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"Consumers' Preferences Toward Farmed Salmon in China: Integrating Sensory and Choice Experiments"

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ABSTRACT

China's growing demand for farmed salmon is apparent, with the country importing 190 thousand tonnes valued at over $1.12 billion in 2023. In response, the Chinese government allowed rainbow trout to be labelled and sold as salmon starting in 2018, bridging the gap between domestically produced trout and imported Atlantic salmon. This study aimed to explore how country-of-origin information influences Chinese consumers' sensory perceptions and willingness to pay (WTP) for salmon. Using a within-subject design with two evaluation rounds (blind and informed) we combined hedonic liking where Chinese consumers rated three salmon samples (from Norway, Chile, and China) with a discrete choice experiment. The results indicated that under the blind taste test, Chinese consumers found no significant difference in sensory preference between domestic rainbow trout and imported Atlantic salmon from Norway and Chile. However, when informed of the product origins, consumer preferences shifted in favor of Norwegian and Chilean Atlantic salmon. Furthermore, consumers' WTP for salmon was unaffected by the country of production unless provenance was disclosed, at which point the origin significantly influenced their preferences. Ecolabels, price, overall liking, education, frequency of aquatic food consumption, and prior experience with salmon were also found to impact WTP for salmon. These insights offer valuable insights for salmon producers/importers/marketers to customize their approaches in response to consumer preferences, refine product positioning, and seize upon opportunities within the competitive salmon market in China.

1 | Introduction

China, the largest aquatic food market in the world, has steady growth and a trend toward imported high-value aquatic species, for example, salmon, lobster, abalone, and sea cucumber (Crona et al. 2020; Food and Agriculture Organization 2020, 2024; Wang and Somogyi 2020). But it is essential to acknowledge the regional variations within China's aquatic food consumption landscape (Cao et al. 2015; Crona et al. 2020). For instance, coastal regions exhibit different consumption patterns compared to inland areas, potentially influenced by factors, such as proximity to fishing grounds, cultural preferences, and economic development levels (Fabinyi 2012; Meng et al. 2023). Additionally, as part of this overall increase in aquatic food consumption, traditional farmed

freshwater species such as carp and tilapia continue to play a significant role in the Chinese diet. The growth in imported high-value species therefore reflects a diversification of consumer preferences and the incorporation of more expensive species into the diet (Newton et al. 2021).

Farmed salmon, though still a relatively young industry, holds significant promise due to its innovative nature and its ability to provide an exceptionally high level of healthy protein while maintaining a lower carbon footprint compared to other livestock (Johannessen 2020; Poore and Nemecek 2018). This makes it a crucial product that is likely to play an important role in the future of global food supply. In 2023, China imported around 190 thousand tonnes of farmed salmon worth more than $1.12 billion to become the largest importer of salmon in the world (General Administration of Customs of the People's Republic of China 2024). Currently, farmed Atlantic salmon is the most preferred salmon species, known for its luxury and premium quality among Chinese consumers. It is mostly consumed in social gatherings in out-of-home dining settings and raw in Japanese type (sushi/sashimi). Some consumers prefer to buy it for home consumption in such convenient formats as groceries or through e-commerce platforms (Budhathoki, Lincen, et al. 2024). Norway dominates the market share at about 49.8% of the total imported value, supplemented by contributions from Chile, the United Kingdom, the Faroe Islands, Australia, Canada, and Iceland. Given that the source countries from which China imports Atlantic salmon produced 2.83 million tonnes from aquaculture and 343.89 t from capture fisheries in 2022, it is estimated that nearly all (approximately 99.99%) of the Atlantic salmon imported by China are farmed (Food and Agriculture Organization 2024). Increasing levels of such imported salmon led the Chinese government to allow locally farmed rainbow trout to be labeled and sold domestically as salmon starting in 2018, providing consumers with more options. The Chinese government's position was that rainbow trout (*Oncorhynchus mykiss*) and Atlantic salmon (*Salmo salar*) both belonged to the Salmonidae family and shared similar characteristics (Smith 2018; Tiffany 2018). Rainbow trout production in China is approximately 37 thousand tonnes (live weight, 2022) (Food and Agriculture Organization 2024). Although attempts have been made to produce Atlantic salmon in China, the production remains minimal due to the relatively high cost of breeding and numerous technical challenges (Godfrey 2020; Lu 2022).

Extrinsic product attributes—external factors related to the product but not part of its physical characteristics—play a significant role in shaping consumers' preferences. Influential extrinsic product attributes related to aquatic food include origin, production method, packaging, price, and brand (Budhathoki et al. 2022; Rodriguez-Salvador and Calvo Dopico 2023). Evidence suggests that consumers may regard the origin as the foremost extrinsic attribute when making aquatic food purchases. Consumers may have preferences for aquatic species from specific regions or countries due to factors, such as perceived quality, safety standards, trust, environmental sustainability, cultural associations, and emotional sensations (Alfnes, Chen, and Rickertsen 2018; Banovic et al. 2019; Budhathoki et al. 2021; Cantillo, Martín, and Román 2020; Rodriguez-Salvador and Calvo Dopico 2023). Bienenfeld et al. (2016) put forward that understanding the influence of country of origin on consumer behavior has become essential to policymakers and food marketers. Certainly, available information on the country of origin accessible to consumers has the potential to shape their expectation-forming process, thereby impacting their attitudes, which subsequently influence their sensory perceptions.

On the other hand, intrinsic product attributes, such as sensory characteristics (e.g., taste, color, smell, texture, and juiciness), are crucial determinants of food liking and choice. These intrinsic attributes are inherent to the product itself and cannot be modified without changing the nature of food. A recent survey of first-tier cities in China shows that the most important specific motives for high-value aquatic species, such as salmon, are umami, deliciousness, and freshness (Wang and Somogyi 2020). For instance, in the case of Atlantic salmon, about 70% of all salmon products imported to China were fresh (Food and Agriculture Organization 2024), whereas approximately 60% of the Chilean salmon were imported in a fresh state (Evans 2023). Further, the sensory attribute of fattiness in salmon is often linked to its omega-3 fatty acid content—an intrinsic quality that strongly influences consumer preferences due to its perceived health benefits (Colombo and Mazal 2020; Kris-Etherton, Harris, and Appel 2002).

Although intrinsic attributes drive immediate sensory appeal, extrinsic factors—such as food production methods, safety standards, certifications, and branding—play a significant role in shaping Chinese consumer preferences for aquatic foods (Wang et al. 2009; Wu and Zhu 2014; Yin et al. 2022; Zheng, Wang, and Shogren 2021). Previous studies have indicated that Chinese consumers recognize European food products as high quality and safe to eat (Agriculture Trade Office 2018; Malcorps et al. 2021). But it is also important to consider that Chinese consumers may have established positive perceptions of Chilean salmon products, particularly given that Chile exported a significant volume of 5.7 thousand tonnes of salmon to China, indicating recognition of their quality and reliability.

Previous researchers have argued that research integrating intrinsic and extrinsic product attributes captures complete and realistic information about consumers' food choices in a real-life context (Asioli et al. 2017; Köster 2009). To date, few studies have combined sensory evaluations with a choice experiment to assess how information affects consumer liking and willingness to pay (WTP). Table 1 shows previous food studies that integrated these two methods to understand consumer food choices. Overall, these studies indicated that available information could influence consumer sensory perceptions and WTP. However, to our knowledge, no previous studies have combined sensory evaluation and choice experiments to examine the effect of information on consumer sensory perceptions and WTP for aquatic foods. Further, combining sensory evaluations for two condition types (blind and informed) with a binding discrete choice experiment (DCE), this study will be the first of its kind to evaluate an aquatic food product. The study aims to evaluate if there are subjective differences in sensory attributes (taste, smell, firmness, juiciness, fattiness, and overall liking) between Norwegian and Chilean Atlantic salmon and Chinese rainbow trout products. Further, we also aim to understand how country-of-origin information affects consumers' sensory liking and WTP for salmon products among Chinese consumers.

