



Contents lists available at ScienceDirect

Food Quality and Preference

journal homepage: www.elsevier.com/locate/foodqual

Do Mexican consumers really care about hen welfare? Understanding their attitudes, constraints and willingness to pay for cage-free eggs

Laura X. Estévez-Moreno^{a,*}, Morris Villarroel^b, Genaro C. Miranda-de la Lama^c

^a Department of Agricultural Sciences and Natural Environment, Agri-Food Institute of Aragon (IA2), University of Zaragoza, Zaragoza, Spain

^b CEIGRAM, ETSIAAB, Technical University of Madrid (UPM), Madrid, Spain

^c Department of Animal Production & Food Science, Agri-Food Institute of Aragon (IA2), University of Zaragoza, Zaragoza, Spain

ARTICLE INFO

Keywords:

Labelled eggs
Photo-elicitation
Laying hen welfare
Consumer studies
Sustainable consumption
Latin American consumers
Egg production systems

ABSTRACT

Mexico has the highest per capita egg consumption in the world and ranks fifth in international egg production. Currently, there is a lack of data on consumer attitudes towards the welfare of laying hens (WLH) and their willingness-to-pay-a-price-premium (WTPPP) for cage-free eggs. To address this gap, a survey was conducted among 1040 Mexican egg consumers in different shopping venues. The average level of concern about hen welfare was 8.6/10, with higher levels of concern among female respondents and those aged 50 and over. Consumers agreed on the impact of welfare conditions on egg quality and the need for hens to be able to express natural behaviors. However, they lacked sufficient information about existing regulations and how hens are reared. At least 54% of consumers were willing to pay a price premium for cage-free eggs and could be further categorized into three groups based on the percentage of price premium they were willing to pay. Gender and age were significant factors differentiating consumer attitudes towards hen welfare at the socio-demographic level. However, these attitudes did not determine WTPPP for cage-free eggs. In contrast, education level played a crucial role in determining WTPPP, but not attitudes towards WLH. Our results indicate that paying premiums for cage-free eggs is insufficient to drive the industry's conversion to cage-free housing systems for egg production. Rather, a strategy should be implemented to provide consumers with reliable information about alternative production systems to cages and their positive and negative impacts on WLH.

1. Introduction

Eggs are a dietary staple due to their high nutritional value, versatility, health benefits, and affordability (Lesniewski & Stangierski, 2018). These attributes have led to a consistent rise in their demand among consumers and the global agri-food industry (Rondoni, Asioli, & Millan, 2020). The exponential growth of the worldwide egg industry, compared to other agricultural sectors, was facilitated by the adoption of caged egg production systems, primarily conventional cages (Sinclair et al., 2022). However, over the past two decades, the egg industry has been particularly affected by public opinion, which has strongly criticized the use of cages for rearing hens because they are very restrictive in physical, behavioral and spatial terms and raise serious animal welfare concerns (Slack, Sharma, Cúg, & Singh, 2023). The societal concern for laying hen welfare (WLH) has prompted significant legislative changes in certain countries across North America, Europe, and Oceania (Bray & Ankeny, 2017), driving a shift in the industry from conventional

cages to alternative systems. Other pivotal drivers of this transformation are the rising consumer demand for transparency in production and an increasing WTPPP for animal welfare-friendly products (Rondoni et al., 2020). WTPPP for these products has also been reported among consumers in emerging markets (e.g. Zhao & Wu, 2011; Miranda-de la Lama et al., 2019) and some developing countries (e.g. Otieno & Ogutu, 2020; Trimania, Kusnadi, & Putri, 2022), especially among the more educated and/or higher income social classes, as a consequence of the globalization of animal welfare as a new subjective quality factor in the agri-food market (Estévez-Moreno et al., 2021). To meet these demands, the egg industry manages a variety of concepts such as “cage-free eggs,” which aim to address consumer concerns and provide information that helps mitigate the lack of knowledge about production systems, due to the progressive loss of connection between consumers and producers (Jiang et al., 2021).

In Mexico, eggs have a significant impact on the economy, diet, culture, food security and culinary traditions (Mendoza et al., 2016).

* Corresponding author.

E-mail address: lestevez@unizar.es (L.X. Estévez-Moreno).

<https://doi.org/10.1016/j.foodqual.2024.105292>

Received 5 December 2023; Received in revised form 8 July 2024; Accepted 3 August 2024

Available online 8 August 2024

0950-3293/© 2024 The Authors. Published by Elsevier Ltd. This is an open access article under the CC BY-NC-ND license (<http://creativecommons.org/licenses/by-nc-nd/4.0/>).

Also, Mexico has the highest annual per capita egg consumption in the world, at 26 kg per person per annum (SADER, 2023). The national egg industry meets 99 % of this demand and, with a census of 202 million laying hens and a production of 3 million tons, Mexico is currently the world's fifth-largest egg producer (UNA, 2023a). The egg sector accounts for 17 % of the nation's animal protein output, 28.7 % of overall livestock production and generates an annual income of USD 3.8 billion. Unlike meat and milk, traditional markets and central supply centers are responsible for 73 % of the country's egg sales, with only 20 % sold in supermarkets and convenience stores, while the remaining 7 % pertains to the cosmetics or food sector (SADER, 2023). From 2017 to 2022, the mean price of eggs per kilogram for consumers was USD 1.54, with a total fluctuation rate of 11 % (UNA, 2023a). Nevertheless, in November 2022, the price of eggs increased the most in comparison with other animal proteins, by 22.9 %, with a year-on-year increase to USD 2.46 per kilogram. The reason behind this escalation was the impact of Ukraine-Russia conflict on global grain markets, along with the outbreak of H5N1 avian influenza (SADER, 2023).

Ninety percent of eggs produced in Mexico originate from conventional cage rearing systems located in large integrated farms that boast high standards of hygiene and biosecurity measures. These farms have a production capacity on par with that of the United States (Ornelas-Eusebio, García-Espinosa, Laroucau, & Zanella, 2020). Five major companies, *Proan*, *Bachoco*, *Guadalupe*, *Calvario* and *Gena*, mostly maintain cage-based systems and dominate forty percent of the domestic egg market (UNA, 2023a). The mean size of layer caged farms is approximately 100,000 hens, although 80 % of national production is from farms with more than 700,000 hens (Pérez, Figueroa, García, & Godínez, 2014). The remaining 10 % of egg production comes from family farms and small and medium-sized enterprises, who may keep hens in backyard, cage or free-range systems (Romo et al., 2022). The latter systems exhibit substantial variation regarding genetic lines, densities, management quality, equipment, efficiency, and production volume (SADER, 2023). Furthermore, it has been reported that at least 80 % of rural Mexican households rear poultry for either personal consumption, immediate social circles or local markets (Hernández-Ortiz et al., 2022). Those eggs are frequently more expensive than commercial eggs, under the unofficial branding of “*huevos de rancho*” or “*huevos de gallina feliz*” (“ranch eggs” or “happy hen eggs”) as consumers perceive them to be of better quality, delicious, and reminiscent of free-range production as a traditional rural value (Cuca-García, Gutiérrez-Arena, & López-Pérez, 2015).

The growing consumer interest in hen welfare and organic farming practices is a global phenomenon that has led to an increase in the availability of eggs from free-range systems (Janssen, Rödiger, & Hamm, 2016). Concurrently, some sectors of civil society and international NGOs have been advocating for a ban on cages (including enriched cages in EU legislation) and a gradual shift to free-range or pastured systems. Although still limited in scope, there are some indications of change, particularly from multinational processors and retailers. Some companies, such as *McDonald's*, *Bimbo*, *Nestlé*, *Alsea*, *Kraft-Heinz* and *Unilever*, have announced their commitment to procure only cage-free eggs from their suppliers by 2030 (Romo et al., 2022). However, these pressures are often not aligned with national legislation and market logic in many emerging economies around the world. The case of Mexico is useful to understand the relationships between consumer perceptions and their WTP for animal welfare-friendly products in emerging economies (Bracke, Vermeer, & van Emous, 2019). The present study aims to enhance comprehension of three key areas. Firstly, it will examine the perceptions of egg consumers regarding welfare-friendly housing (WLH), the nature of the human-hen relationship, and the role of housing systems in WLH. Secondly, it will investigate the factors influencing their willingness to pay a premium for poultry-free eggs (WTPPP). Thirdly, it will profile consumers willing to pay a premium for cage-free eggs, according to the maximum price premiums they would pay for eggs from different cage-free production systems. The study will

make use of insights from Mexico as a point of reference.

2. Material and methods

The present study was conducted between the months of February and March 2023 in the Toluca Metropolitan Valley –TMV– (sixteen municipalities), which is a densely populated area (>905 inhabitants/km²) in the State of Mexico, with an area of 2669.8 km² (COESPO, 2015) and a population of 2,350,000 inhabitants, making it the fifth most populated metropolitan area in the country (INEGI, 2021). At the same time, TMV is a metropolitan area that is widely used in food market research by marketers and consulting companies, since the socio-demographic profile of this city is a diverse, cosmopolitan area that adequately reflects the opinion of the country's general population (Miranda-de la Lama et al., 2017; Rojas-Rivas & Cuffia, 2020; Estévez-Moreno et al., 2021). The objectives of the study were submitted to the Research Ethics Committee of the Autonomous Community of Aragon (CEICA), which recommended that the study be carried out in accordance with the guidelines of the Declaration of Helsinki and confirmed that an ethical vote from its committee was not applicable as the study would be carried out in a foreign country.

