Food Quality and Preference 75 (2019) 28–38

Contents lists available at ScienceDirect

Food Quality and Preference

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

The impact of information on taste ranking and cultivation method on rice types that protect endangered birds in Japan: Non-hypothetical choice experiment with tasting

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A R T I C L E I N F O

Keywords:
Japanese cuisine chefs
Endangered species
Non-hypothetical choice experiment
Tasting

A B S T R A C T

We investigate consumers' reactions to information on rice types produced using a cultivation method that protects the crested ibis (*Nipponia nippon*), a symbol of the endangered birds of Japan. We employ a non-hypothetical choice experiment with real monetary incentives, in which participants taste three types of rice—Niigata rice, Sado rice, and Sado-Ibis certified rice (Ibis rice)—and choose one to take home. The participants make decisions twice in each choice set, once before and once after tasting. Three information treatments are used: information about taste ranking from chefs and consumers, cultivation method, and no-information. Comparing the expected and actual willingness to pay (WTP) for Ibis rice, only the cultivation method information increases the WTP, which triples. The WTP in the taste ranking information treatment becomes lower among the participants who refer to chefs, but there is no significant difference in preferences between the expected and actual stages among all participants. For Sado rice, the WTP increases when we provide no-information or information on the cultivation method. In both cases, the WTP changes from negative to positive relative to Niigata rice; however, this WTP is less than that for Ibis rice. These results imply that consumers are more sensitive to information of process and effort for a cultivation method that protects endangered species than to the information about taste ranking.

1. Introduction

Progress in pesticides and chemical fertilizers has made it easier to control food cultivation. However, these advances have had significantly negative impacts on the natural environment, such as by damaging ecosystems, and global initiatives have begun to warn about these negative environmental impacts. In 2010, the Food and Agriculture Organization (FAO) and the United Nations (UN) defined "sustainable diets" as "diets with low environmental impacts which contribute to food and nutrition security and to healthy life for present and future generations" and stated that sustainable diets effectively protect and respect biodiversity and ecosystems (FAO, 2010). That same year, the 10th Conference of the Parties to the Convention on Biological Diversity was held in Nagoya city in Aichi Prefecture, Japan, drawing increased attention to sustainable agriculture that supports biodiversity. One of the 20 Aichi Biodiversity Targets adopted at the conference was aimed at preventing the extinction of endangered species, and initiatives to protect endangered species were considered necessary to achieve these targets.

Japan's Ministry of Agriculture, Forestry and Fisheries uses the wildlife label to identify agricultural, forestry, and fishery products produced using methods that consider the conservation of endangered species (MAFF, 2010). Rice comprises the vast majority of the products certified with the wildlife label. In 2010, 37 varieties of rice products were given the wildlife label certified by MAFF, covering approximately 0.07% of the land-cultivated rice in Japan (MAFF, 2010). If these initiatives are spread, they can help prevent the extinction of endangered species, as well as contribute to food safety and improvement of the

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https://doi.org/10.1016/j.foodqual.2018.11.021
Received 30 April 2018; Received in revised form 12 November 2018; Accepted 29 November 2018
Available online 30 November 2018

Fig. 1. The label of Sado-Ibis certified rice.
Note: The meaning of the top characters is the certified rice for protecting ibis and the town living with the ibis. The bottom of the characters means a cultivation method for saving biodiversity in Sado city.
Source: Sado city.

natural environment. To achieve these goals, it is necessary to increase the value consumers place on foods produced using methods that consider the conservation of endangered species, and ensure that these food items sell well on the market. If sales improve, the number of producers considering using these methods will increase, ultimately contributing to preventing extinction.

As an example of an agricultural, forestry, or fishery product with wildlife label certification, this study focuses on rice grown using a cultivation method that supports the survival and breeding of the crested ibis (*Nipponia nippon*). The ibis is a species found in Sado Island in Japan and is symbolic of Japanese wildlife. To protect the ibis, the rice production procedures on the island require farmers to limit the use of pesticides and chemical fertilizers and to ensure that there are feeding grounds in the paddies which are methods that differ from typical organic production. Such rice is certified as Sado-Ibis rice as shown in Fig. 1.

When investigating the value consumers place on special rice varieties such as this one, creating a non-hypothetical environment in which consumers can actually purchase or sample the food item, as opposed to a hypothetical environment, is important for increasing practical validity.

This study employs a non-hypothetical choice experiment with monetary incentives to investigate consumer purchasing behavior. Compared with hypothetical choice experiments, the merit of non-hypothetical choice experiments is that they tend to reduce the hypothetical bias (Aoki, Shen, & Saijo, 2010; Harrison & Rutström, 2008). Non-hypothetical choice experiments are employed in several studies related to food (Alfnes, Guttormsen, Steine, & Kolstad, 2006; Aoki et al., 2010; Aoki, Akai, Ujiie, Shimmura, & Nishino, 2014; Asioli, Almli, & Næs, 2016; Bazzani, Caputo, Nayga, & Canavari, 2017; Chang, Lusk, & Norwood, 2009; Chen, Anders, & An, 2013; de-Magistris & Gracia, 2014; Grebitus, Lusk, & Nayga, 2013; Lusk & Schroeder, 2004; Olesen, Alfnes, Røra, & Kolstad, 2010; Yue & Tong, 2009). Apart from choice experiments, non-hypothetical experimental studies on food choice have also been used by the Becker–DeGroot–Marschak (BDM) mechanism (De Steur, Gellynck, Feng, Rutsaert, & Verbeke, 2012; Ginon, Chabanet, Combris, & Issanchou, 2014; Ginon, Lohéac, Martin, Combris, & Issanchou, 2009; Lagerkvist & Okello, 2016; Romagny, Ginon, & Salles, 2017; Seppä, Latvala, Akaichi, Gil, & Tuorila, 2015; Vecchio, 2017; Waldman & Kerr, 2018; Xue, Mainville, You, & Nayga, 2010) in the auction (Avitia, Costa-Font, Gil, & Lusk, 2015; Costanigro, Kroll, Thilmany, & Bunning, 2014; De Steur et al., 2012; Fox, Hayes, & Shogren, 2002; Furno, Verneau, & Sannino, 2016; Hayes, Fox, & Shogren, 2002; Hung & Verbeke, 2018; Lange, Martin, Chabanet, Combris, & Issanchou, 2002; Noussair, Robin, & Ruffieux, 2004; Pappalardo & Lusk, 2016; Shogren, Shin, Hayes, & Kliebenstein, 1994; Zhang & Vickers, 2014), and other methods (Lagerkvist, Normann, & Åström, 2017).

