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The effect of intrinsic and extrinsic quality on the willingness to pay for a convenient meal: A combination of home-use-test with online auctions

Dolores Garrido[1,2] | R. Karina Gallardo[3] | Carolyn F. Ross[4] | Maria Laura Montero[4,5] | Juming Tang[6]

[1]School of Economic Sciences, Washington State University, Pullman, Washington

[2]Department of Economics, Union College, Schenectady, New York

[3]School of Economic Sciences, Puyallup Research and Extension Center, Washington State University, Puyallup, Washington

[4]School of Food Science, Washington State University, Pullman, Washington

[5]National Center for Food Science and Technology (CITA), University of Costa Rica, San José Province, Mercedes, Costa Rica

[6]Distinguished Chair of Food Engineering, Department of Biological Systems Engineering, Washington State University, Pullman, Washington

Correspondence

R. Karina Gallardo, School of Economic Sciences, Puyallup Research and Extension Center, Washington State University, 2606 W. Pioneer Ave, Puyallup, WA 98371, USA.
Email: karina_gallardo@wsu.edu

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Abstract

A sensory evaluation using a home-use-test (HUT) setting and experimental online auctions at three storage times, were used to elicit willingness to pay (WTP) for two samples of ready meals with extended shelf life, one using microwave assisted pasteurization system (MAPS) and the other using freezing. The effect of the information on the name of a new technology and the environmental impacts associated with each technology was also measured. We found that sensory characteristics of the ready meal are the key drivers for subjects' WTP. Considering the specific context of this study, we did not find evidence that the name of the technology and the information on the environmental impacts associated with each technology impacted participants' WTP.

Practical Applications

Our study contributes by presenting a protocol for conducting a combined HUT and online auction across three storage times for a complex food matrix (i.e., the jambalaya ready meal) in which the eating environment is important. Also influential is that participants actually ate the meal, therefore the sensory evaluation results that were gathered were more impactful for bids than the extrinsic attributes included. Given the logistic challenges of conducting a HUT along with experimental auctions across time, this study had a limited number of participants. Therefore, we cannot provide a conclusive evidence that disclosing the name of the technology used and its effects on the environment would encourage purchase of ready meals.

1 | INTRODUCTION

The area of food choice behavior includes psychological, social, economic, as well as sensory studies. The perception of sensory quality attributes is impactful to the WTP but do not fully explain food choice behavior (Jaeger, 2006). In fact, literature on food choice shows that extrinsic factors such as individuals' perceptions and preferences for aspects different from the actual sensory profile of the food have an impact on choice (Lusk & Briggeman, 2009; Lusk, Schroeder, & Tonsor, 2014; Malone & Lusk, 2017). Researchers assert that individuals' preferences are affected by the frame and context of the decision-making process and advocate for the existence of a learning process to unveil individual preferences (Shogren, List, & Hayes, 2000). It is also argued that preferences are often guided by the fundamental values of life such as health, safety, prestige, benevolence, and pleasure (Lusk & Briggeman, 2009). Studies that analyze how the interactions of extrinsic and intrinsic sensory perceptions affect consumer food choices are important to advance the understanding of this complex topic.

The primary goal of this study is to measure the impact of perceived sensory quality, and perception of extrinsic quality, on the WTP of a food product that uses a new food preservation technology. To achieve the objective, we center the analysis on a convenient food product, that is a fully prepared, ready meal. The decision-making process to choose the meal in this study encompasses the convergence of different values that likely underline the perceptions on sensory quality, time and energy savings, use of new food preservation technologies, and the impacts of these technologies on the environment.

There is a myriad of convenient foods sold at grocery stores, and different criteria are used to categorize them. Considering the time and preparation consumers should use before eating the meal, Costa, Dekker, Beumer, Rombouts, and Jongen (2001) categorized convenient foods in four groups: (a) ready-to-eat (RTE) meals which are consumed as purchased (e.g., sandwiches, salads), (b) ready-to-heat (RTH) meals that require no more than 15 min of heating before consumption (e.g., refrigerated, frozen, dehydrated, and canned meals), (c) ready to end-cook (RTEC) meals that require more than 15 min of heating before consumption, and (d) ready-to-cook (RTC) meals with raw ingredients that are minimally prepared and require full cooking. From a food safety perspective, Peng et al. (2017) categorize foods as ready-to-eat (RTE) when those meals are pathogen free, that is, those meals that have gone through a process of pasteurization or sterilization—for example, canned foods or chilled or frozen meals that are pathogen free when stored at <5°C for a specific length of time. In this case, there is no need to heat the meal to ensure killing pathogens, the heating is mainly to achieve taste. The other category is the non-RTE. These are meals that had not gone through a strict pathogen control process and are usually frozen to extend shelf life. Food manufacturing companies provide cooking instructions on the package for consumers to follow, such as heating to 74°C, to ensure the product is safe to eat. According to the above classifications, this study used an RTH and RTE meal. Hereafter, we will refer to the product used as a ready meal.

Typically, ready meals are subject to food processing and preservation technologies to ensure safety and wholesomeness. Existing food preservation technologies, albeit guaranteeing convenience, often affect the sensory and nutritional quality of the food, and their use contrasts with consumers' ideals of freshness and healthiness. That is, with existing food preservation technologies, consumers are forced to make trade-offs between convenience and perceived sensory and health-related benefits (Costa, Schoolmeester, Dekker, & Jongen, 2007). Therefore, to provide consumers with convenient and superior sensory and nutritional quality food options, it is essential to develop and advance current food preservation technologies. Despite the advantages offered by new food technologies in general, consumers tend to reject them because they are perceived to be risky for their health or go against societal norms (Cox & Evans, 2008; Frewer et al., 2011; Lusk, Roosen, & Bieberstein, 2014). These technologies may be rejected even if they often offer additional benefits such as a more favorable environmental impact compared to traditional technologies. Public trust is a fundamental aspect that affects the perception of new food technologies, and there is a consensus that the general public often lacks awareness and understanding of new food processing and preservation technologies' applications in the agri-food industry (Lusk, Roosen, & Bieberstein, 2014; Matin et al., 2012).

Our approach is to compare two samples of ready meals that use the same ingredients and preparation methods but are preserved using two different preservation technologies: the new MAPS and freezing, a traditional technology used to preserve ready meals. MAPS applies microwave energy to enhance safety and preserves the sensory quality more in terms of appearance, taste, and texture as compared to existent conventional technologies such as retort and freezing (Barnett, Sablani, Tang, & Ross, 2019; Resurreccion Jr. et al., 2013; Zhang et al., 2015). Preservation technologies such as freezing are used mainly to extend the shelf life of the food product. Therefore, frozen meals that were not subjected to any other processing, such as pasteurization in food plants, should be cooked by consumers to ensure that the meal reaches an internal temperature of at least 74°C. This is to inactivate pathogens such as *Listeria monocytogenes*, because freezing alone does not necessarily kill pathogens (Resurreccion Jr. et al., 2013; Zhang et al., 2015). Further, MAPS offers environmental benefits by using energy and water efficiently to produce a meal that can be stored under refrigeration conditions. Therefore, the need for freezing and thawing is eliminated, sharply reducing energy needs (Tang, 2015). In this study, we chose freezing as the control to compare MAPS, because a frozen product exhibits a shelf life of about 12 weeks which cannot be achieved with refrigeration.