2.1. Study description

Face-to-face surveys were conducted with 1040 Mexican egg consumers in a buying context. For this purpose, a non-probabilistic sampling was carried out to cover the main types of stores where eggs are sold for household consumption in Mexico. Surveys were conducted in supermarkets/chain convenience stores (43.0 %), and in traditional retail food stores (57 %) (i.e. municipal markets, 19.2 %; traditional street markets called “*tianguis*”, 13.6 %, corner stores/produce stores/poultry shops, 20.3 %, and specialized egg stores, 3.9 %). The surveys were conducted by a group of trained surveyors. Respondents were approached at the location closest to the point of sale of eggs. Each potential respondent was asked two introductory questions: “*Do you eat eggs?*” and “*Do you buy eggs in this store?*”. After receiving an affirmative response to these two questions and confirming that the respondent was at least 18 years of age, the goals of the study were explained to the respondent and verbal consent for participation in the study was requested. Each respondent was informed that the survey was anonymous, would take between 10 and 15 min to complete, and that they would receive no financial compensation for their participation. It was also made clear that they could stop at any time and that the data provided would only be used for research purposes.

The survey was completed after the respondent agreed to participate. The response rate was 69 % (1087 questionnaires) and 47 additional questionnaires were discarded as incomplete. After the surveys were completed and collected it became impossible to identify those interviewed at an individual level. The socio-demographic characteristics of respondents and places where they purchased eggs are presented in Table 1. Most consumers were female (64 %) and one person reported being of a different gender than female or male; 53 % of respondents were between the ages of 18 and 40, and 54 % had a university or postgraduate education. Households (people who share the same dwelling and have a common kitchen) of the respondents varied in size, ranging from 1 to 15 members. However, 65.5 % of the respondents' households had between 2 and 4 members, 27.2% were households with > 4 members, and 7.3 % were single-person households. Regarding the household structure, about half of these consisted of people between the ages of 12 and 59 (44.7 %). Regarding members in the households, 26.8 % of households had children under the age of 12, 17.3 % with no children and adults above 60 years old, and 10.1 % of households with members of all three age groups. No households were reported as consisting only of older adults (>60 years) and 62.9 % of households reported having companion animals. Finally, 77 % of consumers identified traditional retail food stores as their primary place of purchase for eggs.

Table 1
Socio-demographic characteristics of respondents (n = 1040).

Variable	%	Variable	%
<i>Gender</i>		<i>Household size (number of members)</i>	
Male	35.9	1	7.3
Female	64	2	18.3
Other	0.1	3	22.1
<i>Age</i>		4	25.1
18–30	29.8	5	13.0
31–40	23.4	≥ 6	14.2
41–50	21.3	<i>Type of household*</i>	
51–60	16.4	No children – old adults	44.7
>60	9.1	Children	26.8
<i>Education level</i>		No children – old adults	14
Elementary	7.1	Only old adults	4.3
Middle school	13.8	Children – old adults	10.1
Secondary school	13.8	<i>Place of residence</i>	
Technical	9.8	Urban	73.1
University	45.1	Rural	26.9
Postgraduate	8.5	<i>Place to purchase eggs</i>	
<i>Companion animals at home</i>		SC	10.4
Yes	62.9	TS	35.6
No	37.1	SC – TS	54.0

* Households were classified according to the presence of household members aged <12 years (children) or >60 years (old adults), all households except “only old adults” included at least one adult member aged 18–59 years. SC= Supermarkets/convenience retail stores, TS= Traditional stores.

Regarding place of purchase, 74.8 % of consumers reported buying from more than one type of establishment (supermarkets/chain convenience stores, municipal markets, traditional street markets, corner stores/produce stores/poultry shops, specialized egg stores, direct purchase from a producer). Of these, the majority (54 %) combine traditional channels with supermarkets/self-service stores (Table 1).

2.2. Survey design and structure

A draft questionnaire was administered to 70 respondents (not included in the final sample) to ensure that the interview process did not overwhelm them and to ensure consistent interpretation of the questions and response options across participants (Cherry and Adedokun, 2012). The final questionnaire, adjusted according to the results from this pilot study, included 70 questions distributed in seven sections. The first section (7 questions) focused on describing the sociodemographic characteristics of respondents (gender, age, educational level, origin) and their households (members younger than 13 years, older than 59 years, total number of members); ownership of companion animals (yes/no, species of animals), and the first word that came to their mind when thinking about a hen. The second section (7 questions) focused on the respondent’s consumption and purchasing habits, including one question about the main places where consumers purchase eggs (closed multiple-choice question, the other questions were not analyzed in this study). The third section (not analyzed in this study) addressed the motivations and preferences associated with egg consumption (27 questions). In the fourth section (10 questions), respondents are asked to rate how important (using a 10-point scale; 0 –not important- to 10 –very important) was the welfare of companion animals and hens was for them (2 questions). Seven statements about the welfare of laying hens (e.g., hens should be able to express their natural behaviors during rearing) were included to be rated by respondents on a 5-point Likert scale from 1 = strongly disagree to 5 = strongly agree. The multiple-choice question “Who should ensure the welfare of laying hens in México?” was also included in this section.

In the fifth section (7 questions), respondents were first asked about their self-perceived level of knowledge about raising laying hens (high/medium/low/none). Subsequently, a photo-elicitation technique (Harper, 2002) was used to explore their perceptions of the relationships between housing systems and various factors that can affect WLH. Three

photos provided by the authors of the study were shown to illustrate the basic differentiating elements of the three systems: the use of cages (Fig. 1a – “cage”), the absence of cages in a confined environment (Fig. 1b – “barn”), and the possibility of animals having access to the outside (Fig. 1c – “free-range”). In all cases, the images focused on the flock rather than individual animals and were transformed into gray-scale to avoid additional consumer evocations related to color or light-shadow conditions. Respondents were given 10 to 15 s to view the three images before being asked the next questions about them: *In your opinion, which of these three systems provides a) more physical comfort for hens? b) more protection from potential predators? c) more possibilities to express natural behaviors? d) more protection from extreme weather? e) less risk of suffering from fear or negative emotions? and f) less risk of suffering from injury, disease or pain?* Respondents rated the three systems from best to worst (using numbers from 1 to 3), with the possibility of giving the same rating to more than one system or not answering due to lack of knowledge.

The sixth section (6 questions), included questions about consumers’ WTPPP for cage-free eggs. First, consumers were asked about the two main reasons why they would consider buying this product (multiple-choice question); whether during the last 12 months they bought cage-free eggs (usually/sometimes/never), and whether they would currently be willing to pay a price premium for cage-free eggs (yes/no).

Those who answered yes to this last question were asked: *If 1 kg of eggs from cage-raised hens costs 50 MXN (2.8 USD), how much additional money would you be willing to pay a price premium for free-cage eggs produced in a) barns?; b) free-range systems?; and c) free-range systems certified as organic/ecological?* (open-ended questions). In the seventh section respondents expressed their level of agreement (5-point Likert scale, 1 = strongly disagree to 5 = strongly agree) with four statements about their relationship with hens (e.g. *I would like to raise my own hens to produce eggs*). We also asked them: *Have you ever lived in a household where laying hens are kept or have you ever kept them yourself (yes/no)?* Finally, the respondent was asked if they had any comments, which were then transcribed by the interviewer.

2.3. Statistical analysis

Data analysis was carried out using the software SPSS version 22.0. Univariate descriptive analysis of consumer perceptions of hen welfare, consumer-hen relationships, and the role of housing systems in hen welfare was performed using percentages for qualitative variables and medians (with the interquartile range as a measure of dispersion) for quantitative variables, given the non-parametric nature of the latter (tested using the Kolmogorov Smirnov test with the Lilliefors’s correction). The chi-square test was applied to examine the relationships between the overall importance that respondents assigned to hen welfare (10-points scale) and their socio-demographic characteristics ($P < 0.05$). Spearman’s correlation test was applied to compare the scores assigned to the importance of welfare of laying hens and of companion animals ($P < 0.05$). An exploratory factor analysis was performed to establish the underlying relationships between the variables about consumer perceptions of hens and their welfare. Factors were obtained using the principal components method, and the Kaiser Meyer Olkin index (KMO) and Bartlett’s test of sphericity were used to measure the degree of model adequacy. Variables with communalities > 0.5 were retained in the analysis, and the final number of factors was determined by taking eigenvalues > 1 as a criterion. The factors were extracted using the Varimax rotation method.

A binary logistic regression was carried out in order to identify the factors that influence the likelihood that consumers would be willing to pay a price premium for cage-free eggs. Self-reported WTPPP for cage-free eggs (0 = I am not willing to pay a price premium for cage-free eggs, 1 = I am willing to pay a price premium for cage-free eggs), was defined as the binary dependent variable, and explanatory variables included consumers’ socio-demographic characteristics; perceptions

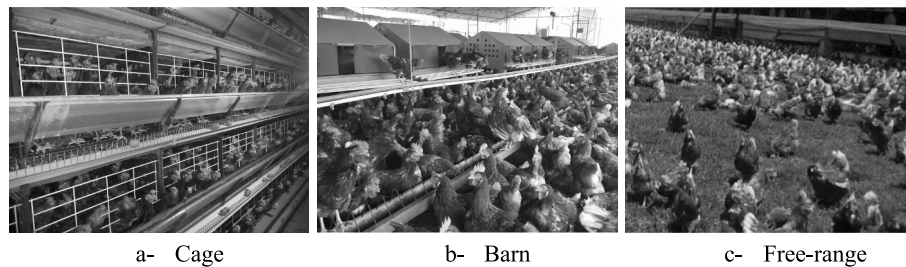


Fig. 1. Images of housing systems used in the photo-elicitation technique.

about hens and hen welfare (resulting from the exploratory factor analysis); perceptions about housing systems (cage, barn, free-range); self-reported level of knowledge about hen farming and previous experience buying free-range eggs and rearing hens. In a preliminary stage, univariate regression models were run to detect possible predictors of WTPPP ($P < 0.05$). A multivariate analysis was then performed using the automatic backward selection. In this method, all variables that were significant at the univariate level entered into the equation, and those less correlated with the dependent variable were removed in successive steps. The process stopped when all predictors in the equation were significantly associated with WTP for cage-free eggs ($P < 0.05$). The Nagelkerke R-square, the Hosmer and Lemeshow test and the classification table were used as measures of model adequacy.