There is still a need for more studies employing non-hypothetical choice experiments with tasting, because tasting is an essential factor for purchasing behavior. Aoki et al. (2010) provided samples of ham that simultaneously incorporated flavor, mold-prevention properties, and the cancer-causing effects of sodium nitrate and found that taste information had a large impact on consumer behavior. This shows that the flavor of food additives has a stronger impact on consumer decisions than does health information. Aoki et al. (2014) also conducted a non-hypothetical choice experiment on Sado-Ibis certified rice and found that individuals with high environmental awareness have greater willingness to pay (WTP) for Ibis rice after they taste it and receive information about its cultivation method, which protects the crested ibis. Su, Adam, Lusk, and Arthur (2017) study the differences in the WTP for rice with improved insect control between a choice experiment and an auction and show that information on the quality of rice increased WTP only in the choice experiment.

Moreover, Kallas, Martínez, Panella-Riera, and Gil (2016) examined the impact of the flavor of pork sausages using a within-subjects design and showed it is effective, especially because the eating experience reduced consumers' uncertainty. Bazzani et al. (2017) investigated consumers' preferences for local and organic applesauce in a non-hypothetical choice experiment with tasting. They found significant differences between personal traits and consumers' preferences for local applesauce. However, these two studies did not investigate the impact of information. In hypothetical choice experiment, Baba, Kallas, Costa, Gil, and Realini (2016) investigated the difference between preferences from choice experiments and those from a hedonic approach and found that information about the enrichment process and health benefits of CLA and n-3 fatty acids affected preferences only in choice experiments.

Based on this experimental setting, the main contribution of this study is investigating the impact of information about the cultivation method that protects the ibis and taste rankings by both chefs of Japanese cuisine and consumers. Information about the cultivation method is necessary to judge whether the food items protect biodiversity. Information about taste ranking is often used to judge whether consumers will decide to buy in the real world. Every year, the Japan Grain Inspection Association evaluates the ranking of representative rice in each prefecture in Japan through an expert panel. On the other hand, the reviews from consumers in e-commerce sites such as Amazon and Yahoo! are also very important. However, there is no official journal for rice evaluation by consumers or non-expert panels. Therefore, we investigate whether rankings by experts or consumers more significantly affect consumers' food choices, especially because rice is the staple food of Japan.

Very few studies have compared the impact of these two types of information. In their pioneering work, Williamson, Lockshin, Francis, and Loose (2016) employed a hypothetical choice experiment and provided participants with sensory information about the flavor of wine and non-sensory information related to tourism, environment, safety, and traditions. Information on flavor and environment had the greatest impacts on the selection behavior of participants.

Sensory evaluations can differ between professional chefs and average consumers. Kelley, Behe, Biernbaum, and Poff (2001) asked participants to sample three types of edible flowers and then fill out a questionnaire. They found that consumers valued flavor more highly than did chefs. Nestrud and Lawless (2008) conducted projective mapping after asking consumers and chefs to sample 10 types of citrus juices and observed differences between the two groups. The

Table 1
Experimental design.

	Step 1: Expected stage	Step 2: Tasting stage	Step 3: Information control stage	Step 4: Actual stage	Respondents
No information	CE	Blind tasting	–	CE	Consumers, chefs
Taste ranking	CE	Blind tasting	Taste ranking by chefs and other consumers	CE	Consumers
Cultivation method	CE	Blind tasting	Cultivation method	CE	Consumers, chefs

differences are thought to be caused by the greater experience or idiosyncratic behavior of chefs.

The remainder of this paper is organized as follows. Section 2 describes the experimental design. Section 3 describes the model, while Section 4 presents the results. Section 5 discusses the results, and Section 6 summarizes and concludes.

2. Material and methods

2.1. Experimental design

This study employs a choice experiment, which is one of the widely preferred methods for eliciting WTP for food. Choice experiments provide a sequential choice set consisting of more than two options with some common attributes assigned with distinct levels. They are often conducted in a hypothetical survey environment when investigating the WTP for a new function of food. However, in this study we employ a non-hypothetical environment, in which participants need to purchase the food they actually choose using real money provided by the experimenter.

Table 1 summarizes the experimental design, which consisted of the following four steps.

- *Step 1 (Expected stage)*: Participants make their decisions about the rice they want to buy using the six choice sets.
- *Step 2 (Tasting stage)*: They taste all types of rice. This study utilizes blind tasting, in which participants sample rice labeled A, B, and C in one sitting. After tasting the three types of rice, the participants rate them in order of preference, and they predict which letter corresponds to which brand. Then, the actual brands are revealed.
- *Step 3 (Information control stage)*: Participants receive information on taste rankings done by Japanese chefs and other consumers or information on the cultivation method. Otherwise, as the benchmark control, they do not receive any information.
- *Stop 4 (Actual stage)*: They again choose the rice they want to buy using the same six choice sets as in Step 1.

To give the participants a monetary incentive to purchase the rice, we set their endowment as ¥400 in each set. However, the endowments are kept by the experimenter and not directly provided to the subjects during the experiment. Providing the endowment money to the participants during the experience poses the risk of inducing the endowment effect, wherein participants prefer keeping the money rather than buying the good. Their earnings are determined as the money remaining in one random choice set once they choose from among all 12 sets plus the rice chosen in that set, to avoid the income effect (Alfnes et al., 2006; Aoki et al., 2014; Lusk & Schroeder, 2004). If earnings are determined as the sum of the 12 sets, their earnings accumulate and as they become larger, participants tend to experience the income effect, in which monetary incentives decrease and decision making becomes perfunctory.