TABLE 1 | Previous food studies integrated sensory and choice experiments.

S.N.	Reference	Country	Research focus	Food product	Sample size, study design
1	Gross, Waldrop, and Roosen (2021)	Germany	Information about animal welfare practices affects consumers' liking and willingness to pay (WTP) for a pork product	Pork-cooked ham products	$N = 154$, blind–expected–informed design Classic hedonic testing + a non-hypothetical choice experiment https://doi.org/10.1016/j.foodqual.2020.104055
2	Gallardo et al. (2018)	The United States	Preferences for external and internal quality characteristics of two fresh apple varieties "Honeycrisp" and "Gala"	Fresh fruit varieties	$N = 384$, hedonic testing + experimental auctions https://doi.org/10.1002/agr.21534
3	Teuber, Dolgopolova, and Nordström (2016)	Germany	Perceive different among value-added whole grain bread, WTP, and information influencing liking scores and WTP	Whole grain bread	$N = 131$, hedonic evaluation + experimental auctions https://doi.org/10.1016/j.foodqual.2016.05.002
4	Caputo, Sogari, and Van Loo (2023)	The United States	Preferences and demand for meat-based, plant-based, and hybrid burgers	Plant-based and blend meat alternatives	$N = 172$, hedonic evaluation (blind–informed) + choice experiment https://doi.org/10.1002/aepp.13247
5	Meyerding et al. (2018)	Germany	Preferences and perceptions toward beef steaks, also including experience characteristics	Beef	$N = 55$, sensory acceptance test, stated WTP, and choice-based conjoint analysis https://doi.org/10.1016/j.appet.2018.05.008
6	Bi et al. (2015)	The United States	Effect of sensory attributes and organic label on consumers' stated preference and marginal WTP for orange juice	Orange juice	$N = 98$, hedonic evaluation + discrete choice experiment https://doi.org/10.1111/ijcs.12164
7	Hong et al. (2023)	Ireland	Preferences and WTP toward two opposing reformulation strategies (i.e., nutrient "addition" and ingredient "reduction") in processed meat	Pork sausages	$N = 326$ + conjoint experiment https://doi.org/10.3390/agriculture13020234

(Continues)

TABLE 1 | (Continued)

S.N.	Reference	Country	Research focus	Food product	Sample size, study design
9	Naspetti et al. (2019)	Italy	Information about some product characteristics (organic production, zero alcohol, brand, and packaging) on sensory liking and WTP of a new organic sparkling mock-wine made of pasteurized must	Wine	$N = 204$ (blind + informed) + choice experiment https://doi.org/10.1108/BFJ-06-2019-0469
10	Papoutsi, Klonaris, and Drichoutis (2021)	Greece	Consumer compromises on taste for potential health benefits from functional snacks—hedonic judgments and willingness to pay (WTP)	Functional snacks	$N = 160$ (blind + informed) + a series of non-hypothetical second-price Vickrey auction https://doi.org/10.1108/BFJ-10-2018-0694
11	Henn et al. (2023)	Denmark	Information about health or environmental benefits of pulses on the acceptance of novel pulse-based products from chickpeas, black beans, and faba beans	Pluse-based spreads	$N = 202$ (blind + informed) + discrete choice experiment https://doi.org/10.1111/1750-3841.16471
12	Kallas et al. (2019)	Spain, Italy, Slovenia, and Croatia	WTP and hedonic evaluation toward new pig breeds (traditional and innovative) in Spain, Croatia, Italy, and Slovenia	Pork	$N = \sim120$ each country (blind + informed) + non-hypothetical discrete choice experiment https://doi.org/10.1016/j.meatsci.2019.04.011

2 | Conceptual Framework and Hypothesis Development

We base our conceptual framework on the food choice model proposed by Köster (2009), which suggests that consumers' food decisions are influenced by both intrinsic attributes (such as sensory perceptions like taste, texture, and appearance) and extrinsic attributes (such as price, ecolabels, brand, and country of origin) (Symmank 2019). Research has shown that sensory appeal is a key factor driving food choices, particularly among Chinese consumers, for whom liking a product is often strongly linked to its sensory characteristics (Budhathoki et al. 2022; Wang et al. 2015; Xu et al. 2024).

Price represents a monetary trade-off that consumers evaluate when considering products like aquatic food (Budhathoki et al. 2022). Several previous studies have indicated that price could influence consumers' evaluation of food products and ultimately impact their WTP (Boccia, Alvino, and Covino 2024; Pandey et al. 2024; Petrescu, Vermeir, and Petrescu-Mag 2020; Wang and Li 2012). For instance, Petrescu, Vermeir, and Petrescu-Mag (2020) found that price was an important motive to judge food product quality or purchase. Studies have found that consumers often associate higher priced food items with better quality (Kovacs and Keresztes 2022). However, WTP is influenced by factors such as consumers' environmental awareness and product type (e.g., organic). For instance, Hu, Woods, and Bastin (2009) found that price consistently had a negative effect across categories, indicating that, all else equal, consumers are less likely to choose higher priced options.

In addition, ecolabels have become increasingly important extrinsic attributes (Majer et al. 2022), particularly for sustainable food products like farmed salmon, where concerns about environmental impact are growing (Budhathoki, Tunca et al. 2024). Many consumers are willing to pay a premium for eco-labeled products, reflecting the increasing importance of sustainability in food choices (Alfnes, Chen, and Rickertsen 2018; Bronnmann and Hoffmann 2018; Rickertsen et al. 2017; Uchida et al. 2014; Winson et al. 2022).

Country of origin is another significant extrinsic factor, often serving as an indicator of product quality and reputation (Budhathoki et al. 2021; Götze and Brunner 2019; Onozaka, Honkanen, and Altintzoglou 2023; Risius, Janssen, and Hamm 2017; Verlegh and Steenkamp 1999). Previous studies indicated that the country of origin is one of the most important attributes for aquatic food choices (Maesano, Carra, and Vindigni 2019). This is particularly relevant in the case of farmed salmon, where countries like Norway are associated with high quality and strong brand recognition (Alfnes, Chen, and Rickertsen 2018). Furthermore, several previous studies have indicated that country of origin can shape sensory perceptions such as taste (Depetris Chauvin et al. 2024; Iaccarino et al. 2006; Klöckner, Langen, and Hartmann 2013; Liu et al. 2022; Thøgersen 2023).

However, consumers vary in the extent to which they prioritize intrinsic versus extrinsic attributes in their decision-making. For example, some consumers rely more heavily on intrinsic factors, whereas others place greater importance on extrinsic factors (Bi et al. 2015; Didier and Lucie 2008; Mueller and Szolnoki 2010). The conceptual model we propose aims to test the impact of both intrinsic and extrinsic product attributes—namely, overall liking, price, ecolabels, and country of origin—on consumer food preferences. Specifically, we will examine how these factors influence consumers' likelihood of choosing domestic versus imported salmon products and whether country-of-origin information impacts sensory perceptions of taste, smell, firmness, juiciness, fattiness, and overall liking.

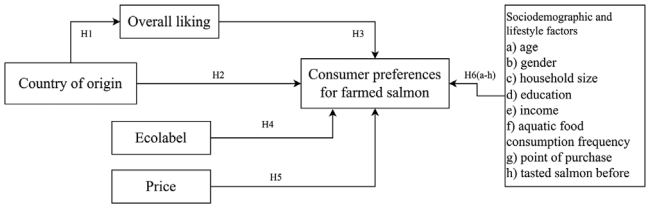


FIGURE 1 | Conceptual framework and hypotheses.

Sociodemographic and lifestyle factors such as age, gender, education, income, and aquatic food consumption habits significantly influence consumer preferences for farmed salmon. Studies have shown that older consumers, those with higher education, and individuals with higher income are more inclined to regularly consume aquatic food and prioritize quality and sustainability in their preferences (Budhathoki et al., 2022; Cantillo et al. 2021; Govzman et al. 2021; Xu et al. 2024; Zander & Feucht 2018). Gender also plays a role, with women generally more concerned about food safety and eco-labelled aquatic food, eventually affecting their willingness to pay (Xu et al. 2012). Additionally, frequent aquatic food consumers tend to prefer familiar products like salmon, and household size or point of purchase can affect preferences for attributes such as freshness, production method, and origin (Budhathoki et al. 2021; Carlucci et al. 2015; Onozaka et al. 2023).

