wang, Dian-Zhu, Wuyang-Hu and Hongsha-Wang, 2015; Loureiro and Umberger, 2007; Tonsor, Schroeder, Fox and Biere, 2005), and fresh fruits (Sepúlveda, Ureta, Hernández and Solorzano, 2018; Wongprawmas and Canavari, 2017), among others.

The Choice Experiment is based on the theory of random utility (McFadden, 1974; Thurstone, 1927) and the theory by Lancaster (Lancaster, 1966). The first suggests that individuals associate a utility with each choice alternative, so consumers choose the one that offers them the most utility (McFadden, 1974). Conversely, Lancaster (1966) proposes that the utility of a good can be broken down into the utilities generated by the different attributes of the products.

The research on pulque distillate in this study is a combination of attributes that include information about the place of origin, type of process, certification, distinctions, and price. Therefore, the preferences and willingness to pay by consumers were identified and evaluated by means of the differentiating attributes of pulque distillate.

MATERIALS AND METHODS

A survey was carried out with 207 participants, generated by Microsoft Forms, which was distributed through social networks. The criteria that were considered were: older than 18 years old, connoisseurs or consumers of pulque distillate, and willingness to participate in the study. For an infinite population, the maximum variance was assumed, with a confidence level of 95% and an error margin of 7% (Martínez-García and Martínez-Caro, 2008).

The survey was composed of three sections: 1) in the first part, participants were asked if they were connoisseurs of the beverage, 2) the willingness to pay for a 750 mL bottle of pulque distillate was evaluated by means of discrete choice experiments where the selection of an alternative of preference was proposed, and 3) sociodemographic data about the consumers were asked (place of origin, age, sex, education, occupation and economic income). The selection of attributes and levels was carried out through a bibliographic review, as well as by approaching producers of the pulque distillate, to determine the attributes that they considered important. The attributes of origin, production process, certification, awards and price were selected (Table 1) as the most important for the study.

The attribute of origin was represented by the state where the distillate was elaborated, which was evaluated in four levels: made in the State of Mexico, Hidalgo, Puebla or Tlaxcala. The attribute production process represented the activities and material used for the transformation of aguamiel into pulque and its distillation, including two levels: artisanal and industrial. The attribute of certification was evaluated in two levels: with certification and without certification. The attribute of awards referred to whether the beverage had received any national or international distinction, such as the medals given in the Spirits Selection of the Concours Mondial de Bruxelles, and it was evaluated in two levels: with medal and without medal. Lastly, the attribute price to be paid for a 750 mL bottle was evaluated at three levels: $400.00 MXN, $700.00 MXN, and $1,000.00 MXN.

The experiment included 16 simulation cards, which were calculated (Table 2) through a Fractioned Factorial Design, using the IBM SPSS Statistics Version 29.0.2.0 software. The cards were grouped into pairs with the aim of obtaining eight sets, where the consumer chose between option A, option B, and included the option of "Would not buy any" (Figure 1).

The choice data were analyzed using the Multinomial Legit Model (MLM), which is based on the theory of random utility (McFadden, 1974), and for this purpose, the statistical analysis was conducted with the XLSTAT Version 2023.2.1414 software.

RESULTS AND DISCUSSION

Table 3 provides a summary of the sociodemographic characteristics of participants in the study. A greater willingness to participate was seen from men, with 58.94%, compared to 41.06% from women. The predominant age range was 18 to 29 years old (39.61%), followed by the group that includes the range of 30-39 years with 32.37%, highlighting that these two groups were the most representative.

Table 1. Attributes and levels of the discrete choice experiment.

Attribute	Attribute Levels
Origin	Mexico, Hidalgo, Puebla, Tlaxcala
Production process	Artisanal, Industrial
Certification	Certificate, No certificate
Awards	Award, No award
Price	MXN$ 400, MXN$ 700, MXN$ 1000

Table 2. Cards obtained through SPSS.

ID	Origin	Process	Certification	Award	Price
1	Tlaxcala	Artisanal	NC	A	$ 1000
2	Mexico	Industrial	NC	NA	$ 400
3	Tlaxcala	Industrial	C	NA	$ 400
4	Tlaxcala	Industrial	NC	A	$ 700
5	Mexico	Artisanal	C	A	$ 700
6	Hidalgo	Artisanal	NC	NA	$ 700
7	Tlaxcala	Artisanal	C	NA	$ 400
8	Hidalgo	Industrial	NC	NA	$ 1000
9	Puebla	Artisanal	NC	A	$ 400
10	Mexico	Artisanal	NC	NA	$ 400
11	Puebla	Industrial	C	NA	$ 700
12	Hidalgo	Industrial	C	A	$ 400
13	Mexico	Industrial	C	A	$ 1000
14	Hidalgo	Artisanal	C	A	$ 400
15	Puebla	Artisanal	C	NA	$ 1000
16	Puebla	Industrial	NC	A	$ 400

NC: No certificate, C: Certificate, NA: No award, A: Award.

Figure 1. Example of choice card for pulque distillate.

The population surveyed reported 63.28% with university education level, while 31.40% declared having studied high school. The National Occupation and Employment Survey reported that the average monthly salary in the fourth trimester of 2023 was $5,750.00 (Secretaría de Economía, 2024); regarding the survey respondents, 56.52% have income in the group of $5,000 to $10,000 pesos Mx, while 43.47% declared having

Table 3. Sociodemographic characteristics of consumers (N=207).