2.2. Products

The product used in this experiment is rice from different production locations, called Niigata rice, Sado rice, and Sado-Ibis certificated rice (Ibis rice). The variety of rice used in this study is Koshihikari, which is the most-cultivated variety among Japonica rice (*Oryza sativa* subsp. *japonica*) in Japan. All the rice used in the study is produced in Niigata Prefecture—either from the mainland Niigata Prefecture (Niigata rice) or from Sado Island within Niigata Prefecture (Sado rice and Ibis rice).

Niigata Prefecture is the most famous production location of rice in Japan, and Niigata rice is Japan's most consumed rice. Compared with Niigata rice, Sado and Ibis rice are not well known, even though they are produced in the same prefecture. Niigata rice is produced using conventional methods (Niigata Prefecture, 2013), while cultivation of Sado rice requires a 50% reduction in pesticides and chemical fertilizers compared to conventional Niigata rice, based on the guidelines of the MAFF (2007). Ibis rice uses the same low levels of chemicals as Sado rice, plus a cultivation method that considers ecosystem conservation (Sado City, 2008). The information for each rice is summarized in the Supplementary materials.

Along with usage of pesticides and chemical fertilizers, the certification of Ibis rice requires meeting four specific conditions regarding the paddy situation, a check of biodiversity conditions, and certification of environment-friendly farmers.

2.3. Choice set design

The choice set consists of three alternatives with identification labels of A, B, and C. The alternatives consist of two attributes: brand labels of rice and their prices, as shown in Table 2. Table 3 shows the attributes and levels. The benchmark control brand of rice is Niigata rice, which is the most popular among Japanese.

There are four price levels (¥200, ¥230, ¥260, and ¥290) per 0.45 kg, which are based on retail prices in several rice stores on the Internet, September 2013. The study uses the quantity of 0.45 kg, because this quantity is popular for souvenirs and cooking rice for a meal (SHOWA, 2003) and is also convenient for taking home. However, this amount is not popular in supermarkets, and so, for reference, study participants also receive information about the price per 5 kg, the most popular amount in supermarkets. The Japanese rice market is so competitive that the price range is very limited, even though Sado and Ibis rice are produced on a remote island using very sensitive methods.

We do not employ an opt-out option. The opt-out option is often used in non-hypothetical choice experiments because including the option helps mimic real world decisions (Grebitus et al., 2013) and is important for measuring market penetration and examining a shift from a usually purchased product to the analyzed one (Kallas, Escobar, & Gil, 2013). Lusk and Schroeder (2004) and Alfnes et al. (2006) used non-hypothetical choice experiments with "no-purchase" option and also noted that including a "no-purchase" option increases the realism of the choice task and improves the accuracy of random parameter logit (RPL) estimates. However, Adamowicz and Boxall (2001) and Carson et al. (1994) suggested that it is difficult to differentiate what kind of expression of opt-out should be used in the different contexts. Kontoleon

Table 2
An example of a choice set.

Alternative	A	B	C
Brand of rice	Niigata rice	Sado-Ibis certified rice	Sado rice
Price per 0.45 kg (JPY)	200	290	230
I would choose…			

Table 3
Attributes and levels.

Attributes	Levels
Brand of rice	Niigata rice, Sado rice, Sado-Ibis certified rice
Price per 0.45 kg (JPY)	200, 230, 260, 290

and Yabe (2003) compared two "opt-out" options ("Not to buy anything" or "Buy my usual one") and found that the latter induces higher rates of choosing opt-out.

We are worried about the result in Lusk and Schroeder (2004), which shows that the frequency of individuals selecting "no-purchase" was 8–33% and that non-hypothetical condition induces higher rate of choosing opt-out option than the hypothetical condition. One way to reduce the percentage of consumers who want to keep the money in non-hypothetical CE is to reward them "unexpectedly" during the experiment in addition to paying them to participate (Kallas et al., 2016).

There are few studies without opt-out option in non-hypothetical choice experiments (Aoki et al., 2010, 2014; Carlsson & Martinsson, 2001). In the hypothetical choice experiment, there are several studies without opt-out options in the contexts of outage choices (Carlsson & Martinsson, 2007), hospital choice (Ryan, Bate, Eastmond, & Ludbrook, 2001), job choice (Kolstad, 2011), washing machine choice (Sammer & Wüstenhagen, 2006), and food choice (Aoki et al., 2010; Carlsson, García, & Löfgren, 2010).

Louviere, Hensher, and Swait (2000) and Hensher (2010) suggest that an opt-out option increases the realism of the choice set, whereas Carlsson, Frykblom, and Lagerkvist (2007) imply that opt-out option results in greater unobserved heterogeneity but does not affect marginal WTP. Kallas and Gil (2012) summarized results and implications of choice experiments with and without opt-out option in the literatures broadly. Following Carlsson et al. (2007), we advance the study without opt-out to extend the discussion of this field.

Given the setting above, we explained to potential participants the need to purchase rice that the experimenter would provide and recruited participants who agreed with that explanation.

Based on the attributes and levels, the number of choice sets using full factorial design is 1728 ($=3^3 \times 4^3$). Since this is an unreasonably large design to employ in the study, we employ fractional factorial designs instead of full factorial designs. Primarily two types of fractional factorial designs are used in choice experiments. One is an orthogonal design, which aims to minimize the correlation between attribute levels. The other is an efficient design, such as a D-efficient design, which aims to minimize all variances and co-variances of all parameter estimates. The orthogonal design works well only in the case where a certain alternative is chosen in almost all choice sets (Hensher, Rose, & Greene, 2015). Following this idea, we employ the D-efficient design. To minimize D-errors and create a D-optimal design, we use the software Design Expert (version 7). Thus, the number of sets in the fractional factorial design is 24. We randomly divide these into four blocks of six choice sets. The same choice sets are used for both chefs and consumers.

2.4. Demographics and the ecologically conscious consumer behavior (ECCB) scale

After the experiment, participants complete a questionnaire on their demographics as well as the ecologically conscious consumer behavior (ECCB) scale. Demographics mainly consist of gender, age, and income, as shown in Table 4. The ECCB scale was developed by Roberts (1996) to evaluate consumers' environmental consciousness and attitudes and consists of 30 items. The alternatives in each item use a five-point Likert-type scale ranging from "never true" (1) to "always true" (5), so that the total score can be 150. See the detailed questionnaire in Roberts (1996). We utilize that scale to show that we employ unbiased eco-friendly subjects among treatments.