Finally, a hierarchical cluster analysis (using Ward's method and squared Euclidean distance) was carried out to identify mutually exclusive consumer profiles according to the price premiums they would be willing to pay for different types of cage-free production systems: a) barn systems, b) free-range systems and c) certified organic free-range systems. This analysis was performed using the subsample of consumers who reported to be willing to pay for cage-free eggs ($n = 560$). The price premium expressed in additional Mexican pesos (MXN) to be paid for 1 kg free-cage eggs over a base price of 50 MXN/kg, was transformed in to a percentage premium. The number of clusters was determined by observing the dendrogram and a new variable was created to assign each consumer to one of the clusters identified. Clusters were then described by identifying significant associations between the variables included in the study and the cluster to which each consumer belonged ($P < 0.05$) using Kruskal-Wallis and Chi-Square tests for quantitative and qualitative variables, respectively. The Dunn-Bonferroni method and the observation of corrected standardized residuals (considered significant for values $\geq +2$ or ≤ -2) were used as post-hoc analysis when the Kruskal-Wallis and Chi-square tests showed significant differences between clusters ($P < 0.05$).

3. Results

3.1. Consumer perceptions about WLH

The importance of the WLH, rated by consumers on a scale from 1 to 10, scored a median of 10.0 (IQR=2.0) and an average of 8.6. Most respondents assigned a score of 9 or 10 to this variable (69.9%), while only 6.1% assigned less than 5. To examine the relationships between this rating and the characteristics of respondents, the former variable was categorized as not important (1 to 3, $n = 73$), not very important (4 to 6, $n = 90$), important (7 to 8, $n = 181$) and very important (9 to 10, $n = 705$). No significant associations were found between this variable and having (or not having) companion animals at home, having reared hens at some point in the respondent's life, or with the respondent's level of education ($P > 0.05$). However, an association was found between the female gender and giving the highest importance to the welfare of hens, and between the male gender and not considering it important (Table 2). Respondents aged 50 and over tended to give the highest scores and those aged 18–30 tended to give intermediate scores

Table 2

Overall importance of hen welfare (1 to 10 scale) according to socio-demographic characteristics (% respondents).

Variable	Not important 1 to 3 ($n = 73$)	Not very important 4 to 6 ($n = 90$)	Important 7 to 8 ($n = 181$)	Very important 9 to 10 ($n = 705$)	P
Gender ($n = 1039$)					
Male	8.0 ⁽⁺⁾	10.7	20.4	60.9 ⁽⁻⁾	0.003
Female	5.0 ⁽⁻⁾	7.5	15.8	71.8 ⁽⁺⁾	
Age (years) ($n = 1040$)					
18–30	7.1	11.7 ⁽⁺⁾	21.7 ⁽⁺⁾	59.5 ⁽⁻⁾	0.001
31–40	8.6	8.2	17.3	65.8	
41–50	5.4	10.0	17.2	67.4	
51–60	3.5	5.3	12.9	78.4 ⁽⁺⁾	
>60	2.1	3.2	12.6	82.1 ⁽⁺⁾	
Type of household ($n = 1040$)					
No children – no old adults	8.2 ⁽⁺⁾	10.3	15.9	65.5	0.035
Children	5.4	8.2	22.2 ⁽⁺⁾	64.2	
No children – old adults	3.4	7.5	17.8	71.2	
Only old adults	2.2	2.2	13.3	82.2 ⁽⁺⁾	
Children – old adults	3.8	6.7	12.4	77.1 ⁽⁺⁾	

P-value < 0.05 indicates significant differences according to the Chi-square test. (+) and (–) indicates standardized corrected residuals higher than +2.0 or lower than –2.0.

to this variable. Regarding the type of household to which the interviewees belonged, those with only older adults or with older adults and children (<13 years) were associated with the “very important” category, while households without members in these age groups were associated with the “not very important” category. Spearman's correlation coefficient (0.604, $P < 0.001$) showed a positive correlation between the respondents' assessment of the importance of the welfare of hens and companion animals. The median score of the importance of companion animals was 10.0 (IQR=1.0); 75.9% of responses were between 9 and 10 and only 2.7% were < 4. Furthermore, 64.3% of respondents scored the welfare of both species the same, 12.5% scored hens higher and the remaining 23.2% scored companion animals higher.

3.1.1. Consumer perceptions about their relationship with hens and WLH

According to the scores assigned on the 5-point Likert scales, the majority of consumers strongly agreed that hens can feel pain or suffering (median 5.0; IQR=1.0). With a median of 4.0/5.0, consumers mostly agreed that the welfare conditions of hens can affect egg quality (IQR=1.0), hens should be able to express their natural behaviors during rearing (IQR=1.0) and hens can feel emotions (IQR=1.0). The perceptions that hens are cute or tender and that consumers would like to raise

their own hens to produce eggs, obtained a median score of 3.0 (IQR=4.0; IQR=2.0, respectively). Consumers mostly disagreed (median = 2.0; IQR=2.0) that in Mexico there is enough information about how hens are raised and that existing regulations in the country guarantee hens' welfare. In addition, they strongly disagreed that they would like to keep a hen as a companion animal (median = 1.5; IQR=3) and that the information they receive when buying eggs let them know how the hens have been raised (1.0; IQR=1.0).

In order to describe the structure of the correlations between these variables, an exploratory factor analysis was carried out. Factor loadings of the three resulting components ranged between 0.61 and 0.84 (Table 3). The first one, called "recognition of hens as sentient animals", explained 24.2 % of the variance and groups the perceptions about the ability of hens to feel emotions, pain, or suffering, and the fact that they should be able to express their natural behaviors while being raised. The second factor named "availability of information and suitable standards on WLH", explained 19.8 % of the variance, and group perceptions about the availability of information about hen raising conditions both at the country level and in the eggs, they buy, and the suitability of Mexican laws and regulations to guarantee their welfare. The third factor was named "strength of the human-hen bond", explaining 19.0 % of the variance and grouped the perception about whether hens are cute or tender, with the interest of consumers to raise their own hens to produce eggs and to have a hen as a companion animal.

3.1.2. Housing systems and WLH

The self-reported consumer level of knowledge about hen husbandry ranged from low to none (35.9 % and 30.9 %, respectively), 28.0 % considered their level of knowledge to be medium and only 4.8 % said they had a high level of knowledge about hen husbandry. Regarding previous experience, 51.4 % of consumers, reported having raised hens or having lived in a household where this was done. Free-range systems were the most frequently reported as providing the best welfare conditions for laying hens, in dimensions such as animal comfort, expression of natural behaviors of the species, less suffering from fear or negative emotions, and less suffering from injuries, diseases and pain (Table 4). In contrast, protection against extreme weather and predators were dimensions that were more associated with cages than with the other systems. In addition, consumers tended to favor only one type of system when referring to animal comfort, but concerning the other dimensions, between 13.8 % and 20.0 % of respondents considered that different systems could provide the same welfare conditions for the hens.

Table 3
Factor analysis.

Variable	Factor loadings	Explained variance (%)
<i>Recognition of hens as sentient animals</i>		
Hens can feel pain or suffering	0.835	24.195
Hens should be able to express their natural behaviors during rearing	0.797	
Hens can feel emotions	0.606	
<i>Availability of information and suitable standards on hen welfare</i>		
In Mexico, there is enough information about how laying hens are raised	0.796	19.810
Mexican laws and regulations guarantee the welfare of laying hens	0.750	
The information I receive when I buy eggs lets me know how the hens have been raised	0.745	
<i>Strength of the human-hen bond</i>		
Hens are cute or tender animals	0.837	19.005
I would like to raise my own hens to produce eggs	0.790	
I would like to have a hen as a companion animal	0.779	

KMO index = 0.700; Bartlett's test of sphericity = <0.001; explained variance = 63.010%.

Table 4

Housing system selected by consumers as providing the best AW conditions (n = 1040, % respondents).

Welfare concerns	Cage	Barn	Free-range	Multiple/no systems
Comfort	4.42	7.79	82.12	5.67
Protection against predators	49.71	17.40	19.13	13.75
Expression of natural behavior	2.31	9.13	76.83	11.73
Protection from extreme weather conditions	40.29	23.65	16.06	20.00
Suffer less from fear/negative emotions	5.87	22.21	56.15	15.77
Suffer less from injury / disease / pain	10.29	25.38	46.63	17.69

3.2. WTPPP for free-cage eggs

A total of 53.8 % (n = 560) of surveyed consumers would be willing to pay a premium for cage-free eggs. These values varied depending on the place of purchase: 66.7 % for those who shop exclusively at supermarkets/chain convenience stores, 55.4 % for those who shop at traditional retail food stores, and 46.5 % for those who shop at both types of stores (P<0.05). Among the general sample, 73.0 % (n = 309) would pay for barn eggs, 95.0 % (n = 532) for free-range eggs and 98.6 % (n = 552) for free-range certified organic eggs. The multivariable logistic regression model identified 8 variables that helped explain the WTPPP for cage-free eggs reported by respondents (Table 5). Having a university or postgraduate education increased the probability of being willing to pay more for cage-free eggs by 2.3 and 7.3 times, respectively, compared to having primary school (or no education). Having regularly purchased cage-free eggs over the last twelve months increased this probability by 2.7 times compared to never purchasing them, while purchasing them sometimes increased it by 1.7 times (Table 5). Consideration that free-range best prevents hens from being frightened also increased the

Table 5

Multivariable regression model: Consumers' WTP for cage-free eggs ("yes"=1, "no"=2) (n = 1040).