Our approach uses a home-use-test (HUT), that is, the study was conducted at each participant's home. Typically, food preference and WTP elicitation is conducted in a laboratory setting. It is being argued that the laboratory offers an environment different from where the actual consumption would take place, potentially influencing behavior (De Wijk et al., 2019; Stelick & Dando, 2018). Hence, alternative field experiments are increasing in popularity. HUT has proved to more accurately reveal consumer's acceptance because the environment plays a significant role in consumers' preferences when compared to the laboratory setting (Boutrolle, Arranz, Rogeaux, & Delarue, 2005).

This study contributes to the advancement of the understanding of food choice behavior by measuring trade-offs made across perceived sensory quality, and perceptions of a new food preservation technology and environmental impacts associated with the food preservation technology used. The HUT approach in this study seeks to better replicate reality by having subjects test the products in their natural environment and elicit WTP by using an online Vikrey incentive compatible experimental auction.

2 | LITERATURE REVIEW

Literature centered on eliciting extrinsic perceptions on consumers' WTP for food is vast. Jaeger (2006) conducted a review of literature of studies that have included non-sensory attributes effects on food choice behavior. The author identified that context, convenience, price, production technology, personal health, branding, and societal issues exert a considerable impact on food choice behavior. Lusk and Briggeman (2009) identified naturalness, taste, price, safety, convenience, nutrition, tradition, origin, fairness, appearance, and environmental impact, as food values impacting food choice. Lusk, Schroeder, and Tonsor (2014) show that individuals assign lower WTP values compared to what they would have actually paid in a real purchase context, to attributes they strongly prefer, such as safety, but might be perceived as ever-present in the marketplace. Therefore, they conclude that experiments designed for preference elicitation need to be combined with belief elicitation.

More specific findings on trade-off between the impact of sensory and non-sensory attributes on WTP can be found in the following literature. Stefani, Romano, and Cavicchi (2006) found that non-sensory attributes, such as region of origin; and hedonic scores for sensory attributes, exerted an impact on consumers' WTP for spelt, a specialty food. Loureiro and Umberger (2007) estimated that U.S. consumers were willing to pay a higher price premium for a label guaranteeing food safety inspections, followed by country of origin and traceability compared to the WTP for tenderness, a sensory quality attribute. Combris, Seabra Pinto, Fragata, and Giraud-Héraud (2009) concluded that the effect on consumers' WTP for sensory intrinsic attributes related to taste was larger than the effect of food safety information. In addition, Malone and Lusk (2017) found that consumers derive most utility out of how they perceive a product's taste compared with how healthy or safe they believe the product would be. In general, evidence is mixed. Results depend largely on the context of the study, and, more importantly, if sensory taste tests are conducted along with the preference elicitation for non-sensory attributes.

A branch of literature compares consumer preference elicitation using the home use test (HUT) with the laboratory environment. The work by Boutrolle et al. (2005) and Boutrolle, Delarue, Arranz, Rogeaux, and Koster (2007) found that the familiarity of consumers' own homes positively impacted hedonic ratings for milk, salted crackers, and sparkling water in a HUT compared to the laboratory setting. Schouteten, Gellynck, and Slabbinck (2019) and Zhang, Jo, Lopetcharat, and Drake (2020) found that consumers were more perceptive to the intensity of eating quality attributes in the HUT than in the laboratory. De Wijk et al. (2019) found that the explicit measures of consumer preference, including liking sensory attributes, were less sensitive to the setting (home versus laboratory setting) than the implicit measures of the participant, including facial expressions, heart rate, and consumption duration. Another feature of the HUT is that it enables sensory taste evaluation over time. It was found that studies using HUT over a period of time contributed to the advancement of the understanding of consumer acceptance of food products over a long term. HUT also allows a larger sample to be used so that sensory perceptions are stabilized over time (Hoek et al., 2013; Moskowitz, 2000; Stubenitsky, Aaron, Catt, & Mela, 1999; Zandstra, Weegels, Van Spronsen, & Klerk, 2004).

Scant papers use the HUT along with a combination of sensory tasting and WTP elicitation. De Groote, Chege, Tomlins, and Gunarata (2014) used both setting locations, a modified version of a HUT and a laboratory setting, along with a Becker-DeGroot-Marschak (BDM) auction. In that study, the HUT took place in a single setting instead of using each participants' home, and this was identified as the most feasible approach to elicit preferences and WTP from rural consumers in Tanzania. They found that the setting did not impact the obtained WTP results. Olsen, Menichelli, Sørheim, and Næs (2012) investigated consumers' drivers for the likelihood of purchase for two samples of ready, healthy meals using a HUT. One sample used a salmon-based meal and the other used a chicken-based meal. They found that flavor likings were more influential on overall liking scores than were the likings for aroma, texture, and appearance of the meals. The socioeconomic factors' impact on the likelihood of buying was product specific. That is, females and higher educated participants were more likely to consume the salmon-based meal, whereas this was not observed for the chicken-based meal. In the present study is the only one that combines a HUT approach along with second price online auction format at three different points in time.

3 | MATERIALS AND METHODS

3.1 | Participants and RTH samples

An untrained panel of 50 consumers was recruited through email by the Sensory Evaluation Laboratory of the School of Food Science at Washington State University (WSU) in Pullman, WA. Due to the logistics challenge of a HUT study at different points in time, we opted for a small, random convenience sample of participants. The downside of this approach is that our results cannot be extended to the general population. The criteria for participation were for individuals to be at least 18 years old, had no food allergies, consumed convenient prepared meals at least twice a month, and were committed to participate throughout the entire length of the study (i.e., 12 weeks). All participants signed an informed consent form and received a cash incentive for their participation in the study, after their responses were submitted. The experimental procedure was approved by the WSU's Institutional Review Board (IRB) for the use of human subjects (Figure 1). The IRB number is 17370-001.

A jambalaya ready meal was selected for the complexity of the food matrix. The meal contained a mixture of proteins and vegetables; it is also considered to be a convenient and complete, or full, meal option. In addition, this food matrix is suitable for MAPS, a technology suggested for processing prepackaged, heat-sensitive, high-viscous, semisolid, solid, multicomponent meals (Tang, Hong, Inanoglu, & Liu, 2018). This meal was also chosen due to the degree of familiarity with jambalaya as it is often available in frozen and refrigerated versions at local grocery stores and at different local restaurants.

Both jambalaya samples, the one preserved by MAPS and the one preserved by freezing, used the same ingredients and followed the

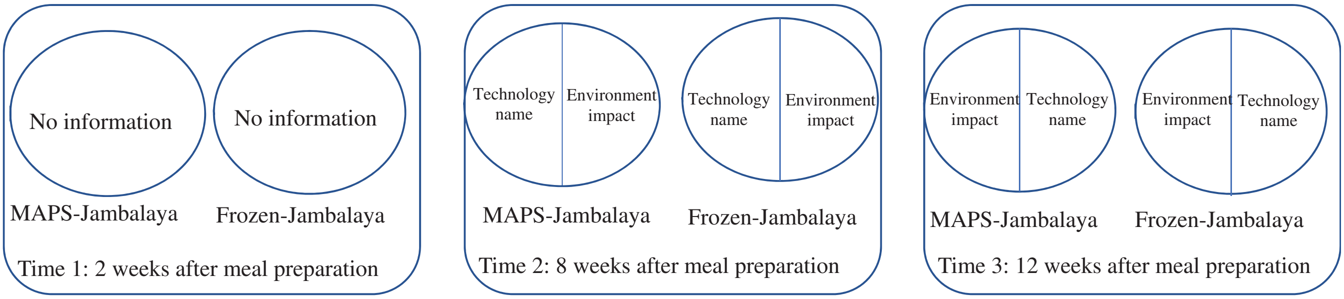

FIGURE 1 Experimental procedure summarizing and depicting the different phases of the experiment and the timing