2.5. Detailed procedures

Each participant sits in the experiment room behind a desk that is separated by 60 × 80 cm white foam core partitions on the front and sides to prevent the participant from being conscious of other participants. Before conducting the experiment, the participants submit a signed consent form sent to them before their participation. Then, they receive an explanation of the experimental procedure, which is read to them aloud. We announce the rewards in this experiment for three stages: earnings from one choice set selected randomly from among 12 sets, a bonus of ¥1000 for answering all the choice sets, and a bonus of ¥700 for answering all questions regarding demographics, ECCB, and socioeconomic background. Thus, the rewards are calculated using the following equation: ¥400 − price in the set selected randomly + ¥700 + ¥1000.

The participants choose one of three types of rice in each of the six choice sets. Then, the participants taste three types of rice that are cooked using the same rice cookers and cooking methods. A chef cooks the rice in a kitchen located near the experiment room. Small amounts (about 30 g) of the three types of rice, identified using label A, B, and C, are placed on separate paper plates on a tray along with a cup of mineral water (100 ml), chopsticks, and a wet wipe. Then, the participants eat all the rice freely and rank the taste. After that, the experimenter announces which label belongs to which type of rice.

The participants receive information in all treatments except the no-information control treatment. In the taste ranking information treatment, Fig. 2 is provided to the participants. This figure shows the results of taste rankings by both Japanese cuisine chefs and consumers who participated in the no-information and cultivation method treatments before conducting the taste ranking treatment. To show these results, the taste ranking information treatment is conducted after finishing the other two treatments. The figure shows that chefs prefer Niigata rice to others, while other participants prefer Ibis rice to others. This observation shows the differences between the taste rankings of chefs and ordinary people. The motivation of this study is to determine whether chefs or ordinary people affect consumer behavior despite such an inconsistent taste ranking. However, we do not announce this difference but just show the graph in Fig. 2 to eliminate bias. After providing that information sheet, participants are asked whose evaluation they treat as the most important: that of chefs, that of other consumers, or their own. In the cultivation method information treatment, the information sheet in the Supplementary materials are presented as one document with double-sided printing as used by Aoki et al. (2014). Additionally, to obtain the taste rankings from Japanese cuisine chefs, we conduct the same experiment with chefs separately from the experiment with consumers.

After that, the participants proceed to choose from the three types of rice in the same choice sets as in Step 1. After completing all choice sets, the participants fill out a questionnaire on their demographics and socioeconomic background. Then, one of the 12 sets is randomly selected, and the participants receive their earnings and the rice type they chose from that set.

3. Model

This study employs an RPL model (Train, 1998, 2009), which relaxes the independence of irrelevant alternatives (IIA) assumption and assumes heterogeneous preferences across participants. This model enhances the accuracy and reliability of the estimated results. The choice experiment is based on random utility theory (RUT), which assumes that decision makers are utility maximizers and suggests that, in a given set of alternatives, decision makers select the alternative that maximizes their utility.

In RUT using the RPL model, an individual q's utility of alternative i

Table 4
Demographics in each information treatment.

	Definitions	No information	Taste ranking	Cultivation method
Female	1: Female, 0: Male	65.7%	84.9%	70.6%
Age	Less than 20 years old	7.8%	4.4%	6.7%
	20–29 years old	11.4%	11.5%	11.2%
	30–39 years old	32.8%	37.1%	46.6%
	40–49 years old	33.5%	27.4%	12.7%
	50–59 years old	10.0%	9.7%	12.0%
	More than 60 years old	4.2%	9.7%	10.5%
Household	1 person	6.4%	6.1%	6.7%
	2 persons	23.5%	16.8%	17.2%
	3 persons	32.1%	35.4%	25.5%
	4 persons	27.1%	36.2%	34.5%
	5 or more persons	10.7%	5.3%	15.7%
Education	Junior high school	2.1%	0.8%	3.7%
	High school	25.0%	15.9%	21.0%
	Academy	10.7%	9.7%	12.7%
	Community college or university	59.2%	71.6%	59.4%
	Graduate school	2.8%	1.7%	3.0%
Annual income	Less than 2.5 million JPY	3.5%	5.3%	7.5%
	2.5–4.0 million JPY	10.7%	12.3%	17.2%
	4.0–5.5 million JPY	18.5%	11.5%	8.2%
	5.5–7.0 million JPY	16.4%	15.9%	19.5%
	7.0–8.5 million JPY	18.5%	12.3%	10.5%
	8.5–10 million JPY	12.8%	15.0%	14.2%
	10–11.5 million JPY	10.7%	12.3%	9.7%
	More than 11.5 million JPY	8.5%	15%	12.7%
ECCB	Average total scale (S.D.)	83.89 (18.63)	87.19 (18.25)	86.66 (17.61)
Food-related job	1: Yes, 0: No	8.4%	4.4%	6.2%
Refer to whose evaluation	Japanese chefs		39.8%	
	Other consumers		18.5%	
	One's own taste		41.5%	
Frequency of eating rice	1: Almost every day	96.6%	94.6%	98.2%
	2: A few times a week	1.6%	5.3%	0.8%
	3: Once or less than once a week	0.8%	0%	0.8%
	4: None	0.8%	0%	0%
Who chooses the type of rice in your diet?	1: Parents	21.4%	11.5%	14.2%
	2: Myself	60%	77.8%	74.4%
	3: Spouse	15.7%	8.9%	9%
	4: Children	0.7%	0%	0.7%
	5: Others	2.1%	1.7%	0.7%
Have you ever eaten Sado rice?	1: Yes, 0: No	10%	5.3%	9.8%
Have you ever eaten Ibis rice?	1: Yes, 0: No	0%	0%	0%
Do you know Ibis rice?	1: Yes, 0: No	4.2%	2.6%	5.3%
No. of participants (No. of chefs)		140 (21)	113 (0)	133 (21)