On the basis of the extant literature, this study proposes a conceptual framework (Figure 1) and develops the following hypotheses:

- **H1**: Country-of-origin information impacts overall liking (an intrinsic attribute) of farmed salmon.
- **H2**: Country-of-origin information positively influences consumer preference for farmed salmon.
- **H3**: Overall liking positively influences consumer preference for farmed salmon.
- **H4**: Price negatively influences consumer preference for farmed salmon.
- **H5**: Ecolabels positively influence consumer preference for farmed salmon.
- **H6 (a-h)**: Sociodemographic and lifestyle factors (age, gender, household size, education, income, aquatic food consumption, point of purchase, tasted salmon before) significantly influence consumer preference for farmed salmon.

3 | Methods and Materials

3.1 | Consumer Sample

Purposive sampling was employed to recruit 110 participants for the study, greater than that recommended for hedonic response studies (Lawless and Heymann 2010). Posters and emails were used to reach out to a consumer panel of the College of Food Science and Technology, Shanghai Ocean University, Shanghai, China where the study took place on November 7, 2023 and November 8, 2023. Inclusion criteria for participating in the study include (1) participants willing to taste salmon products twice, (2) participants without any previously known history of allergies after consuming aquatic food, and (3) participants over 18 years old. Upon arrival in the sensory laboratory, each participant was greeted, briefed, and asked to sign a written consent form. All participants received a small monetary incentive at the end of the session. The total duration of the experiment was around 20–30 min.

3.2 | Salmon Products

In this study, we utilized sashimi salmon products characterized by their high-quality, raw fish preparation and packaging designed for direct consumption. These products adhere to stringent standards, ensuring freshness and quality suitable for raw consumption. It is important to note that sashimi-grade in our study refers to products handled under conditions suitable for raw consumption, which may include both frozen and thawed processes. Although the exact freezing history of sashimi-grade salmon from the e-commerce platform is hard to verify even though they are stated as ice-fresh or frozen for raw consumption (Xiong et al. 2016), previous research supports the use of both frozen and non-frozen thawed sashimi products (Murase 2005). For instance, a recent study indicated that consumer preferences did not differ between frozen and non-frozen thawed sashimi under blind conditions (Watanabe et al. 2020). Similarly, sensory evaluations have shown that the quality of frozen Norwegian Atlantic salmon transported to Japan is comparable to that of chilled ones (Redo et al. 2024).

For our experimental samples, we selected three commercially available sashimi-grade salmon products from each country of origin: one from Norway (farmed Atlantic salmon: ice fresh), one from Chile (farmed Atlantic salmon: frozen and thawed), and one from China (farmed Rainbow trout: frozen and thawed). The salmon products were purchased from the e-commerce platform "www.JD.com" 1 day before the experiment. Upon arrival, samples were stored under consistent refrigeration conditions at 2°C–4°C and were served at room temperature during the taste testing sessions.

The tasting area was lit with red lighting to mask the color of the salmon samples (Figure 2). The use of red lighting aimed to eliminate color bias, which can strongly influence consumer perceptions of sensory attributes like taste and overall liking (Lawless and Heymann 2010). This setup allowed us to focus the participants' attention solely on the sensory qualities of the samples, such as taste, firmness, juiciness, and fattiness, without the influence of color-based expectations. Although red lighting may differ from typical consumer settings, it provides a controlled environment to isolate the sensory evaluation from visual biases. Each sample maintained a consistent color (warm, orangish pink) to minimize any additional variations in consumer perception. Norwegian and Chilean samples had no nutritional information, whereas China samples had a fat content of 17.8 g/100 g. Samples of approximately 8–10 g were placed in a small container and were served with toothpicks. Among each sample tasting, participants received small pieces of cucumber and wholegrain biscuits for palate cleansing (Figure 2). Participants were asked to fill in their socio-demographic characteristics and aquatic food consumption behavior (age, gender, household size, education, monthly income, aquatic food consumption frequency, point of purchase, meal context, and factors for consuming aquatic food) and were then served salmon samples. Each participant received six samples in total: 2 from Norway, 2 from Chile, and 2 from China.

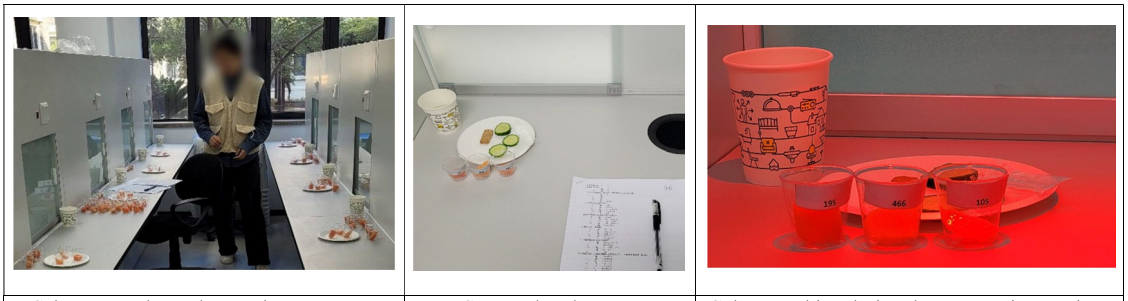
3.3 | Experimental Design

The experimental protocol (Figure 3) included two rounds of sensory evaluation: one blind round without any country-of-origin information, followed by a second round where country-of-origin information was disclosed. In our study, participants were informed of the country of origin of each sample in the 'informed' phase, but they were not provided with specific regulatory details concerning the labeling practices for rainbow trout as salmon in China. The decision not to provide participants with additional regulatory information was based on our goal of assessing consumer preferences and sensory perceptions based on typical market conditions, as consumers typically encounter products labeled simply as "salmon" in China.

In sensory evaluation, each sample was assigned three randomly drawn numbers, each falling within the range of 0–100. The serving order was counterbalanced with six variant arrangements and the samples were randomly served. Figure 2 shows a tray was set up with all samples and was later served by a facilitator. After tasting each sample, participants were asked to rate overall liking and liking of sensory attributes on a 7-point hedonic scale (from 1 = "extremely dislike" to 7 = "extremely like") for overall liking, smell, taste, firmness, juiciness, and fattiness.

In both the blind and informed tasting sessions, participants engaged in a DCE exercise. The attributes selected were based on key factors that are relevant to consumer decision-making for farmed salmon products. These attributes were informed by existing literature on Chinese consumer preferences for aquatic food (Budhathoki et al. 2022; Xu et al. 2024; Zheng, Wang, and Shogren 2021). The following criteria were used to select the attributes and their levels:

Country of Origin: The countries of Norway and Chile were chosen as these represent major exporters of farmed Atlantic salmon to the Chinese market. Rainbow trout from China was selected as a third option due to the specific focus of the research question, which aims to explore consumer preferences for domestic versus imported salmon, including domestically produced rainbow trout that is marketed as "salmon" in China. This allows for a comparison between consumer perceptions of imported Atlantic salmon and domestic alternatives.



Salmon samples and preparing serve tray	Sensory booth set up	Colour masking during the taste testing sessions

FIGURE 2 | Illustrative setup of salmon samples.