same cooking protocol. Each jambalaya sample consisted of 3.5 oz (100 g) of a combination of meats—chicken, shrimp, and Andouille smoke sausage—5.5 oz (150 g) of sofrito based—onion, celery, garlic, pasilla pepper—tomato sauce, blended with a combination of Cajun spices and other seasonings. These samples were poured into polyethylene packages each containing 9 oz per package (250 g—equivalent to one individual serving). Each package was sealed under the following temperature and pressure conditions: 200°C for 4 s under a vacuum of 65 mbar with 400 mbar nitrogen flush. Half of the packages went through the WSU MAPS pilot processing plant. The MAPS processing consisted of delivering energy, using microwave principles for short-time pasteurization (90°C for 12.8 min). See Tang et al. (2018) for a detailed description of the pasteurization process. After being processed, MAPS samples were stored under refrigeration conditions 2°C ± 0.5°C. The other half of the packages went through freezing. These samples were stored under freezing conditions (−31°C ± 2°C). Both MAPS and the frozen jambalaya sample were stored at WSU facilities before each point in time of the experiment.

At weeks one and six microbial analyses were performed. Packages of both jambalaya samples were randomly selected and sent to Micro-chem Laboratories (Seattle). The following analyses from AOAC International Official Methods of Analysis were used to detect spoilage: aerobic plate count (APC) yeasts and molds, and total coliform. To further assure safety before sensory tasting, the samples were also screened for *Bacillus cereus*, *Salmonella*, *Listeria monocytogenes*, and *E. coli* O157:H7. All microbiological tests were negative for the microorganisms listed.

3.2 | Experimental procedure

The MAPS and frozen control samples were evaluated at three points in time of shelf life storage after initial preparation: 2 weeks (December 2018), 8 weeks (January 2019), and 12 weeks (February 2019). The selection of these three points in time were determined based on previous product development processed with MAPS technology and upon observing previous shelf life studies conducted using this technique.

At each point in time of the experiment, participants picked up two samples of jambalaya placed in an insulated cooler bag. The same day of pickup, participants completed the experiment at their home at dinner time, between 5 and 9 p.m., following a two-step procedure: (a) HUT that consisted of tasting and responding to a series of sensory evaluation questions and (b) participating in an online experimental auction. Data were collected using an online ballot via Compusense Cloud. Participants received a $30 cash incentive at each point in time for participating in the study.

On the first day of the experiment, participants attended an orientation session in which they were informed about the goals of the experiment and received a description of the jambalaya preparation and ingredients. They were provided specific instructions on the experimental protocol, including the heating instructions for the meal. These instructions consisted of heating each meal sample in a microwave oven at high power for 3 min, and then letting stand for 1 min inside the microwave. Also, the instructions described the experimental online auction, how to conduct the sensory tasting procedure, and how to access and navigate Compusense Cloud. In all, participants received the two jambalaya samples, written instructions for heating the product, instructions on the experimental protocol, and crackers to clean the palate after tasting each sample. They were instructed to clean their palates with water and with crackers and to take a 5-min break between the two sample tastings. For each jambalaya sample evaluated, participants were given the opportunity to write down their own comments. The two jambalaya samples were labeled with a random three-digit code; participants did not receive any type of information about the meal preparation protocol, processing date, preservation technology, or storage time. In addition, the frozen jambalaya samples were thawed on the day of pickup. The thawing procedure consisted of putting the trays with the frozen samples in water at room temperature for 1.5 hr. In this way, we ensured that participants were not able to infer any a priori difference between the MAPS and the frozen jambalaya samples.

Participants were asked to input their responses in Compusense Cloud. The responses included their ratings using a seven-level hedonic scale (1 = dislike extremely, …, 7 = like extremely) for overall appearance, aroma, flavor, and texture of each of the meat components in the jambalaya (shrimp, chicken, sausage), and overall liking for each sample. The Compusense Cloud questionnaire included sociodemographic and food purchase habit questions. In the survey, the term ready-to-eat meal was used and was defined as a prepackaged, cooked meal consisting of two or more components (e.g., meat, pasta, gravy, vegetables) that requires only heating up to the ideal temperature to be served. In addition, the questionnaire elicited participants' food technology neophobia by using the Food Technology Neophobia Scale (Cox & Evans, 2008). This is a psychometric scale that allows the characterization of consumers based on their neophobic behavior towards foods processed with new technologies.

After the sensory testing, participants submitted two bids, one for each sample of 9 oz (250 g) per unit jambalaya. Bids were entered by the participants in the Compusense Cloud software. The Vikrey second price format was used because it was relatively simple to implement using an online platform. Participants did not see other participants' bids in real time and received the feedback on the highest and second highest bid when announcing the winners (Lusk & Shogren, 2007). During the orientation session, researchers included a detailed explanation of the experimental auction protocol. A practice auction with candy bars was conducted to ensure the participants understood the dynamics of the experiment. To identify the winner in the auction, at the conclusion of each session, one of the samples was randomly selected as binding. The term binding refers to one of the samples that was randomly chosen, and that was used to identify the winner of the auction in each session. The winner of the auction was the participant with the highest bid for the sample selected as binding. The winner received one additional unit of this sample, and in exchange, they had to pay the market price, or the second highest bid. Researchers communicated by email who bid the highest and second highest bid, that is, the market price, after the conclusion of the auction. The winner received the $30 cash incentive minus the market price, for the jambalaya sample. Participants who did not win the auction (i.e., they submitted a bid that was less than the highest bid) received the 30 dollars and no jambalaya sample. This process was repeated at the three storage times: 2 weeks (December 2018), 8 weeks (January 2019), and 12 weeks (February 2019) after the preparation date of the meals.

3.2.1 | Information effects

At the *first storage time*, 2 weeks after the preparation date of the meals, no information on the name of the technology or the environmental impacts was provided before the experimental auction. To avoid the risk of an information order bias, we randomized the order of information disclosed across participants. A within-subject auction design was used with two sets of information introduced at the second and third storage times. The first set of information included the name of the food preservation technology used for each sample (MAPS versus freezing). The second set of information included the environmental impact associated with each preservation technique and was expressed in terms of carbon footprint emissions. The carbon footprint estimations used in this study were approximates to be used as references only; that is, we did not conduct a rigorous estimation tailored to the jambalaya ready meal and the MAPS and frozen preservation technologies. The estimations were entirely based on emission data and assumptions made in the studies by Evans and Brown (2012) and Schmidt Rivera, Espinoza Orias, and Azapagic (2014). We assumed the stages in the supply chain of the MAPS and frozen samples and included processing, preservation, storage (before distribution), transport to retailer, retail storage, domestic transport, domestic storage, and domestic cooking. Based on estimations and assumptions in the two cited studies, we concluded that the frozen, ready jambalaya meal would produce 19% more CO_2 emissions compared to a MAPS-processed ready jambalaya meal. During the *second storage time*, a group of 25 participants was given the information on the name of the technology, and the remaining 25 participants were given the information on the environmental impacts of the MAPS versus the frozen meal sample.

At the *third storage time* of the study, the information disclosure was reversed so that participants who received the information on the name of the technology at 8-weeks of storage received the environmental information at 12 weeks of storage. Likewise, participants who received the environmental information at 8 weeks of storage received the information on the name of the technology at 12 weeks of storage. To not interfere with participants' liking ratings, the name of the technology and environmental impacts was disclosed after the sensory testing was completed.