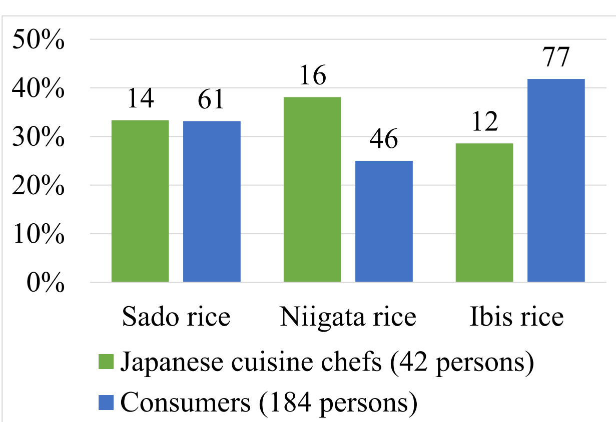


Fig. 2. Taste information sheet.

in each of the t choice sets can be expressed as $U_{iqt} = V_{iqt} + \varepsilon_{iqt} = \beta'_q X_{iqt} + \varepsilon_{iqt}$. The density of β'_q is denoted by $f(\beta|\theta)$, where θ is a vector of the true parameters of the taste distribution. X_{iqt} denotes the explanatory variables of V_{iqt} for alternative i, individual q, and choice set t. The conditional probability of alternative i for individual q in choice set t is expressed as follows:

$$P_{iqt}(\beta'_q) = \frac{exp(\beta'_q X_{iqt})}{\sum_{j=1}^{J} exp(\beta'_q X_{jqt})} \quad (1)$$

The probability of the observed sequence of choices conditional on knowing β'_q is expressed as follows:

$$S_q(\beta'_q) = \prod_{t=1}^{T} P_{i(q,t)qt}(\beta'_q), \quad (2)$$

where $i(q, t)$ represents the alternative selected by individual q in choice set t. The unconditional probability of the observed sequence of choices for individual q is the integral of the conditional probability over all possible variables of β' and can be expressed as follows:

$$P_q(\theta) = \int S_q(\beta) f(\beta|\theta) d\beta. \quad (3)$$

In most applications, the density $f(\beta|\theta)$ is specified to be normal or lognormal, that is, $\beta \sim N(b,W)$ or $\ln\beta \sim N(b,W)$, where the mean, b, and covariance, W, are estimated. In this study, we use normal density.

In the estimation model for the main effect, the explanatory variables consist of the attributes in Model 1. The attribute "brand of rice" is a nominal variable; therefore, dummy variables are used for Sado rice and Ibis rice with the baseline of Niigata rice. All these variables and the prices are assumed as random parameters and are normally distributed because the preferences for all variables are unclear (Revelt & Train, 1998; Train, 1998). The indirect utility function in Model 1 is as follows:

$$\text{Model 1: } V_{iqt} = \beta_{1q}Price_{iqt} + \beta_{2q}Sado_{iqt} + \beta_{3q}Ibis_{iqt} + e_{iqt}, \tag{4}$$

where $Price_{iqt}$ is the price level of rice from alternative i, individual q, and choice set t. $Sado_{iqt}$ and $Ibis_{iqt}$ are Sado rice and Ibis rice from alternative i, individual q, and choice set t, respectively. β_{1q}, β_{2q}, and β_{3q}, are parameters to be estimated by the explanatory variables of the attributes, $Price_{iqt}$, $Sado_{iqt}$, and $Ibis_{iqt}$, respectively.

In the estimation of the main effect with interactions, the explanatory variables also include the variables *Refer to Chefs* and *Refer to Other Consumers,* which are employed only in the taste ranking information treatment. They are based on a question about the assessment of taste ranking information as shown in Step 3. The variable *Refer to Chefs* equals 1 if participants refer to chefs' tasting results, and zero otherwise, and *Refer to Other Consumers* equals 1 if participants refer to other consumers' tasting results, and zero otherwise. These are dummy variables, and the baseline is the participants' own taste ranking. The indirect utility function in Model 2 is as follows:

Model 2:

$$\begin{aligned} V_{iqt} = {} & \beta_{1q}Price_{iqt} + \beta_{2q}Sado_{iqt} + \beta_{3q}Ibis_{iqt} \\ & + \beta_{4q}(Sado_{iqt} \times Refer\ to\ Chefs_{iqt}) + \beta_{5q}(Ibis_{iqt} \times Refer\ to\ Chefs_{iqt}) \\ & + \beta_{6q}(Sado_{iqt} \times Refer\ to\ Other\ Consumers_{iqt}) \\ & + \beta_{7q}(Ibis_{iqt} \times Refer\ to\ Other\ Consumers_{iqt}) + e_{iqt}. \end{aligned} \tag{5}$$

4. Results

4.1. Participants

We recruit residents of Osaka Prefecture, which is the second largest prefecture in Japan. In this prefecture, Niigata rice is most often consumed, and Sado and Ibis rice are not well known. The aim of this study is to measure the premium of biodiversity-friendly rice in a new market where consumers are unaware of it, and thus Osaka is a very good target. The crested ibis is also famous in Osaka.

The participants are recruited from among the residents of 30,000 households in the northern part of Osaka Prefecture through fliers inserted in familiar newspapers. The participants are older than 20 years, and they voluntarily applied for the experiment by fax or mail.

The Japanese chefs are recruited from a company with a chain of Japanese cuisine restaurants, GANKO Food Service Co., Ltd., which is headquartered in Osaka Prefecture. Each chef must be the chief chef in his or her restaurant and have more than 10 years of experience. We recruit 42 chief chefs and divide them into two groups to simultaneously conduct the no-information and cultivation method treatments in separate rooms.

This experiment was approved by the ethical committee at the Faculty of Life and Environmental Sciences at University of Tsukuba in accordance with the ethical rules for using human subjects and protecting personal identifying information enforced by Japanese law (Application No. 25-13, accepted on 11/22/2013).

A total of 430 people applied to participate in the experiments, among which 344 joined the experiment. The average number of participants in each session was about 22. Each participant earned ¥1859 per session on average, and each session lasted approximately one hour. Table 4 summarizes the demographics in each treatment. After obtaining the results, we pool the data of the sample of 344 consumers, along with those of the 42 chefs, who are also residents of Osaka Prefecture. Cronbach's alpha in the ECCB is more than 0.9 in each treatment using LIMDEP 11 and NLOGIT 6, which indicates good internal consistency of the items in the ECCB scale. There are no significant differences in the ECCB among all treatments (ANOVA, p = 0.291), which implies participants have the same degree of attitude toward or consciousness of the environment.