Variable	SE	P	Odd ratio	I.C. 95 % Odd Ratio	
				Lower	Upper
<i>Education level</i>					
Elementary		0.000			
Middle/secondary school	0.254	0.524	1.176	0.715	1.934
Technical	0.309	0.200	1.486	0.811	2.724
University	0.247	0.001	2.345	1.444	3.807
Postgraduate	0.371	0.000	7.326	3.544	15.147
<i>Previous purchase of cage-free eggs (in the last twelve months)</i>					
Never		0.000			
Regularly	0.265	0.000	2.766	1.645	4.651
Sometimes	0.143	0.006	1.485	1.123	1.964
<i>Perceptions and attitudes towards animal welfare</i>					
Welfare conditions of laying hens may affect egg quality	0.069	0.000	1.276	1.115	1.461
Strength of the human-hen bond	0.062	0.001	1.236	1.095	1.395
Overall importance of hen welfare	0.032	0.045	1.067	1.002	1.137
<i>Perceptions about the role of different housing systems on WLH</i>					
Cages are the best protection for hens against predators.	0.142	0.005	0.673	0.510	0.889
Free-range is the system that that most prevents the hens from suffer fear or negative emotions.	0.146	0.009	1.463	1.099	1.949
Barn is the system that best prevents hens from injury, disease or pain.	0.149	0.047	0.744	0.556	0.996
Constant	0.476	0.000	0.059		

Hosmer and Lemeshow test P=0.921; Nagelkerke's R² =0.201; Overall percentage of correct answers = 66.3% (WTP for free-cage eggs: "yes"= 71.3; "No"=60.4).

probability, while thinking that cages are the best protection for hens against predators and that barn is the system that best protects hens from injury, disease or pain, had the opposite effect. Finally, associating WLH with egg quality, having an interest in keeping/rearing hens, and considering animal welfare to be important increased the WTPPP ($P < 0.05$).

3.3. Consumer profiles

The median price premium that consumers who expressed a WTPPP for cage-free eggs ($n = 560$) was 10.0 % (IQR=20.0) for barn eggs, 20.0 % (IQR=26.0) for free-range eggs, and 30.0 % (IQR=40.0) for organic certified eggs. Cluster analysis based on premiums for the three categories of cage-free eggs revealed the existence of three consumer clusters (Table 6) which we have named high WTPPP (H-WTP), low WTPPP (L-WTP) and medium WTPPP (M-WTP): H-WTP groups 21.3 % of consumers ($n = 119$). Their premium willingness is the highest for cage-free eggs of the three types. This premium increased by a further 20.0 % for

Table 6
Cluster profiles of consumers WTP for cage-free eggs ($n = 560$).

	H-WTP ¹	L-WTP ²	M-WTP ³	P
	($n = 119$)	($n = 215$)	($n = 226$)	
<i>Percentage premium to for cage-free eggs (median (IQR))⁺ *</i>				
Barn eggs	40.0 (40) ^a	10.0 (10) ^b	18.0 (11.5) ^c	<0.001
Free-range eggs	60.0 (30) ^a	10.0 (10) ^b	30.0(20) ^c	<0.001
Organic certified eggs	100.0 (30) ^a	20.0 (10) ^b	40.0(20) ^c	<0.001
<i>Socio-demographic characteristics</i>				
Place of residence inside the TMV				
Rural	21.8	36.3 ⁽⁺⁾	22.6 ⁽⁻⁾	0.002
Urban	78.2	63.7 ⁽⁻⁾	77.6 ⁽⁺⁾	
Education level				
Elementary to technical	35.3	45.1 ⁽⁺⁾	32.3 ⁽⁻⁾	0.016
University	48.7	47.0	51.8	
Postgraduate	16.0	7.9 ⁽⁻⁾	15.9	
<i>Perceptions and attitudes towards hens' welfare</i>				
Overall importance of hens' welfare (1 = no important at all. 10 = very important) (median (IQR)) [*]	9.0(2) ^a	10.0 (2) ^b	10.0(2) ^b	0.020
Welfare conditions of laying hens may affect egg quality (1 = totally disagree. 5 = total agree) (median <(IQR)) [*]	5.0(1) ^a	5.0 (1) ^{ab}	4.0(1) ^b	0.045
Strength of the human-hen bond (1 to 5 scale)	3.3 (1.7) ^a	3.0 (2) ^{ab}	3.0(2) ^b	0.024
Recognition of hens as sentient animals (1 to 5 scale)	4.7(1) ^a	4.3(1) ^b	4.3(1.3) ^{ab}	0.013
<i>Main motivation for considering buying cage-free eggs over cage eggs^{**}</i>				
Are healthier	18.5 ⁽⁻⁾	27.4	30.5	0.025
Their productions is environmentally friendly	1.7	2.3	4.4	
Are produced by responsible farmers	13.4	14.9	8.4	
Are better tasting	10.1	12.6	8.0	
Are better for society	2.5	1.1	0.4	
Are produced by healthier hens	13.4	15.8	14.2	
Hens have better welfare	40.3 ⁽⁺⁾	24.7 ⁽⁻⁾	34.1	
<i>Motivations for considering buying cage-free eggs over cage eggs</i>				
Are healthier				0.002
No (%)	71.4 ⁽⁺⁾	55.8 ⁽⁻⁾	57.9	
Yes (%)	28.6	47.3 ⁽⁺⁾	42.1	
Are better tasting				0.010
No (%)	92.4 ⁽⁺⁾	81.4 ⁽⁻⁾	88.5	
Yes (%)	7.6 ⁽⁻⁾	18.6 ⁽⁺⁾	11.5	

¹High Willingness-to-pay, ²Medium Willingness-to-pay, ³Low Willingness-to-pay. ⁺Based on a reference price of 50 Mexican Pesos per 1 kg of cage eggs. Significance level established at $P < 0.05$ according to *Kruskal-Wallis test and **Chi-square test. ^{a,b,c} indicates post-hoc significant differences according to Kruskal-Wallis post-hoc Test with Bonferroni correction.

free-range eggs (IQR=30) and by a further 40.0 % for organic eggs, starting from a median premium of 40.0 % (IQR=40) for barn eggs. They assigned a median score of 9/10 to the overall importance of WLH, significantly lower than that of the other two clusters. These consumers are more convinced that the welfare conditions of laying hens can affect egg quality and their perceptions reflect a greater strength of the human-hen bond compared to those of the M-WTP. Furthermore, they are more convinced that hens are sentient beings compared to the consumer perceptions of L-WTP consumers. In addition, the main motivation of these consumers to buy free-range eggs instead of caged eggs is related to the welfare of the hens and not to the healthier nature of these eggs.

L-WTP comprised 38.4 % of consumers ($n = 215$), who are willing to pay the lowest premiums for cage-free eggs. That is, a median of 10.0 % for both barn and free-range eggs, and a median of 20.0 % for organic certified eggs. This cluster concentrated the highest proportion of rural residents and consumers without university or postgraduate education and the lowest proportion of consumers with postgraduate education. Compared to cluster H-WTP, these consumers attached a higher importance to the welfare of the hens, but a lower level of agreement with their capacity for sentience. Their main motivation for buying free-range eggs was negatively associated with hens having higher welfare under this production system. M-WTP comprised 40.4 % of consumers ($n = 226$) willing to pay an additional 18.0 % for barn eggs, nearly double this amount for free-range eggs, and a premium of 40.0 % for certified organic eggs. M-WTP concentrated a significantly lower proportion of consumers with elementary to technical education and a higher proportion of urban residents; regarding their perceptions, M-WTP consumers assigned a median score of 10/10 to the importance of WLH, higher than that assigned by H-WTP consumers. M-WTP consumers reported a lower level of agreement that the welfare conditions of laying hens may affect egg quality and a lower rating to the strength of the human-hen bond.

4. Discussion

In general, our study is the first to report on Mexican consumer attitudes towards WLH, their WTPPP for cage-free eggs, and to profile consumers according to the percentage price premium they are willing to pay. This is even more relevant on an international level given that Mexico is the world's largest annual per capita consumer of eggs and that 90 % of these eggs come from caged hens (UNA, 2023a). In the present study, surveys were conducted in various types of retail channels, with particular consideration given to the dynamics of the egg market and the importance of the traditional retail channel. This is because, historically, many Mexican studies have focused on either supermarket (e.g. Miranda-de la Lama et al., 2017) or traditional markets (e.g. Serrano-Cruz et al., 2018). In this context, our results indicate that the majority of respondents combine different types of traditional retail food shops or combine some of these shops with supermarkets or chain convenience stores. Further exploration of the motivations behind these strategies could enhance the comprehension of the role of eggs in the Mexican diet, consumer shopping habits and inform the development of future strategies aimed at promoting cage-free egg consumption.

4.1. Consumer perceptions about WLH

Our results confirm the importance of hen welfare for Mexican consumers, with higher scores than those reported by Miranda-de la Lama et al. (2017) for farm animals in general. This is significant given that eggs and milk have a distinct nature as animal products, as they do not involve slaughter in their production and are often marketed and understood as harmless by-products (Docherty & Jasper, 2023). Our findings are also consistent with growing evidence that women hold more pro-WLH attitudes than men (Herzog, 2007; Miranda-De La Lama et al., 2017; Estévez-Moreno, Miranda-de la Lama, & Miguel-Pacheco, 2022). However, in our study, no differences were found between the

educational level of the respondents and the importance they placed on WLH. It is possible that WLH is no longer just a concern of the more educated, but an ethical value of contemporary societies (Estévez-Moreno et al., 2021). Our results also show that older people and households with children attach greater importance to the welfare of hens. These findings contrast with some evidence that only young adults are strongly concerned about the sustainability and welfare implications of animal production and consume accordingly (Ford et al., 2023). Moreover, it suggests that other age-related factors may influence the way consumers perceive hens, such as the possibility of having some lifetime contact with poultry farming, which is less likely for younger generations compared to older ones. However, there is a positive correlation between higher values and having children, suggesting that life stages might influence consumer sensitivity to WLH.