3.3 | Data analyses

Censored models are typically used to analyze experimental auction bids (Lusk & Shogren, 2007). In this study, we found no evidence of censoring as there was no incidence of zero bids at any point in time of the study, therefore a fixed effect ordinary least square (OLS) regression was conducted. Four regressions were conducted to measure the effect of the following factors: technology-induced sensory effects, time-induced sensory effects, information on the name of the technology, and information of the environmental implications of each technology. The specification for the regressions followed:

$$Bid_{is} = \alpha_j Att_{jis} + \beta_1 Tech_s + \beta_2 Time2_s + \beta_3 Time3_s + \beta_4 Inftech_s + \gamma_k Demo_{ki} + e_i \quad (1)$$

where Bid_{is} represents the bid by participants *i* for sample *s*; Att_{jis} is the vector of liking ratings for the *j* quality attribute, *j* = appearance, aroma, flavor, texture shrimp, texture chicken, and texture sausage; $Tech_s$ is the binary variable representing the preservation technology, =1 if MAPS, 0 = otherwise; $Time2_s$ is the binary variable representing storage time 2 (8 weeks after the preparation date of the meals); $Time3_s$ is the binary variable representing storage time 3 (12 weeks after the preparation date of the meals); $Inftech_s$ is the binary variable indicating if the name of the preservation technology was disclosed; $Demo_{ki}$ is the vector of demographic variables: *k* = if millennial, if household size is of three or more individuals, if the household income is more than $58,899; this amount was the average income for our sample of participants; if self-reported as health, and if food technology neophobic, α_j, $\beta_1 - \beta_4$, and γ_k are the parameters to estimate. Parameters were estimated using the STATA v. 13 software.

All four regressions have the stacked bids for the MAPS and the frozen jambalaya samples across the three points in time as the dependent variable. Each regression includes a different set of independent variables. Regression 1 includes as independent variables the liking ratings for sensory quality attributes, binary variable representing the preservation technology, binary variables representing storage time 2 and storage time 3, binary variable indicating that the information on the name of the preservation technology was disclosed, and sociodemographic variables. Regression 2 includes only the liking ratings for the sensory quality attributes. To infer technology-induced effects, we conducted regression 3, which included interaction effects of the preservation technology (MAPS) binary variable and liking ratings for sensory quality attributes. To infer point in time induced effects, we conducted regression 4, which included the interaction effects of time 2 and time 3 binary variables and liking ratings for the sensory quality attributes.

4 | RESULTS AND DISCUSSION

4.1 | Sociodemographic characteristics and consumption habits

Table 1 reports summary statistics for participants' sociodemographic characteristics. The majority of participants were female (66% of participants), white (84% of participants), and WSU staff (64% of participants). The average age was 39 years old. Regarding the self-perceived physical status also reported in Table 1, 84% of the sample self-identified as being healthy and 48% reported to be physically active. In relation to the food technology neophobia, Cox and Evans (2008) reported that the scale can possibly range from 13 to 99, with higher scores indicating more neophobia. They surveyed a sample of 294 individuals in Australia who displayed an average score of 55, and values ranged from 21 to 88 for the food technology neophobia scale. This scale was also used by Matin et al. (2012) who surveyed a sample of 777 individuals in Canada and reported an average score of 58.45 and values ranging from 21 to 91. The mean score for our sample of respondents was 47.66 and values ranged from 24 to 68. This means that compared to the subjects in the cited studies, our sample of respondents is less food technology neophobic and the values are less dispersed.

TABLE 1 Participants' sociodemographic characteristics

Item	Units	Sample ($N = 50$)
Female	%	66.0
Race		
White/Caucasian	%	84.0
Black	%	2.0
Asian	%	4.0
Hispanic	%	12.0
Age	Year	39.7
Household size	No.	2.5
Household annual income	$/year	58,899
Employment status		
University student	%	18.0
University staff	%	64.0
University faculty	%	10.0
Unemployed	%	0.0
Retired	%	4.0
Military	%	0.0
Self-perceived physical status		
Self-identified healthy	%	84.0
Self-identified physically active	%	48.0
Food neophobia scale		
Mean score	No.	47.7
Range	No.	24–66

With regards to food purchasing and consumption habits (Table 2), 90% of participants are the primary shoppers in their household making more than 90 grocery trips per year. When asked about food eating habits, 70% of participants indicated they focus mainly on the taste of the food, 44% indicated they focus mainly on the health aspects of food, and 18% indicated they focus on the convenience. Seventy-four percent of respondents indicated they perceived food prepared at home as healthier than food away from home, and 80% indicated that family meals are important. Results reveal that taste is the most important factor for food purchase decisions (96% of respondents) followed by price (90% of respondents), while other aspects fall behind, such as nutrition and healthfulness (74% of respondents), naturalness (46%), convenience (42%), and environmental impact (26%).

Participants stated that they consumed RTE meals more than 40 times per year. Recall that purchase habits questions in the questionnaire referred to RTE meals as described in the methodology section. The main reason to consume these meals was the time saving aspect of convenience (65% of participants), followed by the energy saving aspect (27% of participants). Frozen RTE meals are the category mostly consumed (76% of participants) followed by chilled or refrigerated (16% of participants). These foods were mostly bought at grocery stores (95% of respondents). These meals are mostly consumed at dinner time (73% of respondents) followed by lunch time (27% of respondents). Participants indicated they consumed these meals at home with family (40% of participants), at home alone (30% of participants), and at the workplace alone (27% of participants). Forty-nine percent of participants indicated they use less than 10 min to prepare (heat) the meal. This time is aligned with the time reported to prepare RTH by Olsen et al. (2012). Thirty-three percent indicated they take 10–20 min, which is aligned with the time reported to prepare RTEC meals, and 19% indicated they use more than 20 min, which is aligned with the time reported to prepare RTC meals, by the above-cited authors. In addition, participants indicated that date labels (i.e., sell-by, use-by, best-by) followed by ingredient list and nutrition facts are the pieces of information in the food package most frequently consulted.

TABLE 2 Summary statistics of participants' food purchasing and eating habits

Item	Unit	Sample ($N = 50$)
Primary shopper	%	90.00
Trips to grocery store	Number/year	93.08
Major orientation to food		
Taste	%	70.00
Health	%	44.00
Convenience	%	18.00
No care	%	6.00
Food prepared at home is healthier than food away	%	74.00
Family meals are important	%	80.00
Important aspects for food purchasing decisions		
Taste	%	96.00
Price	%	90.00
Nutrition/healthfulness	%	74.00
Safety	%	70.00
Appearance	%	54.00
Naturalness	%	46.00
Convenience	%	42.00
Familiarity	%	36.00
Origin	%	26.00
Fairness	%	26.00
Environmental impact	%	26.00
Novelty	%	12.00
Social image	%	6.00
Frequency of RTE meals consumption	Number/year	41.11
Main reasons for consuming RTE meals	Convenience – saves time	
Convenience – saves time	%	64.86
Convenience – saves energy	%	27.03
NA (do not consume RTE frequently)	%	26.00
Flavor liking	%	5.41
Health	%	2.70
Main reason for not consuming RTE meals	Do not like processed food/enjoy cooking	
NA (do consume RTE frequently)	%	74.00
Do not like processed food	%	8.00
Enjoy cooking	%	8.00
Unhealthy	%	2.00
Price	%	2.00
Do not seem fresh	%	2.00
Do not like texture	%	2.00
Not available	%	2.00
Type of RTE meals consumed	Frozen	
Frozen	%	75.68
Chilled/refrigerated	%	16.22
Canned	%	8.11
Ambient (dehydrated)	%	