Table 5
Number of persons for taste evaluation in each treatment.

	No information	Taste ranking	Cultivation method
Niigata rice			
No. 1	40 (28.8%)	35 (31%)	35 (26.5%)
No. 2	39 (28.1%)	33 (29.2%)	35 (26.5%)
No. 3	60 (43.2%)	45 (39.8%)	62 (47%)
Sado rice			
No. 1	48 (34.5%)	37 (32.7%)	42 (31.8%)
No. 2	53 (38.1%)	36 (31.9%)	43 (32.6%)
No. 3	38 (27.3%)	40 (35.4%)	47 (35.6%)
Ibis rice			
No. 1	51 (36.7%)	41 (36.3%)	55 (41.7%)
No. 2	47 (33.8%)	44 (38.9%)	54 (40.9%)
No. 3	41 (29.5%)	28 (24.8%)	23 (17.4%)

4.2. Tasting results

Table 5 shows the taste rankings for each treatment. For all treatments, the largest number of participants ranked Ibis rice the highest. Thus, the taste ranking results indicate that the participants thought Ibis rice tasted the best. There are two reasons we employ the preference ranking method instead of hedonic scaling. The first is to reduce participants' evaluation efforts, as in Varela, Beltrán, and Fiszman (2014), because we compel participants to focus on the decision making in the CE. Second, we cannot distinguish whether the participants have common hedonic scales. There are significant differences in ranking preferences for each rice among all treatments (Fisher's exact test, p = 0.860, 0.575, and 0.214 in Niigata, Sado, and Ibis, respectively).

4.3. Main effect

We analyze the panel RPL regression results using LIMDEP 11 and NLOGIT 6 with 50 Halton draws. According to Chang and Lusk (2011), RPL can produce unreliable estimates with such small sample sizes. Therefore, we also show the results of a multinomial logit model in the Supplementary materials to compare to the RPL results. Table 6 shows the main effect results (Model 1) and those with interactions (Model 2) for both expected and actual stages, respectively. We assume the variable *Price*, *Sado*, and *Ibis* are random parameters and are normally distributed (Carlsson, Frykblom, & Liljenstolpe, 2003; Revelt & Train, 1998; Train, 1998). First, to confirm the differences between the expected and actual stages among all treatments, we employ the likelihood ratio (LR) test using the results of Model 1. The LR test rejects the null hypothesis of parameter equality among the expected and actual stages in all treatments at the 1% level;

$$\begin{aligned} LR = -2(LL_j - \textstyle\sum LL_i) = {} & (-4156.39 - (-728.05 - 693.19 - 584.31 \\ & - 537.26 - 718.24 - 599.68)) = 571.29 \end{aligned}$$

where LL_j is log likelihood values for the pooled model and LL_i are the log likelihood values of separate models from each treatment in each stage. Therefore, these samples can be divided into six groups.

For Model 1, as shown in Table 6, in the no-information treatment, *Price* has a significantly negative sign in both the expected and actual stages, which implies that consumers prefer cheaper rice. *Sado* has a

Table 6
Random parameter estimation results in main effect (Model 1) and main effect with interactions in each treatment (Model 2).

Variables	No information		Taste ranking				Cultivation method	
	Expected stage	Actual stage	Expected stage		Actual stage		Expected stage	Actual stage
	Model 1	Model 1	Model 1	Model 2	Model 1	Model 2	Model 1	Model 1
Random parameter								
Price	−0.03***	−0.03***	−0.02***	−0.02***	−0.03***	−0.05***	−0.01***	−0.04***
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Sado[a]	−1.18***	0.62*	−0.14	−0.06	0.67	2.98***	−1.18***	2.07***
	(0.25)	(0.37)	(0.23)	(0.35)	(0.65)	(0.81)	(0.28)	(0.42)
Ibis[a]	0.93***	1.4***	1.08***	1.56***	1.43***	6.87***	0.69**	4.74***
	(0.28)	(0.51)	(0.38)	(0.53)	(0.58)	(1.22)	(0.29)	(0.62)
Standard deviation								
Price	0.04***	0.05***	0.04***	0.04***	0.04***	0.07***	0.04***	0.05***
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.01)	(0.00)	(0.00)
Sado[a]	1.78***	3.84***	1.39***	1.45***	6.36***	6.96***	2***	3.81***
	(0.34)	(0.51)	(0.4)	(0.42)	(0.82)	(1.03)	(0.33)	(0.97)
Ibis[a]	2.62***	4.25***	3.39***	3.42***	7.53***	7.67***	2.81***	5.47***
	(0.33)	(0.53)	(0.47)	(0.47)	(1.29)	(0.5)	(0.32)	(0.65)
Nonrandom parameter								
Sado*Refer to Chefs[b]				−0.23		−4.7***		
				(0.48)		(1.09)		
Ibis*Refer to Chefs[b]				−0.44		−9.05***		
				(0.7)		(1.63)		
Sado*Refer to Other Consumers[b]				0.06		−0.08		
				(0.61)		(1.39)		
Ibis*Refer to Other Consumers[b]				−1.59*		−2.58*		
				(0.89)		(1.52)		
Log likelihood	−728.05	−693.19	−594.31	−591.73	−537.26	−524.24	−718.24	−599.68
McFadden's R2	0.21	0.24	0.2	0.2	0.27	0.29	0.18	0.31
Observations	839	840	677	677	677	677	798	798
No. of participants	140		113				133	

Notes: Standard errors are in parentheses. ***, **, and * denote that the parameters are different from zero at the 1%, 5%, and 10% significance levels, respectively. [a] denotes the dummy variables, and the baseline is Niigata rice. [b] denotes the dummy variables. [c] denotes the dummy variables, and the baseline is to refers to one's own taste ranking.

significantly negative sign in the expected stage, which changes to a marginally significant positive sign in the actual stage, while *Ibis* has a significantly positive sign in both the expected and actual stages. These results imply that consumers prefer Niigata rice over Sado rice and Ibis rice over Niigata rice before tasting, although they change their preference to Sado rice over Niigata rice and continue preferring Ibis rice over Niigata rice after tasting.