4.1.1. Consumer perceptions about their relationship with hens and WLH

Looking more closely at perceptions of hen welfare, it was found that both egg consumers in this study and meat consumers surveyed by Miranda-de la Lama et al. (2017) tended to agree or strongly agree with statements about sentience and need to express natural behavior. These statements were grouped under the factor “recognition of hens as sentient animals”, suggesting that consumers acknowledged the multi-dimensional nature of animal sentience, and its possible effects on WLH (Mellor, 2019). Egg consumers tended to disagree with statements about the availability of information about how animals are raised in Mexico, as did Mexican meat consumers (Miranda-de la Lama et al., 2017). Similarly, the statement that Mexican laws and regulations guarantee the welfare of laying hens was met with widespread disagreement. Consequently, these three variables are grouped under the factor called “availability of regulations and information supporting the welfare of laying hens”. In the Mexican context, this lack of information is due to the limited scope of the current regulation on egg labeling (Regulation NMX-FF-127-SCFI-2016; SE, 2016), as it does not include specific requirements regarding the farming system in which the eggs were produced. In addition, the sale of eggs in bulk is generally not supported by any information beyond what the seller is willing or able to provide to the customer. The only products that include information on the farming system in their labeling are certified organic or “happy hens” or “pastured hens” sold in self-service stores, which, in any case, are not yet in high demand at the national level (Lara, 2022).

Consumer agreement with statements describing their relationship with hens and the possibility of developing a closer relationship with these animals was generally medium to low. Lack of knowledge or resources to properly raise hens may be a factor in these low scores. However, they may also be connected to the emotional distance between birds and humans, which may be greater than that between humans and other phylogenetically closer animals, such as four-legged mammals (Ingham, Neumann, & Waters, 2015). However, although hens are considered non-traditional companion animals, some evidence suggests that backyard hen husbandry has positive psychological effects on people living in urban environments (Blecha & Leitner, 2014). In addition, there is evidence that household producers perceive a higher quality of eggs while satisfying their ethical concerns about WLH (Macauley & Chur-Hansen, 2022).

4.1.2. Housing systems and WLH

Animal welfare is one of the key agricultural policy goals and is considered extremely important by consumers (Ammann, Mack, Irek, Finger, & El Benni, 2023). Our study found that 67 % of consumers say they have little or no knowledge about hen farming. This result is in line with several studies showing that consumers have difficulty understanding the differences in poultry housing systems and their impact on costs, WLH and the environment (Da Silva-Pires et al., 2021). Another interesting finding is that more than 50 % of respondents reported having kept hens or having lived in a household where hens were kept, which is consistent with Hernández-Ortiz et al. (2022), who reported

that keeping hens at the family level is a deeply rooted rural Mexican custom.

A number of studies on human-animal relationships have employed techniques that provide respondents with additional information to assist in elucidating their opinions or perceptions on specific topics related to animal welfare (Doyon et al., 2023). These techniques include the use of photographs (Bergmann, 2020; Wassermann, Hind-Ozan, & Seaman, 2018), detonating words or concepts (Doyon et al., 2016) and information cards (Cao, Cranfield, Chen & Widowski). In the context of the photo-elucidation technique, participants are exposed to a series of images so that they can use their extensive cognitive repertoire to interpret what is observed (Bergmann, 2020). As part of our survey, when the respondents were shown a card with three photographs of hens in a cage, barn and free-range system, they identified free-range systems as the most comfortable for the hens, allowing them to express their natural behaviors and causing less suffering, pain, injury and disease. These results are in line with the advertising campaigns of many NGOs and scientific studies which show that cage confinement frustrates the behavior of highly motivated hens and reduces their quality of life (Rodenburg, Giersberg, Petersan, & Shields, 2022). However, the consumer perspective on these aspects may also be due to the fact that, in the consumer’s imagination these systems may represent a higher welfare option where hens have more opportunities to engage in their natural behaviors such as pecking, dustbathing and perching (Pettersson et al., 2016; Rodenburg et al., 2022; Bray & Ankeny, 2017). Equally, the business model that has emerged in many countries to meet consumer and supermarket demand for higher welfare labelled eggs relies on hens housed in large, intensive sheds with access to the outdoors (Carey, Parker, & Scrinis, 2017).

Our findings are consistent with Teixeira, Larraín, and Hötzel (2018) findings regarding consumers in Brazil and Chile, who described free-range systems as ideal, with better WLH and high egg quality, despite cage systems still dominating in those countries. Consumers also recognized that cages offer greater protection from extreme weather conditions and potential predators than free-range systems. These results suggest that the use of photographs pertaining to the evaluated housing systems enables consumers to adopt a more nuanced perspective, moving beyond simplistic dichotomies (e.g., good vs. bad) and potentially fostering a more comprehensive and balanced understanding of the subject matter. It is worth noting that there is growing evidence that free-range systems are not necessarily more welfare friendly than other systems, as hens are more exposed to injury from predators and flock-mates, diseases can be more frequent and generally more severe, and as a result, higher mortality is often observed in these animals compared to those kept in barns or cages (Holt, 2021). However, we also found that between 14 % and 20 % of respondents recognized that any of the three systems could lead to WLH conditions. This would reinforce the idea that any proposed change in legislation needs to be accompanied by a series of information campaigns on the pros and cons of each of the egg production systems.

4.2. WTPPP for free-cage eggs

Investigating consumer WTPPP for WLH-friendly products is a priority for stakeholders in cage-free egg production. This is because WLH assurance schemes entail additional costs for all actors in the food chain and need to be compensated with a price premium (Heinola, Latvala, & Niemi, 2023). In our study, which covered all types of shopping environments in the country, 54 % of respondents were willing to pay a price premium for different types of cage-free eggs (certified or not). However, the differences observed in WTPPP according to the type of shops where consumers buy eggs could be related to their purchasing power, as egg prices are usually lower in traditional stores than in supermarkets (PROFECO, 2011). It might also be related to lower exposure to cage-free eggs in traditional stores compared to supermarkets. A previous study by Miranda-de la Lama et al. (2017) in supermarkets the same city

found that 68 % of meat consumers surveyed were willing to pay for WLH-friendly products. Although this percentage is close to that obtained in the current study for consumers buying eggs only in supermarkets, it is higher compared to the WTPPP of those combining supermarket and traditional stores (46.5 %). Consequently, our results emphasize the need for further investigation into the relationship between buying habits and consumer preferences, especially regarding farm animal welfare criteria.

The multivariate logistic regression model used found eight variables that were highly related to WTPPP for non-caged eggs. We found that the higher the level of education, the higher the probability of being willing to pay a price premium for non-caged eggs. This phenomenon has been previously described in consumers willing to pay a price premium for non-caged eggs in developed countries (e.g. [Bejaei, Wiseman, & Cheng, 2011](#)). This may be due to the fact that as consumer education and income levels increase, they become more concerned about food quality issues and their preferences change ([Jaeger, Chheang, & Ares, 2023](#)). Our results also show that consumer WTPPP for cage-free eggs depends on their previous shopping experience. [Cao et al. \(2021\)](#) found a similar result where consumers who had previously purchased cage-free eggs were willing to pay up to \$1.39/dozen more for WLH-enhanced housing systems. Past experience is particularly important in a new market for differentiated quality eggs, such as the Mexican market, where consumer choice is still limited in terms of origin, quality, information and variety. In addition, most cage-free eggs do not fall under any verifiable certification program ([Miranda-de la Lama et al., 2017](#)). In the context of the potential changes in Mexican consumers' purchasing capacity in a post-COVID-19 scenario and in their consumption patterns ([Espinoza-Ortega et al., 2021](#); [Bautista-Arredondo et al., 2024](#)), as well as the contextual juncture of rising Mexican egg prices ([Juarez-Torres et al., 2023](#)), our findings about the role of prior purchase of cage-free eggs in the WTPPP reflect the importance that consumers continue to attach to WLH and the other attributes that they associate with this type of product.

We also found that certain attitudes and/or perceptions are very important in determining WTPPP for WLH-friendly products. For example, WTPPP increases if the consumer believes that egg quality is related to WLH, or recognizes hens as sentient, or gives a high score on a scale of 1 to 10 to the importance of WLH. Those consumers see WLH as a strategically important attribute for which they are willing to pay a price differential. While other studies, such as [Cornish et al. \(2020\)](#), have shown that higher levels of empathy towards hens lead to greater reluctance to compare WLH friendly products, this is particularly important for vegan consumers. Finally, we find that the likelihood of paying for cage-free eggs is higher for free-range eggs as a welfare guarantee, while those who value barn or cage systems as more welfare friendly were strongly against paying a price premium. These results indicate that, for consumers with WTPPP for cage-free eggs, free-range eggs are a product with many attributes (i.e. nutritious, tasty, sustainable, animal welfare), as opposed to a product with only one attribute, such as improved welfare in cages or a transition to barn systems ([Gerini, Alfnes, & Schjøll, 2016](#)).