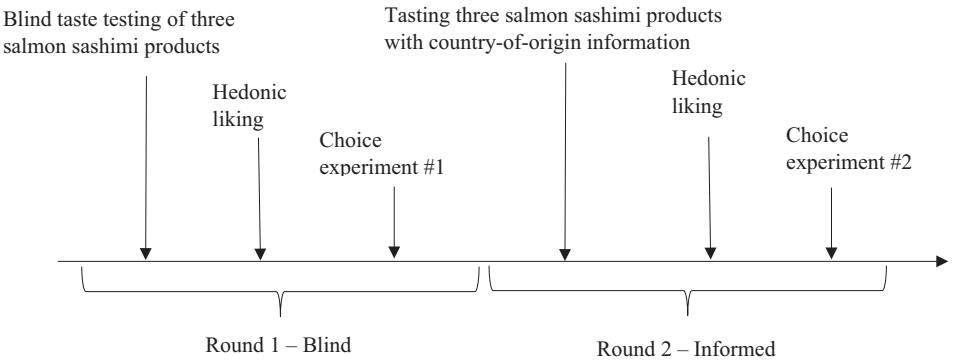


FIGURE 3 | Study design.

Ecolabel: The inclusion of ecolabels as an attribute reflects growing consumer awareness of sustainability and environmental issues related to aquaculture. The ecolabel attribute was varied between two levels: with and without ecolabel, to assess its impact on consumer choice.

Price: Price was included as an essential attribute reflecting market condition. The six price levels (¥ 50, ¥ 75, ¥ 100, ¥ 125, ¥ 150, and ¥ 175) were based on the market price range for a 500 g salmon sashimi product on JD.com at the time of the study.

The choice design used in this study is a full-profile discrete choice design, where each alternative in a choice set is described by a combination of attribute levels. We opted for a full factorial design to explore all possible combinations of attribute levels (3 countries × 2 ecolabels × 6 prices = 36 unique choice profiles). To reduce the cognitive load on participants, we split the 36-choice questions into 2 blocks, with each block containing 6 sets of 3 choice questions. Participants were randomly assigned to one of the two blocks, and within each block, the order of the alternatives was randomized to mitigate potential ordering effects. The choice sets presented to participants included a "no-buy" option, allowing them to opt out of purchasing any of the salmon alternatives if they preferred not to buy.

3.4 | Choice Model

In this study, we applied the multinomial logit (MNL) model to analyze consumer preferences for salmon products. The MNL model is widely used in choice modeling due to its ability to provide interpretable results, making it a suitable tool for examining preferences among multiple alternatives with discrete outcomes. Our decision to use the MNL model was based on the relatively homogeneous characteristics of our sample, which included similar age, education, income, and consumption habits. Given this homogeneity, we considered the assumption of uniform consumer preferences to be reasonable. Although the MNL model assumes homogeneity in consumer preferences, it remains an effective tool for analyzing choice behavior in contexts where variability within the sample is limited. The MNL model is well established in fields, such as economics, transportation, and marketing (Feng, Shanthikumar, and Xue 2022) and is based on the theory of random utility, which assumes that individuals make choices by maximizing their utility (McFadden and Zarembka 1974). By modeling utility maximization behavior, the MNL model provides a robust framework for evaluating consumer decision-making processes, making it particularly relevant in studies of food product preferences. In the MNL model, the systematic and random parts of utility can be expressed mathematically as follows:

$$U_{ij} = \beta V_{ij} + e_{ij} \quad (1)$$

where U_{ij} is the total utility of alternative j for individual i, βV_{ij} is the systematic part of utility that represents the characteristics of the alternative, and e_{ij} is the random part of utility that represents random variation in individual preferences.

The utility model includes origin, ecolabel, and price as primary attributes directly manipulated in the choice experiment, as these factors are essential in consumer decision-making for farmed

salmon products. Additionally, overall liking and the informed condition are included to account for intrinsic preferences and contextual effects that realistically influence consumer choices. Overall liking reflects consumers' sensory satisfaction, which might impact utility even though it was not a direct attribute in the choice experiment. The informed condition captures the effect of providing country-of-origin information, enabling the model to examine how consumer preferences shift with added information about product provenance. Thus, in Equation (1), the systematic part of utility was structured as follows:

$$\begin{aligned} V_{ij} = {} & \beta_1(\text{origin})_{ij} + \beta_2(\text{ecolabel})_{ij} \\ & + \beta_3(\text{price})_{ij} + \beta_4(\text{overall liking})_{ij} \\ & + \beta_5(\text{informed condition})_{ij} + \beta_6(age)_{ij} \\ & + \beta_7(gender)_{ij} + \beta_8(householdsize)_{ij} \\ & + \beta_9(education)_{ij} + \beta_{10}(income)_{ij} \\ & + \beta_{11}(aquaticfoodconsumptionfrequency)_{ij} \\ & + \beta_{12}(pointofpurchase)_{ij} \\ & + \beta_{13}(tastedsalmonbefore)_{ij} \end{aligned}$$

where β_1 represents the coefficient for origin (for Norway, Chile, or China), β_2 represents the coefficient for ecolabel, β_3 represents the coefficient for the price, β_4 represents the coefficient for overall liking, represents the coffecient for informed condition, and $\beta_{6through13}$ represent the coefficients for sociodemographic and lifestyle factors, such as age, gender, household size, education, income, aquatic food consumption, point of purchase, and whether the individual has tasted salmon before.

Furthermore, the probability of each alternative j for a given observation n based on the values of the predictor variables $X_{n,j,k}$ and their associated coefficients β_k in the context of MNL (McFadden and Train 2000) can be expressed mathematically as follows:

$$P_{n,j} = \frac{e^{\sum_{k=1}^{K} \beta_k X_{n,j,k}}}{\sum_{j=1}^{J} e^{\sum_{k=1}^{K} \beta_k X_{n,j,k}}} \quad (2)$$

where $P_{n,j}$ represents the probability of alternatives j for observation n, $X_{n,j,k}$ represents the value of predictor variable k for observation n and alternatives j, β_k represents the coefficient associated with predictor variable k, K represents the total number of predictor variables, and J represents the total number of alternatives.

After the estimation of the MNL model, the coefficients were used to calculate the WTP for each type of salmon through the Delta method (Daly et al. 2012). Assuming that an individual has a binary choice situation (e.g., to either buy or not to buy), the WTP for a particular attribute can be calculated using the following mathematical formula:

$$\text{WTP}_{\text{attribute } k} = -\frac{\beta_{\text{attribute } k}}{\beta_{\text{attribute price}}} with\ SE_{WTP_k}\ and\ p\ value \quad (3)$$

where, $\beta_{\text{attribute k}}$ is the coefficient for the attribute k, $\beta_{\text{\_attribute price}}$ is the coefficient for the price, $\text{SE}_{\text{WTP\_k}}$ is the standard error for WTP (calculated using the propagation formula, and p value is the significance level of the WTP estimate.

3.5 | Data Preparation and Analysis

Initially, the collected data was entered and organized in Excel, and analyses were performed in RStudio for Windows 1.4.1103. Several R packages were employed, each chosen for its specific functionality in addressing the needs of the study. The ImerTest package (Kuznetsova, Brockhoff, and Christensen 2017) was used to perform significance testing for mixed-effects models, which allowed us to assess both fixed and random effects in our data. This was crucial given that the study design included both fixed factors (e.g., product attributes) and random factors (e.g., individual differences). The emmeans package (Lenth 2022) was used to estimate and compare marginal means for the sensory attributes (smell, taste, firmness, juiciness, and fattiness) of the sashimi samples under two conditions: blind and informed tasting. To evaluate the relative importance of sensory traits for overall liking, we used relaimpo package (Grömping 2007), which allowed us to determine which sensory attributes (e.g., taste, texture, and smell) had the greatest impact on consumer sensory perceptions. The Apollo package (Hess and Palma 2019) was employed to estimate an MNL model, a method commonly used in DCEs for analyzing consumer choice data. The Apollo package was specifically selected due to its flexibility in handling complex choice models and its efficiency in managing large datasets.