In the taste ranking treatment, *Price* and *Ibis* have significantly negative and positive signs in both the expected and actual stages, respectively. These results imply that consumers prefer cheaper rice and Ibis rice over Niigata rice. However, *Sado* is not significant in either the expected or actual stages. This result indicates indifference in preference between Sado rice and Niigata rice.

In the cultivation method treatment, *Price* has significantly negative signs in both expected and actual stages and *Ibis* has significantly positive signs in both expected and actual stages. The variable *Sado* has a significantly negative sign in the expected stage and changes to a positive sign in the actual stage. The signs of the estimation results in the cultivation method treatment are the same as those in the no-information treatment. These results imply that consumers prefer Niigata rice over Sado rice and Ibis rice over Niigata rice, then they continue preferring Ibis rice over Niigata rice but change their preference to Sado rice over Niigata rice after tasting and receiving the cultivation method information.

Finally, the standard deviations for each variable in all treatments are significant, which implies that the preferences for the attribute variables are heterogeneous as in the RPL assumptions.

4.4. Main effect with interaction in the taste ranking treatment

In the results of Model 2 in the taste ranking treatment, *Ibis × Refer to Other Consumers* is significantly negative in both the expected and actual stages. This result means that participants who refer to others' evaluations also prefer Niigata rice to Ibis rice and retain their preferences after receiving information about others' evaluations. *Sado × Refer to Chefs*, *Ibis × Refer to Chefs*, and *Ibis × Refer to Other Consumers* have significantly negative signs in the actual stage. These results imply that participants who refer to chefs' evaluations reduce the values of Sado and Ibis rice. This is because chefs evaluate Niigata rice as number one in their taste ranking, and participants who refer to chefs follow these evaluations.

Including the interaction variables does not change the signs of the main attributes, which implies that the coefficients of the attributes are robust. While keeping the sign, *Sado* changes from insignificant in the expected stage to significant in the actual stage. To consider the interaction effect, the results show that participants prefer Sado and Ibis rice to Niigata rice. This is because the interaction effect excludes the effect of participants who prefer Niigata rice to Ibis rice after receiving the negative chef evaluations for Sado and Ibis rice.

4.5. WTP

Table 7 shows the means of the marginal WTP for each significant variable in both the expected and actual stages in Model 1 in each treatment, which are derived using the Krinsky and Robb (1986) method. Fig. 3 shows the kernel density distributions of the means of the marginal WTP based on the estimation results of Model 1 using statistical software R (version 3.5.1). We define the marginal WTP in

Table 7
Mean marginal WTP from Krinsky and Robb simulations.

	No information		CC test	Taste ranking		CC test	Cultivation method		CC test
	Expected stage	Actual stage		Expected stage	Actual stage		Expected stage	Actual stage	
Sado	−37.92 [−58.57, −21.92]	16.03 [−3.79, 36.98]	***	–	–	–	−68.59 [−127.37, −33.95]	51.75 [30.66, 82.13]	***
Ibis	30.65 [12.99, 53.04]	36.98 [10.33, 64.4]		45.7 [13.46, 89.86]	37.92 [7.72, 70.92]		41.62 [4.05, 96]	117.37 [88.13, 159.43]	**

Notes: Numbers in brackets show 95% confidence intervals. *** and ** denote that the parameters are different from zero at the 1% and 5% significance levels according to the complete combinational (CC) test, respectively.

the expected and actual stages as expected and actual marginal WTP, respectively.

The actual marginal WTP for Sado rice is higher than the expected marginal WTP in both the no-information and cultivation method treatments. They differ significantly according to the complete combinational (CC) test (Poe, Giraud, & Loomis, 2005) using Limdep 11/Nlogit 6.

The expected marginal WTP for Ibis rice is higher than the actual marginal WTP in both the no-information and cultivation method treatments. However, the difference between the treatments is insignificant according to the CC test. On the other hand, in the taste ranking treatment, the expected marginal WTP for Ibis rice is higher than the actual marginal WTP. The difference in this treatment is significant according to the CC test.

Thus, the results above imply that one's own taste ranking in the no-information treatment changes the value of Sado rice and receiving cultivation information increases the value of Sado and Ibis rice.

5. Discussion

5.1. Higher importance of process information than taste ranking information

This study experimentally demonstrates that only information on cultivation method, increases the WTP for Ibis rice, but information on taste ranking does not affect it. This result partially supports Williamson et al. (2016), who found that both sensory information about taste and non-sensory information about the environment increase the WTP for wine.

Tasting with information on the cultivation method increased the WTP for Sado rice. Information on the cultivation method of Sado rice shows the reduction in pesticides and chemical fertilizers. This result suggests that consumers place greater value on rice produced using a cultivation method that does not harm the natural environment. This result is consistent with Aoki, Akai, and Ujiie (2017), who found that Japanese participants' WTP for organic rice was much higher than that of Thai participants. The process of the cultivation method has a greater impact on the WTP.

In the aspect of process information, Caporale and Monteleone (2004) conducted tastings and studied how Italian consumers liked different beers; they suggested that providing information on the methods of producing beer increases the value of that beer. Sörqvist et al. (2015) showed that consumers believed that eco-friendly foods taste good.

When comparing the taste ranking and cultivation process, taste ranking can reflect the satisfaction for eating rice, while the cultivation process represents the efforts of producing food. The result of this study shows the possibility that WTP is likely more strongly affected by effort for producing rice than the satisfaction for tasting. The satisfaction of foods seems difficult to judge by consumers, while the efforts are easier to measure. That is, neither tasting with no-information nor tasting with taste ranking information affects the WTP for Ibis rice.