4.3. Consumer profiles

The results of the cluster analysis suggest that the price premiums consumers would be willing to pay for welfare-friendly eggs are quite broad ([Morales, Ugaz, & Cañon-Jones, 2020](#)), particularly for cage-free eggs. Furthermore, they indicate that these premiums vary according to the cage-free housing system. Thus, H-WTP and M-WTP consumers are willing to pay premiums that increase when switching from barn to free-range eggs and from these to certified organic eggs. The L-WTP consumers, on the other hand, are willing to pay similar premiums for barn and free-range eggs and twice as much for organic eggs. Besides, the H-WTP segment is willing to pay higher premium prices for the three types of eggs than the L-WTP cluster. These premium prices, which ranged

from a median of 40 % to 100 %, are the closest to the reality of the Mexican market. In this regard, data provided by the National Union of Poultry Farmers (according to weekly reports between July and October 2023 for Mexico City, e.g. [UNA, 2023b](#); [UNA, 2023c](#)) show that the premium prices per dozen for organic eggs compared to white eggs in supermarkets often exceed 120 %, while free-range eggs tended to be 80 % more expensive. Our results indicate a considerable gap between the maximum premiums most consumers are willing to pay for different types of cage-free eggs and the prices of products currently available in the formal market. This gap may be due to the high current prices of cage eggs ([SADER, 2023](#)), which limit the ability of middle- and low-income groups to pay for credence attributes ([Schroback et al., 2023](#)). Additional explanations include the consumer's lack of knowledge about the additional costs of cage-free production, or their interest in buying these products in alternative markets. This is the case for "huevos de rancho", usually sold directly by the producer or through a local retailer (e.g., corner stores). Although there is no reference data about price premiums, these are usually lower than those of free-range eggs sold in supermarkets. All these hypotheses require confirmation in future studies. Nevertheless, the results pose significant questions about the feasibility of developing (multi-level) labels to finance the transition of egg production towards more animal-friendly systems ([Kühl et al., 2024](#)) under the current market conditions.

Considering potential future regulatory actions in Mexico in this direction, our findings suggest that increases in production costs and final consumer prices could lead to consumer welfare losses, as seen in California (USA) by [Mullally and Lusk \(2018\)](#). In Mexico, these shifts could significantly impact food security, given that the historical rise in egg consumption is linked, among other factors, to declining purchasing power among the population, which relies on eggs as a substitute for more expensive animal protein ([Hernández & Padilla, 2015](#)). Moreover, the potential consequences of these changes on the structure of the poultry industry and the dynamics of the egg market ([Kato, Shimasaki, & Yayou, 2024](#); [Mullally & Lusk, 2018](#)) underscore the necessity of developing public policy measures aimed at absorbing the costs necessary to fulfill consumers' expectations for WLH (welfare-friendly livestock husbandry).

Our results also reveal that even within the segment of consumers willing to pay a price premium for free-cage eggs, differences in price premiums are related to socio-demographic characteristics, consumer perceptions about WLH and their relationship with these animals, and motivations behind the intention to buy free-cage eggs. To our knowledge, this has not been explored in depth in previous studies. Living in rural environments and not having access to university education are related to the lower price premiums observed in the L-WTP group, which could be associated with a lower purchasing power of these consumers. The motivations of these consumers to buy cage-free eggs, associated with better taste and healthier attributes, and less with animal welfare, correspond to the 'individualistic' consumers described by [Güney and Giraldo \(2020\)](#), whose motivations to buy organic eggs are driven by individual benefits. This may also be related to the higher proximity in rural, peri-urban, or suburban contexts to the consumption of "huevos de rancho" or backyard eggs, which have other quality attributes such as good taste or healthiness ([Del Ángel-Coronel, Torres-Rivera, Ortíz-Rubio, & Aguas-Hernández, 2016](#)). On the other hand, since these motivations are not tied to previous consumption experiences or direct contact with egg production, they might indicate the misconception mentioned by [Da Silva-Pires et al. \(2021\)](#), related to specific socio-demographic characteristics of this consumer segment.

Access to higher education may be related to the higher premiums paid for M-WTP compared to L-WTP, but it does not explain the price differences between these two clusters with H-WTP. However, these are related to a greater recognition of the sentience of hens, that the welfare conditions of laying hens can affect egg quality, and a greater interest in having a physical bond with these animals. In line with these aspects, H-WTPs are consumers motivated by the collective benefits associated

with purchasing this product (Güney & Giraldo, 2020). Additionally, higher income correlates with a greater ability to pay, and education level may influence the demand for higher welfare standards for farm animals (Boaitey & Minegishi, 2020). Overall, the existence of this consumer segment is strategically important for promoting differentiated markets for cage-free eggs. Overall, our results highlight the need for enhanced communication to consumers regarding the potential impacts of housing systems on both hen welfare and intrinsic egg quality characteristics (Da Silva-Pires et al., 2021). Further research is also necessary to distinguish the effects of housing systems on these characteristics from other factors influencing egg quality (Da Silva-Pires et al., 2021). Our results also highlight the need for further research into the factors influencing the premium that Mexican consumers are willing to pay for each of these housing systems. For example, greater access to information about the impact of different housing systems on WLH has shown to influence the price premium that consumers are willing to pay (Cao et al., 2021). In addition, it would be necessary to report on other possible types of impacts of such housing systems, such as health, welfare, and biosecurity impacts (Holt, 2021).

4.4. Contributions and limitations of the study

In general, the results of the present study can contribute to the existing international literature on consumers' perceptions and preferences regarding WLH (Rondoni et al., 2020; Janssen et al., 2016; Ochs et al., 2018) by introducing the use of visual methodologies to investigate consumers' perceptions regarding the impact of various housing systems on WLH. This perspective provides a new tool for understanding these perceptions, as consumers often do not fully grasp the meaning of labels or written information attached to products and their implications for animal welfare (Janssen et al., 2016; Gorton et al., 2023). The study also connects perceptions from different consumer segments with the highest premiums they are willing to pay for eggs from various cage-free production systems (Kühl et al., 2024; Doyon & Bergeron, 2016). Furthermore, the approach employed in this study complements findings from studies based on observed market data (Chang, Lusk, & Norwood, 2010) by delving in to perceptions about WLH that influence these preferences. The empirical data provided in this study are pivotal for shaping Mexican public policies aimed at enhancing the welfare of laying hens (Vanhonacker & Verbeke, 2014) and guiding food labeling policies, particularly due to the lack of information about the perceptions and preferences of egg consumers. Moreover, these findings are crucial for developing multi-level labels that accurately reflect variations in housing systems (Kühl et al., 2024), offering essential guidance to the egg industry in meeting consumer demands effectively (Rondoni, et al., 2020).

Finally, it is important to consider that our results, both regarding the WTPPP for cage-free eggs (yes/no question) and the maximum price premium they would pay for eggs from different cage-free systems, can be impacted by hypothetical bias towards higher WTPPP. This is due to the fact that this study employed a hypothetical method based on surveys without real economic consequences (Doyon & Bergeron, 2016). Given the analysis conducted in this study, such a bias could imply the presence of a certain 'attitude-behavior gap' arising from feelings that do not necessarily translate into real purchasing decisions for WLH-friendly products (Pettersson, Weeks, Wilson, & Nicol, 2016; Cornish et al., 2020). To mitigate potential bias, the surveys in this study were conducted in an egg-buying environment (Humble et al., 2021), and the question about consumers WTPPP emphasized the current buying situation. However, future studies could benefit from additional strategies to address hypothetical bias in private goods like eggs (Atozou et al., 2022; Bergeron, Doyon, & Muller, 2019), such as cheap talk (Bergeron et al., 2019), choice experiments (Risius, Hamm, & Janssen, 2019) or non-hypothetical experimental auctions (Doyon & Bergeron, 2016). These approaches may help refine the analysis of WTPPP for eggs produced under different cage-free systems and their relationship to

consumer perceptions of WLH.

5. Conclusions

Overall, our study shows that Mexican egg consumers value hen welfare as a commercial attribute, although they have different economic, emotional and ethical concerns that affect their WTP for cage-free eggs. The utilization of photo-elicitation has led to the conclusion that there is a general consensus on the contribution of free-range systems to physical comfort or the expression of natural behaviors of the animals. However, there is also evidence of favorable perceptions towards cage-free systems in aspects such as the protection of hens against extreme weather conditions and predators. The study revealed the existence of consumers willing to pay a premium for cage-free eggs, which are distributed into three groups based on their willingness to pay a higher price for eggs from different housing systems. Gender and age influence the importance consumers attach to hen welfare, although they are not determining factors in the WTPPP for cage-free eggs. In contrast, educational level is a predictor of WTPPP and helps to differentiate consumer clusters. Finally, our results indicate that paying premiums for cage-free eggs is insufficient to drive the industry's conversion to cage-free housing systems for egg production. Instead, a comprehensive strategy should be implemented that offers consumers reliable information on alternative production systems to cages and the positive and negative impacts of each on WLH. Such an approach would enable consumers to make well-informed purchasing decisions.

Funding

This study was supported by the *Tiny Beam Fund* in which the principal researcher is L.X. Estévez-Moreno.

Ethical statement

The objectives of the study were submitted to the Research Ethics Committee of the Autonomous Community of Aragon (CEICA), which recommended that the survey be carried out in accordance with the Declaration of Helsinki guidelines and confirmed that an ethical vote from its committee was not applicable as the study would be carried out in a foreign country.

CRedit authorship contribution statement

Laura X. Estévez-Moreno: Conceptualization, Investigation, Methodology, Data curation, Formal analysis, Writing – original draft, Writing – review & editing, Project administration, Supervision, Funding acquisition. **Morris Villarreal:** Conceptualization, Writing – original draft, Writing – review & editing. **Genaro C. Miranda-de la Lama:** Conceptualization, Methodology, Supervision, Visualization, Writing – original draft, Writing – review & editing.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Data availability

Data will be made available on request.

References

- Ammann, J., Mack, G., Irek, J., Finger, R., & El Benni, N. (2023). Consumers' meat commitment and the importance of animal welfare as agricultural policy goal. *Food Quality and Preference*, 112, Article 105010.