(Continues)

TABLE 2 (Continued)

Item	Unit	Sample (N = 50)
Place where RTE meals are mostly bought	Grocery store	
Grocery store	%	94.59
Sit-down restaurant	%	2.70
Take-out restaurant	%	2.70
Time when RTE meals are mostly consumed	Dinner	
Dinner	%	72.97
Lunch	%	27.03
Place where RTE meals are mostly consumed	At home, with family	
At home, with family	%	40.54
At home, alone	%	29.73
At workplace, alone	%	27.03
Other (restaurant)	%	2.70
Length of time that it takes to prepare RTE meals	Less than 10 min	
Less than 10 min	%	48.65
Between 10–20 min	%	32.43
More than 20 min	%	18.92
Packaging information frequently consulted	Date labels	
Date labels	%	44.00
Ingredient list	%	34.00
Nutrition facts	%	30.00
Statements about health	%	12.00
Statements about sustainability	%	6.00
Statements about fairness	%	2.00
Technology issues	%	0.00

4.2 | Summary of sensory evaluation liking ratings

The mean sensory attribute liking ratings for the MAPS and the frozen jambalaya samples at each storage point of the experiment are presented in Table 3. The pairwise *t* test results show no statistically significant differences in the ratings for the sensory attributes of both samples (MAPS and frozen) at the three storage times, 2, 8, and 12 weeks after meal preparation. These results indicate that the preservation technology used, MAPS compared to freezing, at the time period studied, did not induce changes in the samples' appearance, aroma, flavor, texture of shrimp, chicken, sausage, and the overall liking. Also, results signal that the perception of attributes of one sample relative to the other sample did not vary across the three storage times.

Also, results from a Tukey pairwise test indicate that there are not consistent differences in the ratings for appearance, aroma, flavor, texture of shrimp, chicken, sausage, and the overall liking across the three storage times. For example, for the MAPS sample, there are no differences in the attribute ratings between time 2 weeks and 8 weeks, and between 8 weeks and 12 weeks. However, the liking ratings for MAPS texture of shrimp at 8 weeks has a statistically significant difference from 12 weeks. For the frozen sample, the liking ratings for frozen flavor at 2 weeks have a statistically significant difference from the frozen flavor in at 8 weeks.

4.3 | Summary of bids

The average bids for each jambalaya sample evaluated at each point in time of the experiment are reported in Table 4. A pairwise *t* test indicates that there are no statistically significant differences between the bids for the MAPS and the bids for the frozen sample at storage time 1, 2, and 3. In addition, we compared bids across storage times for each sample. For both the MAPS sample and the frozen sample, there were no statistically significant differences in bids between time 1 and time 2, time 1 and time 3, and time 2 and time 3.

The average bids for each jambalaya sample, when different information treatments were presented to participants, are reported in

TABLE 3 Sensory attribute liking ratings across samples by point in time of the experiment and across the three storage times of the experiment

	Average liking rating (1 = "dislike extremely," ..., 7 = "like extremely")														
	T1 = 2 weeks			T2 = 8 weeks			T3 = 12 weeks			Tukey *p*-values			Frozen Tukey *p*-values		
Sensory attribute	MAPS	Frozen	Pairwise *t*-test MAPS-frozen	MAPS	Frozen	Pairwise *t*-test MAPS-frozen	MAPS	Frozen	Pairwise *t*-test MAPS-frozen	T1-T2	T1-T3	T2-T3	T1-T2	T1-T3	T2-T3
Appearance	5.56 (1.11)	5.58 (1.25)	0.933	5.66 (1.12)	5.72 (1.13)	0.790	5.76 (1.17)	5.82 (1.10)	0.792	0.898	0.652	0.898	0.818	0.556	0.903
Aroma	5.76 (0.94)	5.94 (1.00)	0.355	6.76 (0.94)	5.84 (0.96)	0.674	5.84 (1.09)	5.98 (0.84)	0.476	1.000	0.915	0.915	0.854	0.975	0.735
Flavor	6.28 (0.90)	6.30 (0.86)	0.910	5.86 (0.95)	5.74 (1.21)	0.582	5.86 (1.21)	5.92 (0.92)	0.781	0.107	0.107	1.00	0.017**	0.147	0.646
Texture of shrimp	5.12 (1.62)	5.48 (1.47)	0.249	5.48 (1.09)	5.38 (1.18)	0.661	4.80 (1.68)	5.20 (1.56)	0.221	0.450	0.531	0.061*	0.934	0.585	0.800
Texture of chicken	5.12 (1.41)	5.16 (1.54)	0.892	5.12 (1.35)	4.88 (1.47)	0.397	4.60 (1.58)	4.78 (1.49)	0.559	1.00	0.175	0.175	0.620	0.416	0.941
Texture of sausage	5.74 (1.31)	5.86 (1.16)	0.628	5.78 (1.13)	5.64 (1.16)	0.542	5.52 (1.40)	5.60 (1.23)	0.762	0.987	0.669	0.571	0.622	0.516	0.984
Overall liking	5.70 (1.11)	5.74 (1.01)	0.851	5.58 (0.97)	5.60 (1.11)	0.924	5.54 (1.30)	5.68 (0.91)	0.534	0.857	0.761	0.983	0.769	0.953	0.918

Note: Values in parentheses are standard deviations.
*Significance at 10% level.
**Significance at 5% level.

TABLE 4 Average bids across samples at each point in time of the experiment

	Average bid ($/9 oz unit)		
	Average bids at each point in time		
	MAPS sample	Frozen sample	Pairwise *t*-test MAPS-frozen
Time 1: 2 weeks	3.54 (1.36)	3.55 (1.35)	0.947
Time 2: 8 weeks	3.55 (1.37)	3.39 (1.39)	0.542
Time 3: 12 weeks	3.74 (1.35)	3.56 (1.31)	0.510

Bids comparison across information treatments within sample Tukey test *p*-values					
MAPS sample			Frozen sample		
Time 1-time 2	Time 1-time 3	Time 2-time 3	Time 1-time 2	Time 1-time 3	Time 2-time 3
0.997	0.741	0.784	0.808	1.000	0.794

TABLE 5 Average bids across samples across informational treatments

	Average bid ($/9 oz unit)		
	Average bids across informational treatments		
	MAPS sample	Frozen sample	Pairwise *t*-test MAPS-frozen
No information	3.54	3.55	0.947
	(1.36)	(1.35)	
Environmental inf.	3.58	3.41	0.559
	(1.45)	(1.43)	
Name technology inf.	3.72	3.54	0.490
	(1.27)	(1.26)	

Bids comparison across information treatments within sample Tukey test *p*-values					
MAPS sample			Frozen sample		
No inf—Env inf	No inf—Tec inf	Env inf—Tec inf	No inf—Env inf	No inf—Tec inf	Env inf—Tec inf
0.988	0.786	0.865	0.850	0.998	0.876

Table 5. Pairwise *t* tests shows that there are no statistically significant differences between the bids for the MAPS and the frozen sample: when no information was given; when the name of the technology was disclosed; and when environmental information associated with each technology was disclosed. This indicates that neither the name of the technology nor the perceptions of environmental consequences of using either technology had a statistically significant effect on bids.