Variable	Central	Western	Southern	Total
Gender				
Male	32.37	9.66	16.91	58.94
Female	22.71	8.21	10.14	41.06
Age				
18-29	17.87	8.21	13.53	39.61
30-39	19.81	5.31	7.25	32.37
40-49	12.08	3.86	4.83	20.77
50-59	5.31	0.48	1.45	7.24
Educational level				
Upper Secondary Education	14.98	6.76	9.66	31.4
Higher Education	37.68	11.11	14.49	63.28
Postgraduate Education	2.42	0.00	2.90	5.32
Occupation				
Rural farmer / Agriculturist	0.97	0.48	0.97	2.42
Government employee	1.45	0.00	0.48	1.93
Student	8.21	3.38	6.28	17.87
Industrial worker	19.81	3.86	8.70	32.37
Self-employed	11.59	4.35	6.76	22.7
Other	13.04	5.80	3.86	22.7
Monthly income				
MXN$ 5,000 to MXN$ 10,000	29.95	11.59	14.98	56.52
MXN$ 10,000 to MXN$ 15,000	19.32	4.83	9.66	33.81
MXN$ 15,000 to MXN$ 20,000	2.90	1.45	0.48	4.83
Greater than MXN$ 20,000	2.90	0.00	1.93	4.83

income higher than $10,000 pesos MX. Regarding occupational categories, 32.37% indicated they work as laborers in various companies, while 22.7% declared being independent workers.

From Table 4, the goodness of fit provides several indicators of the model obtained and the variability of the data. The most relevant value is that of χ^2 and R^2 (McFadden) associated with the logarithm rate, which is equivalent to Fisher's F test of the linear model.

In this case, the probability is lower than 0.0001 (Table 5), and it can be concluded that the variables contribute a significant amount of information; in addition, R^2 (McFadden)=0.368, which is a value within the range of 0.10-0.50, considered acceptable in social studies (Ozili, 2022). According to Melo-Guerrero *et al.* (2020), a value of R^2 (McFadden) obtained between 0.2 and 0.4 would be equivalent to R^2 of 0.70-0.90 in ordinary least squares, which indicates a good fit.

The logit model was used to estimate and calculate the coefficient for each variable and to obtain the significance at a value of $Pr>\chi^2$ for those attributes that help to explain the punishment or overprice from consumers. Table 6 shows the attributes and levels analyzed; from these, the price of $400 MXN, origin Tlaxcala, artisanal process, with certification,

Table 4. Statistics of goodness of fit.

Statistic	Independent	Complete
Observations	4968	4968
Sum of weights	4968.000	4968.000
DF	4967	4957
−2 Log-Likelihood	6324.405	3997.252
R^2 (McFadden)	0.000	0.368
R^2 (Cox and Snell)	0.000	0.374
R^2 (Nagelkerke)	0.000	0.519
AIC	6326.405	4019.252
BIC	6332.916	4090.870
Iterations	0	12

Table 5. Hypothesis test.

Statistic	DF	χ^2	p-value
−2 Log-Likelihood	10	2327.153	<0.0001
Score	10	2094.052	<0.0001
Wald	10	1296.979	<0.0001

Table 6. Standardized coefficients for WTP.

Attribute	Coefficient	Standard Error	p-value	Lower Limit (95%)	Lower Limit (95%)
Interception	−2.822	0.107	<0.0001		
Hidalgo	0.000	0.000			
Puebla	0.034	0.168	0.838	−0.294	0.363
Tlaxcala	1.237	0.171	<0.0001	0.902	1.572
Mexico	0.419	0.153	0.006	0.119	0.719
Industrial	0.000	0.000			
Artisanal	0.910	0.097	<0.0001	0.719	1.101
C	2.378	0.288	<0.0001	1.813	2.943
NC	0.368	0.290	0.205	−0.201	0.937
A	−0.318	0.214	0.137	−0.737	0.101
NA	−1.280	0.200	<0.0001	−1.672	−0.889
400	2.274	0.120	<0.0001	2.040	2.509
700	0.155	0.124	0.213	−0.089	0.398
1000	0.000	0.000			

and without medal were the characteristics that were statistically significant and because of which consumers are willing to pay extra or receive compensation.

The marginal WTP is commonly expressed as the negative rate of the coefficient of the attribute unrelated to the price and the price coefficient. This willingness to marginal payment is reported in Table 7, and it shows that consumers expect to receive economic

Table 7. Marginal willingness to pay for pulque distillate.

Attribute	Coefficient	Marginal WTP
Hidalgo	0.000	0.00
Puebla	0.034	−0.02
Tlaxcala	1.237	−0.54
Mexico	0.419	−0.18
Industrial	0.000	0.00
Artisanal	0.910	−0.40
C	2.378	−1.05
NC	0.368	−0.16
A	−0.318	0.14
NA	−1.280	0.56

compensation when the distillate is originally from Tlaxcala (−$0.54 MXN), is obtained through artisanal process (−$0.40 MXN), or has certification (−$1.05 MXN); or they expect to pay extra when it does not have any medal such as the CMB ($0.56 MXN).

Facing this situation, some of the factors that affected the consumer's perception and influenced the WTP are ignorance from participants, because they were not familiar with the terms used or considered them irrelevant since it was a study where both connoisseurs and consumers were considered; some of the participants do not belong to the segment that values these attributes. The consumers who valued most the price valued less the artisanal process or the certifications.

CONCLUSIONS

The study showed that consumers have different levels of willingness to pay because of the attributes of the pulque distillate, highlighting that not all the attributes are equally valued. This emphasizes the importance of understanding the priorities and perceptions of the market and the consumers. The most influential attributes were the price, the origin (especially Tlaxcala), the process of artisanal production, and the certification. However, characteristics such as awards did not obtain a significant positive valuation, which could be related to lack of awareness or perception of irrelevance from consumers. Considering these aspects, more participants from different regions and sociodemographic profiles could be incorporated, with the purpose of providing a more representative view of the market, as well as implementing communication strategies that explain the value of attributes such as certification, artisanal process, and awards which could increase the consumer's valuation.

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