- Atouzo, B., Bergeron, S., Doyon, M., & Tamini, L. D. (2022). Improving meta-analyses on hypothetical bias by using separate models for private and public goods. *Journal of Environmental Economics and Policy*, 11(3), 260–271.
- Bautista-Arredondo, L. F., Muñoz-Rocha, T. V., Figueroa, J. L., Téllez-Rojo, M. M., Torres-Olascoaga, L. A., Cantoral, A., & Lamadrid-Figueroa, H. (2024). A surge in food insecurity during the COVID-19 pandemic in a cohort in Mexico City. *Plos One*, 19(5), e0297694.
- Bejaei, M., Wiseman, K., & Cheng, K. M. (2011). Influences of demographic characteristics, attitudes, and preferences of consumers on table egg consumption in British Columbia, Canada. *Poultry Science*, 90(5), 1088–1095.
- Bergeron, S., Doyon, M., & Muller, L. (2019). Strategic response: A key to understand how cheap talk works. *Canadian Journal of Agricultural Economics/Revue Canadienne d'agroeconomie*, 67(1), 75–83.
- Bergmann, I. M. (2020). Naturalness and the legitimacy of thoroughbred racing: A photo-elicitation study with industry and animal advocacy informants. *Animals*, 10(9), 1513.
- Blecha, J., & Leitner, H. (2014). Reimagining the food system, the economy, and urban life: New urban chicken-keepers in US cities. *Urban Geography*, 35(1), 86–108.
- Boatey, A., & Minegishi, K. (2020). Who are farm animal welfare conscious consumers? *British Food Journal*, 122(12), 3779–3796.
- Bracke, M. B., Vermeer, H. M., & van Emous, R. A. (2019). Animal welfare regulations and practices in 7 (potential) trade-agreement partners of the EU with a focus on laying hens, broilers and pigs: Mexico, Chile, Indonesia, Australia, New Zealand, Turkey and the Philippines (No. 1160). Wageningen Livestock Research.
- Bray, H. J., & Ankeny, R. A. (2017). Happy chickens lay tastier eggs: Motivations for buying free-range eggs in Australia. *Anthrozoös*, 30(2), 213–226.
- Cao, Y. J., Cranfield, J., Chen, C., & Widowski, T. (2021). Heterogeneous informational and attitudinal impacts on consumer preferences for eggs from welfare enhanced cage systems. *Food Policy*, 99, Article 101979.
- Carey, R., Parker, C., & Scrinis, G. (2017). Capturing the meaning of “free range”: The contest between producers, supermarkets and consumers for the higher welfare egg label in Australia. *Journal of Rural Studies*, 54, 266–275.
- Chang, J. B., Lusk, J. L., & Norwood, F. B. (2010). The price of happy hens: A hedonic analysis of retail egg prices. *Journal of Agricultural and Resource Economics*, 406–423.
- Cherry, C. R., & Adelakun, A. A. (2012). Truck driver perceptions and preferences: Congestion and conflict, managed lanes, and tolls. *Transport Policy*, 24, 1–9.
- COESP. (2015). El Cambio Demográfico como Impulsor del Desarrollo Consejo Estatal de Población. Toluca, México: Gobierno del Estado de México (On line version: http://coesp.edomex.gob.mx/sites/coesp.edomex.gob.mx/files/files/PPEM_final.pdf).
- Cornish, A. R., Briley, D., Wilson, B. J., Raubenheimer, D., Schlosberg, D., & McGreevy, P. D. (2020). The price of good welfare: Does informing consumers about what on-package labels mean for animal welfare influence their purchase intentions? *Appetite*, 148, Article 104577.
- Cuca-García, J. M., Gutiérrez-Arena, D. A., & López-Pérez, E. (2015). La avicultura de traspatio en México: Historia y caracterización. *Agroproductividad*, 8(4), 30–36.
- Da Silva-Pires, P. G., Bavaresco, C., Prato, B. S., Wirth, M. L., & de Oliveira Moraes, P. (2021). The relationship between egg quality and hen housing systems-A systematic review. *Livestock Science*, 250, Article 104597.
- Del Ángel-Coronel, O. A., Torres-rivera, J. A., Ortiz-Rubio, L. S., & Aguas-Hernández, M. F. (2016). Evaluación sensorial, parámetros fisicoquímicos y preferencias de consumo de huevo de gallina de traspatio, orgánico e industrializado en la región cafetalera central de Veracruz, México. *Revista de Planeación y Control Microfinanciero*, 2(3), 21–31.
- Docherty, D., & Jasper, C. (2023). The cheese paradox: How do vegetarians justify consuming non-meat animal products? *Appetite*, 188, Article 106976.
- Doyon, M., & Bergeron, S. (2016). Understanding strategic behavior and its contribution to hypothetical bias when eliciting values for a private good. *Canadian Journal of Agricultural Economics/Revue canadienne d'agroeconomie*, 64(4), 653–666.
- Doyon, M., Bergeron, S., Cranfield, J., Tamini, L., & Criner, G. (2016). Consumer preferences for improved hen housing: Is a cage a cage? *Canadian Journal of Agricultural Economics/Revue canadienne d'agroeconomie*, 64(4), 739–751.
- Doyon, M., Bergeron, S., Saulais, L., Labonté, M.É., & Provencher, V. (2023). Do consumers value welfare and environmental attributes in egg production similarly in fresh eggs and prepared meals? *Animals*, 13(3), 324.
- Espinosa-Ortega, A., Martínez-García, C. G., Rojas-Rivas, E., Fernández-Sánchez, Y., Escobar-López, S. Y., & Sánchez-Vegas, L. (2021). Consumer and food changes in Mexican households during maximal contingency in the COVID-19 pandemic. *International Journal of Gastronomy and Food Science*, 24, Article 100357.
- Estévez-Moreno, L. X., María, G. A., Sepúlveda, W. S., Villarroel, M., & Miranda-de la Lama, G. C. (2021). Attitudes of meat consumers in Mexico and Spain about farm animal welfare: A cross-cultural study. *Meat Science*, 173, Article 108377.
- Estévez-Moreno, L. X., Miranda-de la Lama, G. C., & Miguel-Pacheco, G. G. (2022). Consumer attitudes towards farm animal welfare in Argentina, Chile, Colombia, Ecuador, Peru and Bolivia: A segmentation-based study. *Meat Science*, 187, Article 108747.
- Ford, H., Gould, J., Danner, L., Bastian, S. E., & Yang, Q. (2023). “I guess it’s quite trendy”: A qualitative insight into young meat-eaters’ sustainable food consumption habits and perceptions towards current and future protein alternatives. *Appetite*, 190, Article 107025.
- Gerini, F., Alfnes, F., & Schjøll, A. (2016). Organic and animal welfare-labelled eggs: Competing for the same consumers? *Journal of Agricultural Economics*, 67(2), 471–490.
- Güney, O. I., & Giraldo, L. (2020). Consumers’ attitudes and willingness to pay for organic eggs: A discrete choice experiment study in Turkey. *British Food Journal*, 122(2), 678–692.
- Gorton, M., Yeh, C. H., Chatzopoulou, E., White, J., Tocco, B., Hubbard, C., & Hallam, F. (2023). Consumers’ willingness to pay for an animal welfare food label. *Ecological Economics*, 209, Article 107852.
- Harper, D. (2002). Talking about pictures: A case for photo elicitation. *Visual Studies*, 17(1), 13–26.
- Heinola, K., Latvala, T., & Niemi, J. K. (2023). Consumer trust and willingness to pay for establishing a market-based animal welfare assurance scheme for broiler chickens. *Poultry Science*, 102(7), Article 102765.
- Hernández, J., & Padilla, R. (2015). Evolución reciente de la producción y consumo de huevo en México. *Mundo Siglo XXI*, 11(37), 75–87.
- Hernández-Ortiz, J., Galicia-Rojano, O. J., Melo-Guerrero, E., Valdivia-Alcalá, R., & Valenzuela-Núñez, L. M. (2022). El huevo de traspatio: Ventana de oportunidad de ingresos en comunidades del Municipio de Texcoco, Estado de México. *Revista Mexicana de Ciencias Pecuarias*, 13(1), 287–296.
- Herzog, H. A. (2007). Gender differences in human–animal interactions: A review. *Anthrozoös*, 20(1), 7–21.
- Humble, M., Palmér, M., & Hansson, H. (2021). Internalisation of farm animal welfare in consumers’ purchasing decisions: A study of pork fillet at point of purchase using the means-end chain and laddering approach. *Animal Welfare*, 30(3), 355–363.
- Holt, P. S. (2021). Centennial Review: A revisiting of hen welfare and egg safety consequences of mandatory outdoor access for organic egg production. *Poultry Science*, 100(12), Article 101436.
- INEGI. (2021). *Presentación resultados: Estados Unidos Mexicanos. Instituto nacional de Geografía, Estadística e Informática*. (On line version: https://www.inegi.org.mx/contenidos/programas/ccpv/2020/doc/Censo2020_Principales_resultados_ejecutiva_EUM.pdfhttps://www.inegi.org.mx/contenidos/programas/ccpv/2020/doc/Censo2020_Principales_resultados_ejecutiva_EUM.pdf).
- Ingham, H. R. W., Neumann, D. L., & Waters, A. M. (2015). Empathy-related ratings to still images of human and nonhuman animal groups in negative contexts graded for phylogenetic similarity. *Anthrozoös*, 28(1), 113–130.
- Jaeger, S. R., Chheang, S. L., & Ares, G. (2023). Beyond plant-based alternatives to milk and meat: Product and individual variables influence purchase intention for plant-based yoghurt and eggs. *Food Quality and Preference*, 112, Article 105019.
- Janssen, M., Roediger, M., & Hamm, U. (2016). Labels for animal husbandry systems meet consumer preferences: Results from a meta-analysis of consumer studies. *Journal of Agricultural and Environmental Ethics*, 29, 1071–1100.
- Jiang, R., Sharma, C., Bryant, R., Mohan, M. S., Al-Marashdeh, O., Harrison, R., & Torrico, D. D. (2021). Animal welfare information affects consumers’ hedonic and emotional responses towards milk. *Food Research International*, 141, Article 110006.
- Juarez-Torres, M., Arellano-Gonzalez, J., & Contreras Astiazarán, B. (2023). Egg Prices to Skyrocket. *The Effect of Avian Influenza in Egg Domestic Prices: Evidence from Mexican Markets*. AggEconSearch.
- Kato, H., Shimasaki, T., & Yayou, K. I. (2024). Simulations of Future Trends in Welfare-Centric Egg Production Systems: Impacts on Productivity and Prices. *The Journal of Poultry Science*, 61, 2024019.
- Kühl, S., Schütz, A., & Busch, G. (2024). Willingness to pay for a multi-level animal husbandry label: An analysis of German meat consumers. *British Food Journal*, 126(5), 2099–2121.
- Lara, G. (2022). Poultry and Products Annual. Report number: MX2022-0045. USDA-Foreign Agricultural Services – GAIN – Global Agricultural Information Network. <https://apps.fas.usda.gov/newgainapi/api/Report/DownloadReportByFileName?fileName=Poultry%20and%20Products%20Annual%20Mexico%20City%20Mexico%202022-0045.pdf>.
- Lesniewski, G., & Stangierski, J. (2018). What’s new in chicken egg research and technology for human health promotion?—A review. *Trends in Food Science & Technology*, 71, 46–51.
- Mullally, C., & Lusk, J. L. (2018). The impact of farm animal housing restrictions on egg prices, consumer welfare, and production in California. *American Journal of Agricultural Economics*, 100(3), 649–669.
- Macauley, L., & Chur-Hansen, A. (2022). Human health benefits of non-conventional companion animals: A narrative review. *Animals*, 13(1), 28.
- Mendoza, Y. Y., Brambila, J. D. J., Arana, J. J., Sangerman-Jarquín, D. M., & Molina, J. A. (2016). Egg market in Mexico: A tendency towards differentiation in consumption. *Revista Mexicana de Ciencias Agrícolas*, 7(6), 1455–1466.
- Mellor, D. J. (2019). Welfare-aligned sentence: Enhanced capacities to experience, interact, anticipate, choose and survive. *Animals*, 9(7), 440.
- Miranda-De La Lama, G. C., Estévez-Moreno, L. X., Sepúlveda, W. S., Estrada-Chavero, M. C., Rayas-Amor, A. A., Villarroel, M., & María, G. A. (2017). Mexican consumers’ perceptions and attitudes towards farm animal welfare and willingness to pay for welfare friendly meat products. *Meat Science*, 125, 106–113.
- Miranda-de la Lama, G. C., Estévez-Moreno, L. X., Villarroel, M., Rayas-Amor, A. A., María, G. A., & Sepúlveda, W. S. (2019). Consumer attitudes toward animal welfare-friendly products and willingness to pay: Exploration of Mexican market segments. *Journal of Applied Animal Welfare Science*, 22(1), 13–25.
- Morales, N., Ugaz, C., & Cañon-Jones, H. (2020). Perception of animal welfare in laying hens and willingness-to-pay of eggs of consumers in Santiago, Chile. *Proceedings*, 73(1), 2.
- Ochs, D. S., Wolf, C. A., Widmar, N. J., & Bir, C. (2018). Consumer perceptions of egg-laying hen housing systems. *Poultry Science*, 97(10), 3390–3396.
- Ornelas-Eusebio, E., García-Espinoza, G., Laroucau, K., & Zanella, G. (2020). Characterization of commercial poultry farms in Mexico: Towards a better understanding of biosecurity practices and antibiotic usage patterns. *Plos One*, 15(12), e0242354.
- Otieno, D. J., & Ogutu, S. O. (2020). Consumer willingness to pay for chicken welfare attributes in Kenya. *Journal of International Food & Agribusiness Marketing*, 32(4), 379–402.