4.4 | Fixed-effect regression

Table 6 reports parameter estimates for the following four fixed effects OLS regressions. Because the sample size in this study is small (N = 50), we conducted a bootstrap regression as a robustness check. Coefficient estimates of the bootstrap regression standard errors are presented in Table 7. No large differences in p-values and standards errors between regressions are found, therefore we discuss the results of the fixed effects OLS regression in Table 6. In regression 1, the coefficient for the liking ratings for aroma and flavor are positive and statistically significant. Whereas the coefficient estimates for the variables representing the disclosure of the information on preservation technology and the environmental effects associated with each technology resulted in no statistical significance. Recall that pairwise *t* tests resulted in no statistically significant differences in the ratings for the sensory attributes of both MAPS and frozen samples at the three storage times. That is, the two meals were, from a sensory point of view, very similar. Therefore, the interaction between process information and sensory perception is difficult to elucidate. Also noteworthy is that 70% of the participants stated that the major driver for food consumption is taste and 96% stated that taste is an important aspect for food purchasing decision. This is contrasted with the 26% who stated that the environmental impact was the most important aspect. It is possible, that the specific group of participants value taste more than other related aspects of the food.

TABLE 6 Fixed-effect regression estimates

Variable	Model 1 Parameter	Model 1 Standard errors	Model 2 Parameter	Model 2 Standard errors	Model 3 Parameter	Model 3 Standard errors	Model 4 Parameter	Model 4 Standard errors
Intercept	−0.778	0.588	−0.121	0.520	3.500***	0.111	3.544***	0.137
Attribute liking								
Appearance	−0.057	0.073	−0.065	0.071	–	–	–	–
Aroma	0.251***	0.093	0.210**	0.092	–	–	–	–
Flavor	0.242**	0.101	0.227**	0.098	–	–	–	–
Texture shrimp	0.087	0.062	0.100	0.063	–	–	–	–
Texture chicken	0.012	0.060	−0.011	0.062	–	–	–	–
Texture sausage	0.135	0.087	0.170*	0.091	–	–	–	–
Time, technology, and information								
Maps	0.158	0.138	–	–	–	–	–	–
Time 2	0.053	0.207	–	–	–	–	–	–
Time 3	0.249	0.193	–	–	–	–	–	–
Tech information	0.027	0.162	–	–	–	–	–	–
Sociodemographic dummies								
Millennial	−0.295*	0.169	–	–	–	–	–	–
HHsize 3 or more	−0.651***	0.140	–	–	–	–	–	–
HHincome > $58,899	0.487***	0.167	–	–	–	–	–	–
Healthy (self-reported)	0.408**	0.180	–	–	–	–	–	–
Food technology neophobic	0.111	0.146	–	–	–	–	–	–
Interaction effects								
With MAPS								
Maps	–	–	–	–	−3.545***	0.737	–	–
Maps × appearance	–	–	–	–	−0.098	0.109	–	–
Maps × aroma	–	–	–	–	0.181	0.121	–	–
Maps × flavor	–	–	–	–	0.211*	0.117	–	–
Maps × texture shrimp	–	–	–	–	0.096	0.084	–	–
Maps × texture chicken	–	–	–	–	0.054	0.097	–	–
Maps × texture sausage	–	–	–	–	0.200	0.134	–	–
With point in time								
Time 2	–	–	–	–	–	–	−4.754***	0.8611
Time 2 × appearance	–	–	–	–	–	–	0.002	0.130
Time 2 × aroma	–	–	–	–	–	–	0.252	0.190
Time 2 × flavor	–	–	–	–	–	–	0.245	0.178
Time 2 × texture shrimp	–	–	–	–	–	–	0.101	0.126
Time 2 × texture chicken	–	–	–	–	–	–	0.0173	0.122
Time 2 × texture sausage	–	–	–	–	–	–	0.181	0.118
Time 3	–	–	–	–	–	–	−3.576***	0.866
Time 3 × appearance	–	–	–	–	–	–	−0.310***	0.117
Time 3 × aroma	–	–	–	–	–	–	0.288**	0.123
Time 3 × flavor	–	–	–	–	–	–	0.362**	0.133
Time 3 × texture shrimp	–	–	–	–	–	–	0.039	0.101
Time 3 × texture chicken	–	–	–	–	–	–	0.045	0.102

(Continues)

TABLE 6 (Continued)

Variable	Model 1		Model 2		Model 3		Model 4	
	Parameter	Standard errors	Parameter	Standard errors	Parameter	Standard errors	Parameter	Standard errors
Time 3 × texture sausage	–	–	–	–	–	–	0.221*	0.132
Number of observations	300		300		300		300	
R square	0.285		0.166		0.100		0.161	

*The parameter estimate is statistically significant at 10% level.
**The parameter estimate is statistically significant at 5% level.
***The parameter estimate is statistically significant at 1% level.

TABLE 7 Fixed-effect regression estimates [bootstrapping robustness check]

Variable	Model 1		Model 2		Model 3		Model 4	
	Parameter	Bootstrap standard errors	Parameter	Bootstrap standard errors	Parameter	Bootstrap standard errors	Parameter	Bootstrap standard errors
Intercept	−0.778	0.602	−0.121	0.539	3.500***	0.115	3.544***	0.123
Attribute liking								
Appearance	−0.057	0.070	−0.065	0.070	–	–	–	–
Aroma	0.251***	0.093	0.213***	0.077	–	–	–	–
Flavor	0.242**	0.106	0.227**	0.101	–	–	–	–
Texture shrimp	0.087	0.062	0.100*	0.054	–	–	–	–
Texture chicken	0.012	0.066	−0.011	0.063	–	–	–	–
Texture sausage	0.135	0.091	0.170**	0.082	–	–	–	–
Time, technology, and information								
Maps	0.158	0.120	–	–	–	–	–	–
Time 2	0.053	0.200	–	–	–	–	–	–
Time 3	0.249	0.184	–	–	–	–	–	–
Tech information	0.027	0.167	–	–	–	–	–	–
Sociodemographic dummies								
Millennial	−0.295*	0.174	–	–	–	–	–	–
HHsize 3 or more	−0.651***	0.131	–	–	–	–	–	–
HHincome > $58,899	0.487***	0.162	–	–	–	–	–	–
Healthy (self-reported)	0.408**	0.198	–	–	–	–	–	–
Food technology neophobic	0.111	0.156	–	–	–	–	–	–
Interaction effects								
With MAPS								
Maps	–	–	–	–	−3.545***	0.733	–	–
Maps × appearance	–	–	–	–	−0.098	0.120	–	–
Maps × aroma	–	–	–	–	0.181	0.128	–	–
Maps × flavor	–	–	–	–	0.211*	0.126	–	–
Maps × texture shrimp	–	–	–	–	0.096	0.080	–	–
Maps × texture chicken	–	–	–	–	0.054	0.095	–	–
Maps × texture sausage	–	–	–	–	0.200	0.131	–	–
With point in time								
Time 2	–	–	–	–	–	–	−4.754***	0.955
Time 2 × appearance	–	–	–	–	–	–	0.002	0.156

TABLE 7 (Continued)

Variable	Model 1		Model 2		Model 3		Model 4	
	Parameter	Bootstrap standard errors	Parameter	Bootstrap standard errors	Parameter	Bootstrap standard errors	Parameter	Bootstrap standard errors
Time 2 × aroma	–	–	–	–	–	–	0.273	0.235
Time 2 × flavor	–	–	–	–	–	–	0.245	0.180
Time 2 × texture shrimp	–	–	–	–	–	–	0.101	0.141
Time 2 × texture chicken	–	–	–	–	–	–	0.017	0.140
Time 2 × texture sausage	–	–	–	–	–	–	0.182	0.132
Time 3	–	–	–	–	–	–	−3.576***	0.919
Time 3 × appearance	–	–	–	–	–	–	−0.310**	0.122
Time 3 × aroma	–	–	–	–	–	–	0.288**	0.126
Time 3 × flavor	–	–	–	–	–	–	0.362**	0.159
Time 3 × texture shrimp	–	–	–	–	–	–	0.039	0.104
Time 3 × texture chicken	–	–	–	–	–	–	0.045	0.105
Time 3 × texture sausage	–	–	–	–	–	–	0.222	0.146
Number of observations	300		300		300		300	
R square	0.285		0.166		0.100		0.161	

*The parameter estimate is statistically significant at 10% level.
**The parameter estimate is statistically significant at 5% level.
***The parameter estimate is statistically significant at 1% level.