Descriptive analysis was conducted for socio-demographic characteristics and aquatic food consumption behavior/habits. Data were presented in mean (standard deviation) for continuous variables and percentage (number) for categorical variables. Hedonic liking data were analyzed employing a linear mixed model through the lmer()-function of the lme4 package. The model comprised "samples" (Atlantic salmon from Norway versus Atlantic salmon from Chile versus Rainbow Trout from China), "condition types" (blind versus informed), and their "interaction effect" (salmon samples versus condition types). In the model, consumers were entered as a random effect, whereas fixed factors considered were age, gender, household size, education, income, seafood consumption frequency, seafood point of purchase, and previously tasted salmon. Overall liking and sensory attributes (smell, taste, firmness, juiciness, and fattiness) were coded as dependent variables. *F*-statistics with Satterthwaite approximations for a denominator of freedom was used to determine the effects of categorical fixed factors. Further, we conducted the relative importance analysis for determining the contributions of smell, taste, firmness, juiciness, and fattiness to overall liking. The multi-collinearity between the considered sensory attributes was determined through the variance inflation factors (VIFs). We compared estimated marginal means (emmeans) using the Tukey adjustment to see how samples and conditions interacted.

The choice experiment data were formatted in "wide" format, with one row per observation, before applying the MNL model in the preference space through a five-step procedure (initialization > data > model parameters > model definition > estimation and model output) in the Apollo package. The model included an

alternative-specific constant (ASC) to account for baseline utility differences across the salmon alternatives, adjusting for unobserved factors affecting consumer preferences. Using revealed preference (RP) and stated preference (SP) approaches, the model settings defined unique individual IDs and output parameters, followed by loading and processing the dataset. Initial parameter estimates included ASCs and attribute coefficients for attributes such as country of origin, ecolabel, price, and overall liking. The RP and SP segments were defined separately within the model: The RP segment represented choices made without country-of-origin information, whereas the SP segment reflected choices made when this information was disclosed. The RP utilities were scaled by a *mu_blind* parameter and SP utilities by $u\_informed$, indicating preference differences depending on origin information. In the model, the price variable was log-transformed to account for the non-linear relationship between price and consumer preferences. This transformation helps stabilize model estimates and ensures that the effect of price on consumer untility diminishes as the price level increases. These models were then combined, with panel data handling incorporated to account for multiple observations per individual. The final estimation step used all inputs and defined probabilities. The model was estimated using Bierens-Green-Williams algorithm (Bunch et al. 1993)

The MNL model coefficients in the preference space were subsequently used as priors for MNL estimates in the WTP space through the $apollo\_deltaMethod$ function. WTP values were derived by converting MNL model coefficients into WTP values, with the price attribute as the numeraire in the WTP-space model. The Delta method results provide estimated WTP coefficients based on price changes for different salmon origins, reflecting the amount consumers are willing to pay for each attribute and the impact of price changes on preferences for Norwegian and Chilean Atlantic salmon and Chinese rainbow trout.

4 | Results

4.1 | Socio-Demographic Characteristics

The socio-demographic characteristics of the participants are presented in Table 2. Of the 110 participants, the majority were females (59.1%) aged 25 years or younger, possessing a level of monthly income between ¥ 3001 and ¥ 6000, and holding educational qualifications at the level of Master and above. Regarding the aquatic food consumption frequency, 40.9% of participants consumed aquatic food one to four times per week. The preferred point of purchasing seafood is seafood market/specialty shops (43.6%), followed by restaurants/takeaways (33.6%), supermarket/discount stores (13.6%), and e-commerce platforms (7.3%). Furthermore, a significant majority of participants (41.8%) indicated a preference for consuming seafood as a cold dish consumed as part of the main evening meal. Participants consider health and nutrition (76.4%), sensory appeal (66.4%), quality (37.3%), food safety (36.4%), and price (30.9%) as the top five important factors for consuming seafood. The majority of the participants had previously consumed salmon (70%).

4.2 | Blind and Informed Salmon Tasting Session

The emmeans (±standard error) of sensory attributes and overall liking for Atlantic salmon from Norway and Chile and rainbow trout from China, under both blind and informed conditions, are presented in Table 3. The results indicated that consumer liking of sensory attributes (taste, firmness, juiciness, and fattiness) and overall liking of Norwegian Atlantic salmon increased after provenance information was provided ($p < 0.05$). Similarly, consumer liking of the sensory attributes "taste" and "overall liking" of Chilean Atlantic salmon significantly increased ($p < 0.05$) after the country-of-origin information was provided. However, for Chinese rainbow trout, no significant difference in sensory attributes or overall liking was observed ($p > 0.05$). Thus, hypothesis (H1) can be partially accepted, as country-of-origin information significantly impacted the overall liking of Norwegian and Chilean Atlantic salmon but did not have a significant effect on the overall liking of Chinese rainbow trout.

4.3 | Contributions of Sensory Traits to the Overall Liking of Salmon

The contributions of each sensory trait to overall liking are presented in Table 4. The results indicate that taste contributed the most (34.48%), followed by fattiness (20.29%), juiciness (19.56%), smell (18.07%), and firmness (6.58%), which summed to R^2 (41.52%). The VIFs among variables are <3.3, which suggests no multi-collinearity and indicates that the values of contributions to overall liking for sensory traits are reliable.

4.4 | Impact of the Country-of-Origin Information on the Overall Liking Score

According to Table 5, the overall liking score was significantly influenced by whether the participant had tasted salmon before the current experiment (F (1, 627) = 11.071; p = 0.000), the different types of sashimi salmon samples (F (2, 627) = 7.199; p = 0.000), and condition type (blind vs. informed) (F (1, 627) = 6.009; p = 0.014). In the blind condition, the results from post hoc analysis (Table 5) indicated that the emmeans (±standard error) of the overall liking score of the Chinese rainbow trout sample tended to be higher than for the Chilean Atlantic salmon samples ($\Delta = 0.609 \pm 0.236$, $p = 0.027$) and lower, although not significantly so, than for the Norwegian Atlantic salmon samples ($\Delta = 0.018 \pm 0.236$, $p = 0.996$). Further, the overall liking score of the Norwegian Atlantic salmon sample was significantly higher than for the Chilean Atlantic salmon sample ($\Delta = 0.627 \pm 0.236$, $p = 0.021$).

In the informed condition (Table 6), the overall liking score of the Chinese rainbow trout sample did not differ significantly from the Chilean Atlantic salmon sample ($\Delta = 0.045 \pm 0.236$, $p = 0.979$), whereas both Chilean Atlantic salmon ($\Delta = 0.636 \pm 0.236$, $p = 0.019$) and Chinese rainbow trout ($\Delta = 0.590 \pm 0.236$, $p = 0.033$) were significantly less liked than Norwegian Atlantic salmon. Conversely, in the blind condition, Chinese rainbow trout showed a similar preference to Norwegian Atlantic salmon and was preferred over Chilean Atlantic salmon, although the

TABLE 2 | Socio-demographic characteristics of the participants in the consumer taste testing ($N = 110$).

Socio-demographic characteristics	Categories	Percent (n)
Age, year, mean ± SD		24 ± 2
Gender, % (n)	Male	40.9 (45)
	Female	59.1 (65)
Household size, % (n)	2	20 (22)
	3	29.1 (32)
	4 or more	50.9 (56)
Education	High school degree	1.8 (2)
	Bachelor degree	25.5 (28)
	Masters and above	72.7 (80)
Income (monthly)	¥ 3000 and less	17.3 (19)
	¥ 3001–6000	33.6 (37)
	¥ 6001–9000	23.6 (26)
	¥ 9001–12,000	17.3 (19)
	¥ 12,001 and above	8.2 (9)
Aquatic food consumption frequency	Rarely	17.3 (19)
	Less than once per week	33.6 (37)
	1–2 times per week	23.6 (26)
	3–4 times per week	17.3 (19)
	More than 4 times per week	8.2 (9)
Preferred point of purchase	Aquatic food market/specialty stores	43.6 (48)
	Supermarket/Discount stores	13.6 (15)
	Online (Taobao, JD.com)	7.3 (8)
	Restaurants/Takeaway	33.6 (37)
	Others	1.8 (2)
Preferred meal context[b]	Breakfast and cold dish	5.5 (6)
	Breakfast and hot dish	2.7 (3)
	Lunch and cold dish	30.9 (34)
	Lunch and hot dish	30.9 (34)
	Snack and cold dish	34.5 (38)
	Snack and hot dish	12.7 (14)
	Dinner and cold dish	41.8 (46)
	Dinner and hot dish	30 (33)
Important factor for consuming aquatic food[b]	Health and nutrition	76.4 (84)
	Food safety	36.4 (40)
	Sensory appeal (taste, color, etc.)	66.4 (73)
	Price	30.9 (34)
	Quality (freshness, naturalness)	37.3 (41)
	Country of origin	12.7 (14)
	Production method (capture, farmed)	8.2 (9)
	Sustainability profile (better for climate change)	3.6 (4)
	Animal welfare (better for fish health and wellbeing)	1.8 (2)
Have you ever consumed salmon before?	Yes	70 (77)
	No	30 (33)

[b]Multiple-response options.

difference compared to Norwegian Atlantic salmon was not statistically significant.