- Pérez, F., Figueroa, E., García, A., & Godínez, L. (2014). La avicultura en México: Retos y perspectivas. In *Aportaciones en ciencias sociales: economía y humanidades* (pp. 293–300). México: Universidad Autónoma Chapingo.
- Petterson, I. C., Weeks, C. A., Wilson, L. R. M., & Nicol, C. J. (2016). Consumer perceptions of free-range laying hen welfare. *British Food Journal*, 118(8), 1999–2013.
- Procuraduría Federal del Consumidor [PROFECO]. (2011, 11 de noviembre). Precios del huevo ¿A granel o empaquetado?. Gobierno de México. <https://www.gob.mx/profeco/documentos/precios-de-huevo-a-granel-o-empaquetado>.
- Risius, A., Hamm, U., & Janssen, M. (2019). Target groups for fish from aquaculture: Consumer segmentation based on sustainability attributes and country of origin. *Aquaculture*, 499, 341–347.
- Rodenburg, T. B., Giersberg, M. F., Petersan, P., & Shields, S. (2022). Freeing the hens: Workshop outcomes for applying ethology to the development of cage-free housing systems in the commercial egg industry. *Applied Animal Behaviour Science*, 251, Article 105629.
- Rojas-Rivas, E., & Cuffia, F. (2020). Identifying consumers' profile and factors associated with the valorization of pulque: A traditional fermented beverage in Central Mexico. *Food Science and Technology International*, 26(7), 593–602.
- Romo, S., López, D., Ledesma, N., Gutiérrez, C., Quintana, A., & Rangel, L. (2022). Comparación en la calidad de huevos obtenidos en un sistema de producción en corrales al aire libre y los producidos en un sistema de jaula. *Revista Mexicana de Ciencias Pecuarias*, 13(1), 32–42.
- Rondoni, A., Asioli, D., & Millan, E. (2020). Consumer behaviour, perceptions, and preferences towards eggs: A review of the literature and discussion of industry implications. *Trends in Food Science & Technology*, 106, 391–401.
- SADER. (2023). Riesgos en la avicultura nacional e impactos económicos en los costos de producción avícola por los brotes de influenza aviar H5N1, en México. *Secretaría de Agricultura y Desarrollo Rural*. https://dj.senasica.gob.mx/Contenido/files/2023/abril/Riesgosenlaaviculturanacionaleimpactosecon%C3%B3micosenloscostosdeproducci%C3%B3nnav%C3%ADcolaporlosbrotesdelAH5N1enM%C3%A9xico_6d95188b-1d2c-4c40-ac94-33f060630990.pdf.
- Schrobbach, P., Zhang, A., Loechel, B., Ricketts, K., & Ingham, A. (2023). Food credence attributes: A conceptual framework of supply chain stakeholders, their motives, and mechanisms to address information asymmetry. *Foods*, 12(3), 538.
- Secretaría de Economía (SE). (2016). *NMX-FF-127-SCFI-2016: Productos avícolas – Huevo fresco de gallina – Especificaciones y métodos de prueba (cancela a la NMX-FF-079-2004)*. Ciudad de México: SE.
- Serrano-Cruz, M. R., Espinoza-Ortega, A., Sepúlveda, W. S., Vizcarra-Bordi, I., & Thomé-Ortiz, H. (2018). Factors associated with the consumption of traditional foods in central Mexico. *British Food Journal*, 120(11), 2695–2709.
- Slack, N. J., Sharma, S., Cúg, J., & Singh, G. (2023). Factors forming consumer willingness to pay a premium for free-range eggs. *British Food Journal*, 125(7), 2439–2459.
- Sinclair, M., Lee, N. Y., Hötzel, M. J., Tan de Luna, M. C. T., Sharma, A., Idris, M., & Marchant, J. N. (2022). Consumer attitudes towards egg production systems and hen welfare across the world. *Frontiers in Animal Science*, 3, Article 995430.
- Teixeira, L. D., Larraín, R., & Hötzel, M. J. (2018). Are views towards egg farming associated with Brazilian and Chilean egg consumers' purchasing habits? *PLoS One*, 13(9), e0203867.
- Trimania, I., Kusnadi, N., & Putri, T. A. (2022). Consumer willingness to pay for premium price of eggs animal welfare in Mojokerto, East Java. In *IOP Conference Series: Earth and Environmental Science* (Vol. 1107, No. 1, p. 012080). IOP Publishing.
- Unión Nacional de Avicultores (UNA). (2023). *Compendio de Indicadores Económicos del Sector Avícola 2022*. Unión Nacional de Avicultores México: Dirección de Estudios Económicos. <https://una.org.mx/indicadores-economicos>.
- Unión Nacional de Avicultores (UNA). (2023b). *Reporte Estadístico Semanal de Precios del Mercado Avícola. 13 de septiembre de 2023*. <https://una.org.mx/download-category/reporte-semanal-2023/>.
- Unión Nacional de Avicultores (UNA). (2023c). *Reporte Estadístico Semanal de Precios del Mercado Avícola. 11 de octubre de 2023*. <https://una.org.mx/download-category/reporte-semanal-2023/>.
- Vanhonacker, F., & Verbeke, W. (2014). Public and consumer policies for higher welfare food products: Challenges and opportunities. *Journal of Agricultural and Environmental Ethics*, 27, 153–171.
- Wassermann, S. N., Hind-Ozan, E. J., & Seaman, J. (2018). Reassessing public opinion of captive cetacean attractions with a photo elicitation survey. *PeerJ*, 6, e5953.
- Zhao, Y., & Wu, S. (2011). Willingness to pay: Animal welfare and related influencing factors in China. *Journal of Applied Animal Welfare Science*, 14(2), 150–161.