Despite the sample of participants in this study is small ($N = 50$), we included in regression 1, sociodemographic variables and some of their coefficients resulted statistically significant. The coefficient estimates for millennials and for household size with three or more individuals are negative and statistically significant. The coefficient estimates for a household income greater than $58,899 per year who self-reported as healthy were positive and statistically significant. The coefficient for the food technology neophobia score was not statistically significant for the variation of bids.

Coefficient estimates of model 2 are aligned with model 1, as estimates for aroma and flavor are positive and statistically significant. The difference is that in model 2, in addition to the mentioned coefficient estimates, the estimate for the texture of sausage is positive and statistically significant. Coefficient estimates of model 3 are not conclusive. While the coefficient estimate for the binary variable MAPS was negative and statistically significant in relation to frozen, the estimate for the interaction effect of MAPS and liking rating for flavor was positive and statistically significant. This implies that MAPS induced flavor has a positive effect on the bids, but that MAPS alone exerts a negative effect on bids.

Coefficient estimates of model 4 are also not conclusive. The coefficient estimates for time 2 and time 3 are negative and statistically significant, in relation to time 1. This implies that bids decrease with time as both bids in time 2 and time 3 are lower compared to time 1. The interaction between time 3 and the liking rating for appearance is negative. However, the interactions between time 3 and the liking rating for aroma, time 3 and flavor, and time 3 and texture of the sausage are positive and statistically significant. These results imply that at time 3 the effect of the liking ratings of appearance is negative but the liking ratings of aroma, flavor, and texture of the sausage have a positive effect on the bids.

Overall, our results show evidence that the WTP for two samples of ready jambalaya meals is driven by the perceptions of sensory quality but not by the name of the technology or environmental impacts associated with each food preservation technology. It is possible that the interaction between preservation technology information, environmental impacts, and sensory perception cannot be fully explained because the two sample meals in the study were similar from a sensory perspective. It is also possible that the negligible impact of the preservation technology used on bids is driven by the familiarity that most consumers have with the words “microwave” and “pasteurization.” Further, results might be driven by the sample of participants, which on average exhibited lower food technology neophobia scores compared to participants in studies conducted in Australia and Canada (Cox & Evans, 2008; Matin et al., 2012).

5 | SUMMARY AND CONCLUSION

This study applies a HUT along with experimental auctions to infer consumers' WTP for sensory quality attributes of two samples of ready meals, while measuring and recording observations of the use of a new food preservation technology and perceptions of the environmental impact associated with each technology. The approach used combined HUT with hedonic sensory scores and experimental auctions following an online setup, and it was replicated at three storage times (i.e., two, eight, and twelve weeks after meal preparation).

Our results suggest that sensory characteristics are the key drivers for participants' WTP. We did not find evidence that the name of the technology and the information on the environmental impacts associated with each technology impacted participants' WTP. Our results lead us to conclude that the impact of the name of the technology resulting from the food production-processing technology used, and environmental consequences of such technologies are technology, product, and subject driven. In our specific case, the two sample meals in the study were, from a sensory point of view, very similar; making it difficult to fully explain the interaction between process information, environmental impacts, and sensory perception. Also, the new technology contains the words "microwave" and "pasteurization"; which are familiar to consumers. This is likely a factor that positively affects its acceptance by consumers and makes them indifferent towards the new and the traditionally used preservation technology. The product used in this study, a ready meal, also drives these results. The "level" of processing for a ready meal is low compared to other convenient meals using other types of processing technologies. It is likely that results would vary depending on the level of processing or on the type of technology used. Participants who are used to consuming convenient foods, are less food technology neophobic compared to subjects in other studies (Cox & Evans, 2008; Matin et al., 2012), and display relative low levels of concern on the environmental consequences of the food technology used as only 26% indicated this is an important aspect when purchasing food.

From a methodological point of view, our study contributes by presenting a protocol for conducting a combined HUT and online auction across time for a complex food matrix (i.e., the jambalaya meal) in which the eating environment is important. Also influential is that participants actually ate the meal, therefore the sensory evaluation results that were gathered were more impactful for bids than the extrinsic attributes. Furthermore, our study highlights the importance of including additional explanatory variables, in addition to conventional demographic characteristics, to analyze food choice behavior in the context of new technologies. Limitations of our study include the limited sample size of participants. It would be ideal to conduct this study with a larger and more representative sample of consumers to more accurately measure source of preference heterogeneity.

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ORCID

R. Karina Gallardo https://orcid.org/0000-0002-6609-4711
Carolyn F. Ross https://orcid.org/0000-0001-8861-0230

REFERENCES

Barnett, S. M., Sablani, S. S., Tang, J., & Ross, C. F. (2019). Utilizing herbs and microwave-assisted thermal sterilization to enhance saltiness perception in a chicken pasta meal. *Journal of Food Science*, *84*, 2313–2324. https://doi.org/10.1111/1750-3841.14736

Boutrolle, I., Arranz, D., Rogeaux, M., & Delarue, J. (2005). Comparing central location test and home use test results: Application of a new criterion. *Food Quality and Preference*, *16*, 704–713. https://doi.org/10.1016/j.foodqual.2005.03.015

Boutrolle, I., Delarue, J., Arranz, D., Rogeaux, M., & Koster, E. P. (2007). Central location test vs. home use test: Comparing results depending on product type. *Food Quality and Preference*, *18*, 490–499. https://doi.org/10.1016/j.foodqual.2006.06.003

Combris, P., Seabra Pinto, A., Fragata, A., & Giraud-Heraud, E. (2009). Does taste beat food safety? Evidence from the "Pera Rocha" case in Portugal. Presented at the *European Association of Agricultural Economists seminar "International Marketing and International Trade of Quality Food Products"*. Bologna, Italy, March 8–10.

Costa, A. I. A., Dekker, M., Beumer, R. R., Rombouts, F. M., & Jongen, W. M. F. (2001). A consumer-oriented classification system for home meal replacements. *Food Quality and Preference*, *12*, 229–242. https://doi.org/10.1016/S0950-3293(01)00010-6

Costa, A. I. A., Schoolmeester, D., Dekker, M., & Jongen, W. M. F. (2007). To cook or not to cook: A means-end study of motives for choice of meal solutions. *Food Quality and Preference*, *18*, 77–88. https://doi.org/10.1016/S0950-3293(01)00010-6

Cox, D. N., & Evans, G. (2008). Construction and validation of a psychometric scale to measure consumers' fears of novel food technologies: The food technology neophobia scale. *Food Quality and Preference*, *19*, 704–710. https://doi.org/10.1016/j.foodqual.2008.04.005

De Groote, H., Chege, C. K., Tomlins, K., & Gunarata, N. S. (2014). Combining experimental auctions with a modified home-use test to assess rural consumers' acceptance of quality protein maize, a biofortified crop. *Food Quality and Preference*, *38*, 1–13. https://doi.org/10.1016/j.foodqual.2014.04.014