4.5 | Choice Experiment

The goodness of fit statistics for the MNL suggest a reasonable model fit (Table 7). The pseudo R^2 value of 0.153 indicates a moderate level of explanatory power, whereas the adjusted pseudo R^2 of 0.144 accounts for the number of predictors in the model. The log-likelihood values of −1523.85, the Akaike information criterion (AIC) of 3081.7, and the Bayesian information criterion (BIC) of 3169.52 provide additional metrics for evaluating the model's fit and relative quality, with lower values suggesting a better fit(Vrieze, 2012). Although the model provides valuable insights into consumer preferences, as shown by significant predictors, such as ecolabel, price, overall liking, and sociodemographic and lifestyle factors, it explains a moderate

TABLE 3 | Estimated marginal means (±standard error), and difference between consumer liking scores for sensory attributes and overall liking of sashimi samples under blind and informed condition.

Sashimi sample	Sensory attributes	Type		Difference	*p* value
		Blind	Informed		
Norway	Smell	4.49 ± 0.24	4.73 ± 0.24	0.236	0.144
	Taste	**4.74 ± 0.27**	**5.14 ± 0.27**	**0.391**	**0.036**
	Firmness	**4.93 ± 0.28**	**5.31 ± 0.28**	**0.381**	**0.032**
	Juiciness	**4.86 ± 0.28**	**5.40 ± 0.28**	**0.545**	**0.001**
	Fattiness	**5.21 ± 0.27**	**5.61 ± 0.27**	**0.400**	**0.026**
	Overall liking	**4.90 ± 0.26**	**5.43 ± 0.26**	**0.527**	**0.002**
Chile	Smell	4.18 ± 0.24	4.33 ± 0.24	0.145	0.368
	Taste	**3.96 ± 0.27**	**4.40 ± 0.27**	**0.436**	**0.019**
	Firmness	4.49 ± 0.28	4.45 ± 0.28	−0.045	0.799
	Juiciness	4.60 ± 0.28	4.84 ± 0.28	0.236	0.176
	Fattiness	4.66 ± 0.27	4.76 ± 0.27	0.100	0.578
	Overall liking	**4.28 ± 0.26**	**4.79 ± 0.26**	**0.518**	**0.003**
China	Smell	4.24 ± 0.24	4.36 ± 0.24	0.118	0.464
	Taste	4.24 ± 0.27	4.38 ± 0.27	0.145	0.436
	Firmness	4.77 ± 0.28	4.62 ± 0.28	−0.154	0.386
	Juiciness	5.02 ± 0.28	4.90 ± 0.28	−0.118	0.499
	Fattiness	4.86 ± 0.27	4.80 ± 0.27	−0.054	0.761
	Overall liking	4.61 ± 0.26	4.84 ± 0.26	−0.227	0.192

Note: Data gathered from 110 untrained consumers. Scale 7-point hedonic scale ranging from Score 1 as "extremely dislike" to Score 7 as "extremely like." Fixed factors considered were age, gender, household size, education, income, seafood consumption frequency, seafood point of purchase, previously tasted salmon, and consumers as random factors. Degrees-of-freedom method: Kenward–Roger. Bold values represent significant differences.

TABLE 4 | Relative importance attributes of sensory traits for overall liking and multi-collinearity test.

Sensory attributes	Relative importance (%)	95% Lower confidence interval	95% Upper confidence interval	VIF
Smell	19.58	0.129	0.258	2.005
Taste	34.49	0.380	0.527	2.476
Firmness	16.31	0.081	0.212	2.485
Juiciness	13.31	−0.040	0.103	2.829
Fattiness	16.31	0.085	0.223	2.862

Note: $R^2 = 71.22\%$; AIC = 1477.882; BIC = 1509.328.

Abbreviations: AIC, Akaike information criterion; BIC, Bayesian information criterion; VIF, variance inflation factor.

proportion of the variation in preferences, as indicated by the pseudo R^2.

Based on the MNL model parameter estimates (Table 7) consumers' preferences for salmon reveal several key insights. The alternative-specific constants (ASC) for alternatives 2 and 3 are not statistically significant, with p-values of 0.06 and 0.07, respectively, suggesting that these alternatives do not stand out to consumers in any significant way based on unobserved factors. The result indicated that the country of production did not impact consumer utility unless consumers were informed about the provenance. This suggests that country-of-origin information plays a role in shaping consumer preferences when it is available, supporting H2: consumer preference for farmed salmon is positively influenced by country-of-origin information when disclosed. Additionally, the results show that overall liking of the salmon was associated with higher utility, meaning consumers derived greater satisfaction from products they rated more favourably. This confirms H3, as overall liking positively influences consumer preference for farmed salmon. Conversely, as the price of salmon products increased, the level of consumer utility decreased, indicating a negative relationship between

TABLE 5 | Mixed-effects model of overall liking.

	Overall liking			
	F	**df1**	**df2**	***p* value**
Age	1.153	9	191	0.327
Gender	0.498	1	191	0.480
Household size	0.631	2	191	0.532
Education	**3.883**	**2**	**191**	**0.022***
Income	1.023	4	191	0.396
Point of purchase	1.639	4	191	0.166
Seafood consumption frequency	1.552	3	191	0.202
Tasted salmon before	**9.604**	**1**	**191**	**0.002****
Sashimi salmon samples	**14.684**	**2**	**436**	**0.000*****
Condition types (blind vs. informed)	**16.028**	**1**	**191**	**0.000*****

Note: Fixed effect, age, gender, household size, education, income, seafood consumption frequency, seafood point of purchase and previously tasted salmon and consumers as random factors. Conditional $R^2 = 0.197$, AIC = 2300.694, BIC = 2457.923.

Abbreviations: AIC, Akaike information criterion; BIC, Bayesian information criterion. Bold values represent significant differences. *$p < 0.5$, **$p < 0.01$, ***$p < 0.001$.

TABLE 6 | Impact of country-of-origin information on overall liking.