De Wijk, R. A., Kaneko, D., Dijksterhuis, G. B., van Zoggel, M., Schiona, I., & Visalli, M. (2019). Food perception and emotion measured over time in-lab and in-home. *Food Quality and Preference*, *75*, 170–178. https://doi.org/10.1016/j.foodqual.2019.02.019

Evans, J., & Brown, T. (2012). *Carbon emissions from chilled and frozen cold chains for a typical UK Sunday roast chicken meal*. North Somerset, UK: Refrigeration Developments and Testing Ltd. Retrieved from http://bfff.co.uk/wp-content/uploads/2013/06/Carbon-Emissions-from-Chilled-Frozen-Report-Sept-12.pdf

Frewer, L. J., Bergmann, K., Brennan, M., Lion, R., Meertens, R., Rowe, G., … Vereijken, C. (2011). Consumer response to novel agri-food technologies: Implications for predicting consumer acceptance of emerging food technologies. *Trends in Food Science & Technology*, *22*, 442–456. https://doi.org/10.1016/j.tifs.2011.05.005

Hoek, A. C., Elzerman, J. E., Hagema, R., Kok, F. J., Luning, P. A., & de Graaf, C. (2013). Are meat substitutes liked better over time? A repeated in-home use test with meat substitutes or meat in meals. *Food Quality and Preferences*, *28*, 253–263. https://doi.org/10.1016/j.foodqual.2012.07.002

Jaeger, S. R. (2006). Non-sensory factors in sensory science research. *Food Quality and Preference*, *17*, 132–144. https://doi.org/10.1016/j.foodqual.2005.03.004

Loureiro, M. L., & Umberger, W. J. (2007). A choice experiment model for beef: What US consumer responses tell us about relative preferences for food safety, country-of-origin labeling and traceability. *Food Policy*, *32*, 496–514. https://doi.org/10.1016/j.foodpol.2006.11.006

Lusk, J. L., & Briggeman, B. C. (2009). Food values. *American Journal of Agricultural Economics*, *91*, 184–196. https://doi.org/10.1111/j.1467-8276.2008.01175.x

Lusk, J. L., Roosen, J., & Bieberstein, A. (2014). Consumer acceptance of new food technologies: Causes and roots of controversies. *Annual*

Review of Resource Economics, *6*, 381–405. https://doi.org/10.1146/annurev-resource-100913-012735

Lusk, J. L., Schroeder, T. C., & Tonsor, G. T. (2014). Distinguishing beliefs from preferences in food choice. *European Review of Agricultural Economics*, *41*, 627–655. https://doi.org/10.1093/erae/jbt035

Lusk, J. L., & Shogren, J. F. (2007). *Experimental auctions: Methods and applications in economic and marketing research*. Cambridge, UK: Cambridge University Press.

Malone, T., & Lusk, J. L. (2017). Taste trumps health and safety: Incorporating consumer perceptions into a discrete choice experiment for meat. *Journal of Agricultural and Applied Economics*, *49*, 139–157. https://doi.org/10.1017/aae.2016.33

Matin, A. H., Goddard, E., Vandermoere, F., Blanchemanche, S., Bieberstein, A., Marette, S., & Roosen, J. (2012). Do environmental attitudes and food technology neophobia affect perceptions of the benefits of nanotechnology? *International Journal of Consumer Studies*, *36*, 149–152. https://doi.org/10.1111/j.1470-6431.2011.01090.x

Moskowitz, H. R. (2000). Engineering out food boredom: A product development approach that combines home use tests and time-preference analysis. *Food Quality and Preference*, *11*, 445–456. https://doi.org/10.1016/S0950-3293(00)00016-1

Olsen, N. V., Menichelli, E., Sørheim, O., & Næs, T. (2012). Likelihood of buying healthy convenience food: And at-home testing procedure for ready-to-heat meals. *Food Quality and Preference*, *24*, 171–178. https://doi.org/10.1016/j.foodqual.2011.11.001

Peng, J., Tang, J., Barrett, D. M., Sablani, S. S., Anderson, N., & Powers, J. R. (2017). Thermal pasteurization of ready-to-eat foods and vegetables: Critical factors for process design and effects on quality. *Critical Reviews in Food Science and Nutrition*, *57*, 2970–2995. https://doi.org/10.1080/10408398.2015.1082126

Resurreccion, F. P., Jr., Tang, J., Pedrow, P., Cavalieri, R., Liu, F., & Tang, Z. (2013). Development of a computer simulation model for processing food in a microwave assisted thermal sterilization (MATS) system. *Journal of Food Engineering*, *118*, 406–416. https://doi.org/10.1016/j.jfoodeng.2013.04.021

Schmidt Rivera, X. C., Espinoza Orias, N., & Azapagic, A. (2014). Life cycle environmental impacts of convenience food: Comparison of ready and home-made meals. *Journal of Cleaner Production*, *73*, 294–309. https://doi.org/10.1016/j.jclepro.2014.01.008

Schouteten, J. J., Gellynck, X., & Slabbinck, H. (2019). Influence of organic labels on consumer's flavor perception and emotional profiling: Comparison between a central location test and home-use-test. *Food Research International*, *116*, 1000–1009. https://doi.org/10.1016/j.foodres.2018.09.038

Shogren, J. F., List, J. A., & Hayes, D. J. (2000). Preference learning in consecutive experimental auctions. *American Journal of Agricultural Economics*, *82*, 1016–1021.

Stefani, G., Romano, D., & Cavicchi, A. (2006). Consumer expectations, liking and willingness to pay for specialty foods: Do sensory characteristics tell the whole story? *Food Quality and Preference*, *17*, 53–62. https://doi.org/10.1016/j.foodqual.2005.07.010

Stelick, A., & Dando, R. (2018). Thinking outside the booth—The eating environment, context, and ecological validity in sensory and consumer research. *Current Opinion in Food Science*, *21*, 26–31. https://doi.org/10.1016/j.cofs.2018.05.005

Stubenitsky, K., Aaron, J. I., Catt, S. L., & Mela, D. J. (1999). Effect of information and extended use of the acceptance of reduced-fat products. *Food Quality and Preference*, *10*, 367–376. https://doi.org/10.1016/S0950-3293(98)00056-1

Tang, J. (2015). Unlocking potentials of microwaves for food safety and quality. *Journal of Food Science*, *80*, 1776–1793. https://doi.org/10.1111/1750-3841.12959

Tang, J., Hong, Y. K., Inanoglu, S., & Liu, F. (2018). Microwave pasteurization for ready-to-eat meals. *Current Opinion in Food Science*, *23*, 133–141. https://doi.org/10.1016/j.cofs.2018.10.004

Zandstra, E. H., Weegels, M. F., Van Spronsen, A. A., & Klerk, M. (2004). Scoring or boring? Predicting boredom through repeated in-home consumption. *Food Quality and Preference*, *15*(6), 549–557. https://doi.org/10.1016/j.foodqual.2003.12.001

Zhang, M. T., Jo, Y., Lopetcharat, K., & Drake, M. A. (2020). Comparison of a central location test versus a home usage test for consumer perception of a ready-to-mix protein beverages. *Journal of Dairy Science*, *103*(4), 3107–3124. https://doi.org/10.3168/jds.2019-17260

Zhang, W., Luan, D., Tang, J., Sablani, S. S., Rasco, B., Lin, H., & Liu, F. (2015). Dielectric properties and other physical properties of low-acyl gellan gel as relevant to microwave assisted pasteurization process. *Journal of Food Engineering*, *149*, 195–203. https://doi.org/10.1016/j.jfoodeng.2014.10.014

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