Condition types	Sample	Estimates	Standard error	df	*t* ratio	*p* value
Blind	Chile–China	−0.336	0.169	436	−1.989	0.116
	Chile–Norway	**−0.627**	**0.169**	**436**	**−3.709**	**0.000**
	China–Norway	−0.018	0.169	436	−1.720	0.198
Informed	Chile–China	−0.045	0.169	436	−0.269	0.961
	Chile–Norway	**−0.636**	**0.169**	**436**	**−3.763**	**0.000**
	China–Norway	**−0.590**	**0.169**	**436**	**−3.494**	**0.001**

Note: df: degrees of freedom, post hoc comparison with Tukey adjustment; dependent variable: overall liking; fixed factors: age, gender, household size, education, income, seafood consumption frequency, seafood point of purchase, and previously tasted salmon; random factor: consumer. Conditional $R^2 = 0.197$, AIC = 2300.694, BIC = 2457.923. Bold values represent significant differences.

price and consumer preference. Therefore, H4 is supported, with increased prices negatively affecting consumer preference for farmed salmon. Finally, the results reveal that product certifications, such as Aquaculture Stewardship Council Certification and Best Aquaculture Practices (BAP) ecolabels, had a positive impact on utility, suggesting that consumers are willing to pay a premium for salmon produced to international certification standards. This supports H5, as ecolabels positively influence consumer preference for farmed salmon. Education and aquatic food consumption frequency also significantly influence preferences, with education having a positive effect and frequent seafood consumption having a negative effect, supporting hypotheses H6 d and f. Tasted salmon before has a significant negative impact, indicating that those who have previously tasted salmon are less likely to choose it, supporting H6h. Other factors such as age, gender, household size, income, and point of purchase were not statistically significant, suggesting that these variables do not have a substantial impact on salmon preferences, rejecting hypotheses H6a, b, c, e, and g. The WTP estimates from Table 8 provide significant insights into consumer preferences for salmon. Importantly, there are no significant differences in WTP across countries of origin, as indicated by the estimates for Norway, Chile, and China ($p > 0.05$). This finding challenges the expectation that imported salmon would command a price premium over domestic salmon, suggesting that the country of production alone does not justify higher consumer spending when sensory attributes and other factors are considered. However, the presence of ecolabel (WTP = 0.731) is influenced by their overall liking of the product (WTP = 0.603). Education also has a positive effect on WTP (1.023), with more educated consumers willing to pay higher prices. However, the result for being informed about the country of origin is particularly notable, as it significantly reduces WTP (-3.291), contradicting the hypothesis that country-of-origin information would enhance consumer preferences (H2). This suggests that consumers may have negative associations with certain countries when informed about the origin, rather than being positively influenced by the disclosure. Consumers who have tasted salmon before also show a lower WTP (-2.312), indicating that prior experience with salmon is less willing to pay a premium for salmon. Demographic factors, such as age, gender, household size, and income, do not significantly influence WTP, and factors like point of purchase

TABLE 7 | The results of the multinomial logit (MNL) model estimate of consumers' salmon preferences.

Attributes and model details	Multinominal logit model			
	Coefficient	**Standard Error**	**t-ratio**	***p*-value**
ASC (alternative 1)	Reference			
ASC (alternative 2)	0.096	0.060	1.6	0.06
ASC (alternative 3)	−0.105	0.070	−1.5	0.07
Norway	1.158	1.576	0.7	0.23
Chile	1.159	1.576	0.7	0.23
China	1.465	1.586	0.9	0.18
Ecolabel	**0.355**	**0.077**	**4.6**	**0.000*****
Price	**−0.485**	**0.114**	**−4.3**	**0.000*****
Overall liking	**0.293**	**0.043**	**6.7**	**0.000*****
Informed about country of origin	**1.597**	**0.223**	**7.2**	**0.000*****
Age	0.034	0.084	0.4	0.34
Gender	0.082	0.462	0.2	0.43
Household size	0.124	0.298	0.4	0.34
Education	**0.496**	**0.296**	**1.7**	**0.05***
Income	−0.023	0.271	−0.1	0.47
Aquatic food consumption frequency	**−0.434**	**0.251**	**−1.7**	**0.04***
Point of purchase	−0.046	0.149	−0.3	0.38
Tasted salmon before	**−1.122**	**0.327**	**−3.4**	**0.000*****
Observations				
Pseudo *R*2		0.153		
Adjusted *R*2		0.144		
Log-likelihood		−1523.85		
Akaike Information Criterion		3081.7		
Bayesian Information Criterion		3169.52		

Abbreviations: AIC, Akaike information criterion; ASC, alternative-specific constant; BIC, Bayesian information criterion. Bold values indicate significant differences. *$p < 0.05$, ***$p < 0.001$.

show no significant impact. Frequent aquatic food consumption negatively affects WTP (-0.894), suggesting that regular aquatic food consumers are less willing to pay a premium price for salmon.

5 | Discussion

The result of the study shows that country of origin significantly affects consumer preferences in the Chinese salmon market. In a blind taste test, Chinese consumers did not perceive a significant quality difference between domestic rainbow trout and imported Atlantic salmon from Norway and Chile. Interestingly, they preferred domestic rainbow trout over Chilean Atlantic salmon. However, informing consumers of the origin significantly shifted their preference toward Norwegian and Chilean Atlantic salmon. This suggests that country-of-origin information influences Chinese consumers' perceptions of salmon sensory quality. These findings are consistent with previous literature that emphasizes the importance of provenance in consumer food choices (Boncinelli et al. 2018; Cantillo, Martín, and Román 2020; Rodriguez-Salvador and Calvo Dopico 2023; Sigurdsson et al. 2020).

Interestingly, while the country of production did not enhance WTP overall, the disclosure of country-of-origin information led to a notable reduction in WTP in certain cases, contrary to the hypothesis that it would enhance consumer preferences (H2). This unexpected outcome suggests that consumers may harbour negative associations or scepticism about specific origins, likely influenced by food safety concerns or cultural biases. Although Norwegian and Chilean Atlantic salmon benefit from reputations for high quality, reinforced by origin information, domestic rainbow trout faced challenges in achieving similar perceptions. These findings highlight a critical trust gap in domestically produced salmon, highlighting the importance of building consumer confidence through certifications and effective communication about quality and safety.

The lack of significant differences in WTP between Norwegian and Chilean Atlantic salmon and domestic trout further complicates the narrative. While prior assumptions might expect higher

TABLE 8 | Willingness to pay (WTP) estimates for consumer preferences related to salmon.

Factors	WTP	Standard Error	*p*-value
ASC (alternative 1)	Reference		
ASC (alternative 2)	0.096	0.060	0.06
ASC (alternative 3)	−0.105	0.070	0.07
Norway	2.386	2.627	0.359
Chile	2.389	2.631	0.359
China	3.019	2.650	0.247
Ecolabel	**0.731**	**0.166**	**0.000*****
Overall liking	**0.603**	**0.106**	**0.000*****
Informed about country of origin	**−3.291**	**0.599**	**0.000*****
Age	0.069	0.085	0.414
Gender	0.169	0.385	0.660
Household size	0.256	0.249	0.298
Education	**1.023**	**0.356**	**0.001****
Income	−0.047	0.177	0.788
Aquatic food consumption frequency	**−0.894**	**0.264**	**0.000*****
Point of purchase	−0.094	0.134	0.480
Tasted salmon before	**−2.312**	**0.580**	**0.000*****

Bold values indicate significant differences. **$p < 0.01$, ***$p < 0.001$

WTP for imported products due to their perceived quality, this result suggests that Chinese consumers do not assign a monetary premium based solely on origin when other factors, such as sensory attributes, are comparable. This finding emphasizes the need for domestic producers to focus on competitive differentiation through sustainability certifications or traceability systems to compete effectively with imports salmon.

The stronger preference for Norwegian and Chilean Atlantic salmon in the informed condition could also be linked to the familiarity and positive associations that Chinese consumers have with these countries. For example, Norwegian Atlantic salmon has been popular in sushi and sashimi dishes in Japan since the late 20th century and is well-known among Chinese consumers (Norwegian Seafood Council 2022). In contrast, the practice of eating raw fish originated in southern China before 200 C.E., with dishes like "Shunde-style sashimi," but trout—often sold as salmon in China—is not widely consumed across the country. This limited familiarity may contribute to consumers being less discerning about the sensory quality of salmon products (Newman 2004). Consumers' evaluation of food products is influenced by their familiarity with the items. Maheswaran (1994) found that when consumers are not familiar with a country's product, they use the country's image as a "halo effect" for evaluating the products.

The proximity of production to consumers may explain why Chinese rainbow trout was equally liked as Norwegian Atlantic salmon in the blind test. Shorter transportation distances can help maintain product freshness, a critical factor in quality perception (Carlucci et al. 2015). However, as China's history with farmed salmon is relatively new compared to other species like tilapia or carp, consumers may not have strong preferences or familiarity with it. To improve market positioning, domestic producers could differentiate their products by emphasizing sustainability and certifications, as ecolabels are increasingly valued by Chinese consumers (Xu et al. 2024; Xu et al. 2012; Yin et al. 2022; Zhang et al. 2020)

The study also highlights the persistent issue of food fraud in China, where consumers are increasingly skeptical about the authenticity of domestically produced food. In this context, transparency regarding origin and the use of certification labels may help alleviate consumer concerns and build trust. As suggested by Kendall et al. (2018), the inclusion of authenticity cues—such as traceability information or certification labels—can enhance consumer trust in food safety and quality.

The study indicated that consumers' overall liking of salmon significantly influences their utility, with sensory attributes such as taste, color, and appearance being crucial factors in their purchasing decisions (Dang 2010; Wang et al. 2015). Marketers targeting the Chinese market should focus on sensory-related strategies, such as promoting the darker red color of salmon, which has been shown to increase consumer WTP (Zheng, Wang, and Shogren 2021). Organizing taste-testing events at various retail locations, including grocery stores, farmers' markets, or food festivals, enables consumers to try the salmon to determine sensory appeal and increase familiarity.

Price also plays a crucial role in consumer decisions, with no significant difference in WTP for Norwegian and Chilean Atlantic salmon compared to Chinese rainbow trout. Marketers can capitalize on domestically produced rainbow trout's competitive pricing by offering promotions, dynamic pricing, or loyalty programs (Bogomolova et al. 2015; Liu 2007; Ni Mhurchu et al.

2010). In the foodservice sector, meal packages, smaller servings, or tasting menus could enhance affordability for price-sensitive consumers. Highlighting salmon's nutritional benefits, like its high protein and omega-3 content, can justify its price and influence purchase decisions.

In addition to the key factors such as ecolabels, price, and overall liking, the analysis revealed that education positively influences consumer preferences, suggesting that more educated consumers may place greater value on attributes like product quality or sustainability. Frequent seafood consumption and prior experience with salmon, however, were associated with lower preferences, potentially indicating a saturation effect or unmet expectations from past experiences. Conversely, most demographic factors such as age, gender, and income showed no significant impact, except education, which had a positive and significant effect on consumer preferences. This highlights the need to tailor marketing strategies based on lifestyle, sensory attributes, and educational levels to better resonate with consumers.

In sum, these findings add new insights into Chinese consumer preferences for aquatic food, showing that provenance information can significantly shift preferences toward imported salmon, despite similar sensory qualities between domestic and international products. It highlights that Chinese consumers tend to prioritize food safety and trust in product origin, suggesting that domestic products can gain favor if these concerns are addressed. The study emphasizes the importance of certification and transparent supply chains in building consumer trust, recommending that the Chinese aquaculture industry promote the safety, traceability, and quality of local products.

5.1 | Strengths, Limitations of the Study, and Future Studies

This study contributes to the literature by integrating sensory evaluation with a non-hypothetical choice experiment to assess Chinese consumer preferences for salmon. It enhances our understanding of how country-of-origin information influences consumer liking and purchasing decisions. However, there are some limitations. The sample size used for the choice experiment was relatively small (Caputo and Scarpa 2022; Ye and Lord 2014), which is typical for sensory laboratory studies but meets the minimum requirement for multivariate analysis (Stevens 2002).

First, although the study used a choice experiment, it was hypothetical, which introduces potential hypothetical bias. Consumers may behave differently in real purchasing situations compared to a controlled experiment setting, where they are not making purchase decisions. This could lead to overstatement or understatement of their true preferences. Future studies should explore ways to mitigate this bias, such as by using real purchase data or more realistic choice contexts. Our study's sample was not representative of the broader Chinese population, as it mainly consisted of females aged 25 or younger, with higher education and moderate income. These demographic characteristics may have influenced preferences, limiting the generalizability of the results. Future research should consider a more diverse sample and apply market segmentation to explore how country-of-origin information impacts different consumer groups. Segmenting by factors, such as age, education, and income, would provide deeper insights into varying preferences across distinct consumer segments. Further, while our analysis employed MNL model and included predictors such as ecolabel, price, overall liking, and sociodemographic and lifestyle factors to account for observable differences, the model's assumption of homogeneous consumer preferences remains a limitation. The MNL model does not account for unobserved heterogeneity in preferences, which may vary even within a seemingly homogeneous sample. Future studies could employ mixed logit models or latent class analysis to better capture consumer heterogeneity, especially with more representative samples that reflect a broader range of preferences.

Additionally, differences in storage and transportation methods may have affected the sensory attributes of the sashimi samples. Although the Norwegian Atlantic salmon sample was ice-fresh, the Chilean Atlantic salmon and Chinese rainbow trout samples were frozen and thawed, potentially altering their texture and flavor (Alizadeh et al. 2007). Future research should control for these variables to isolate their impact on consumer perceptions.

Further studies could combine descriptive sensory analysis with consumer evaluations to bridge the gap between the technical aspects of salmon products and consumer preferences (Lawless and Heymann 2010). Including regulatory information on the classification of Rainbow Trout as salmon might have introduced an atypical influence, potentially shifting the focus of the study from sensory and country-of-origin preferences to regulatory perceptions. Therefore, future research could explore how providing this regulatory context affects consumer perceptions and preferences. Additionally, future studies could investigate the interactions between sensory attributes and other extrinsic factors, such as food safety, production methods, and nutritional value, which also influence consumer preferences for salmon.

6 | Conclusion

This study shows that Chinese consumers initially perceived no sensory differences between domestic rainbow trout and imported Atlantic salmon from Norway and Chile in blind taste tests, favoring domestic trout over Chilean Atlantic salmon. However, when informed of the product's origin, consumer preferences shifted toward Norwegian and Chilean Atlantic salmon, highlighting the significant role of provenance in shaping perceptions of imported aquatic food. Interestingly, no significant differences were observed in consumers' WTP for salmon based on the country of origin, indicating that origin alone does not warrant higher consumer spending when sensory attributes and other factors are comparable. Moreover, when informed about the country of origin, WTP decreased in certain cases, highlighting potential negative associations or scepticism tied to specific origins. Furthermore, sociodemographic factor (education) and lifestyle factors (prior experience with salmon and aquatic food consumption frequency) influenced consumer preferences. Chinese consumers prioritized taste in overall satisfaction, while country-of-origin information, ecolabels, price, and product appeal also impacted their WTP.

In comparing the Chinese and European markets, European consumers often value local products for their freshness and envi-

ronmental benefits, although Chinese consumers tend to prefer international salmon, likely due to concerns about local food safety. Improving the perception of domestic products in China will require enhanced quality controls and greater supply chain transparency to address these concerns. Emphasizing the safety and unique qualities of local products could build consumer trust and increase WTP for domestic aquatic food options.

Additionally, the study highlights an opportunity to spotlight the comparable sensory qualities of domestic rainbow trout to imported Atlantic salmon. Country-of-origin labeling regulations further support this goal by providing transparency and reassuring consumers about product authenticity, quality, and safety. From a marketing standpoint, domestic trout marketers should focus on sensory qualities—taste, smell, color, and texture—and consider offering tasting events or samples to build familiarity and boost purchase intent. Economically, the study highlights that consumers' WTP depends on both sensory qualities and product origin. Thus, domestic producers can position Chinese rainbow trout competitively by emphasizing its sensory profiles along with targeted promotional efforts. Meanwhile, premium imported Atlantic salmon holds potential in the high-end market, where consumers are willing to pay more for certifications related to sustainability and traceability.

Industrially, the study highlights the importance of transparency and certification in building trust. Both domestic and international salmon producers and suppliers should invest in ecolabels and traceability to meet the growing demand for sustainably sourced aquatic food, especially where food safety is a primary concern. Enhanced food safety standards and traceability for domestic aquatic food products could shift consumer perceptions and boost demand for Chinese rainbow trout.

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Ethics Statement

The study was approved by the Ethics Committee of the Institute of Aquaculture, University of Stirling, UK (application number: 15652).

Conflicts of Interest

The authors declare no conflicts of interest.

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