5.2. Impacts of negative and positive information

In the taste ranking information, chefs did not rate Ibis rice as tasting the best, and therefore chefs' evaluations functioned as negative information for the consumers. At the same time, other consumers ranked Ibis rice as tasting the best, and this information functioned as positive information for the consumers. In other words, the taste ranking in this study provided both positive and negative information

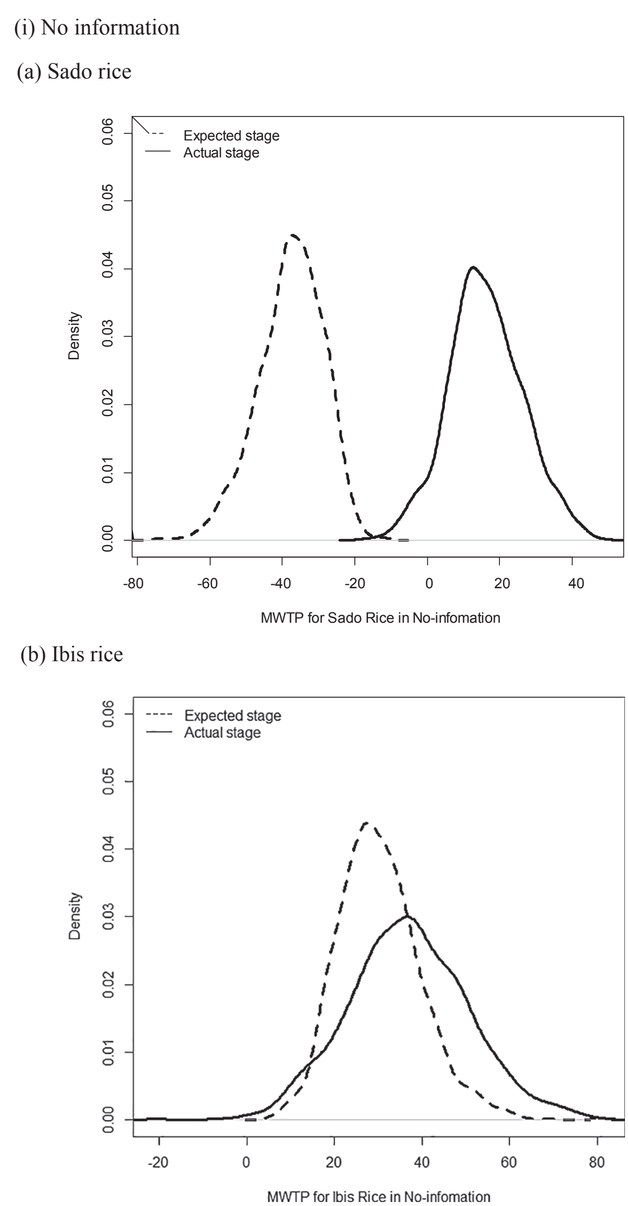
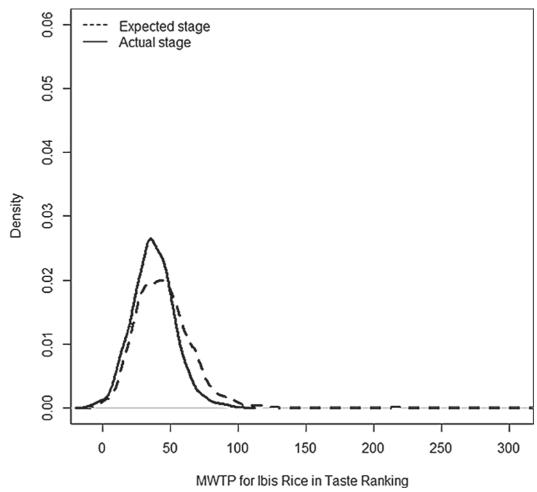


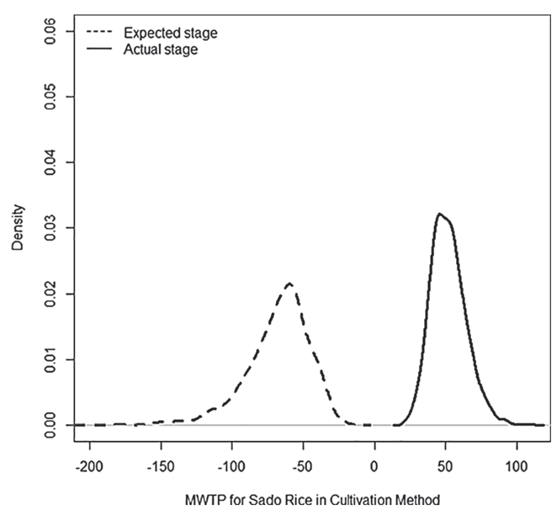
Fig. 3. Marginal WTP for each type of information treatment.

(ii) Taste ranking: Ibis rice (only significant variable)



(iii) Cultivation method

(a) Sado rice



(b) Ibis rice

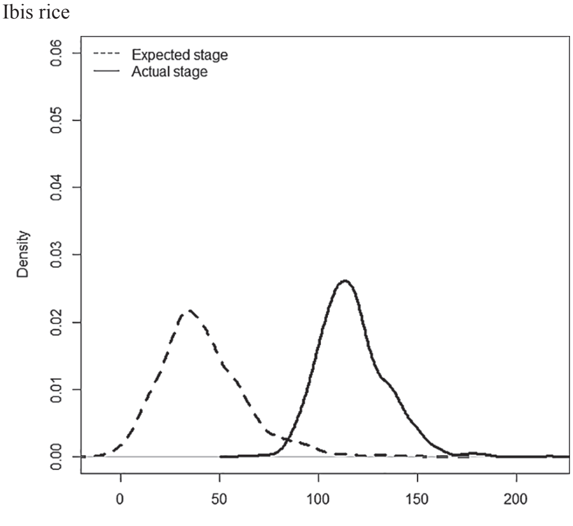


Fig. 3. (*continued*)

simultaneously. Participants who refer to chefs' evaluations reduced the value of Sado and Ibis rice. Since the benefit from taste is difficult to measure for ordinary consumers, as described in Section 5.1, professional evaluations of taste appear to have a certain degree of influence on the value of food.

Siegrist and Cousin (2009) found that consumers' rating of wine was lower when they received negative information from a famous wine critic before tasting the wine than when they received positive information. However, when they were given the information after tasting, neither positive nor negative information had a statistically significant effect on their rating. This result is supported by our result that there is no statistically significant difference in the WTP between expected and actual stages in the taste ranking treatment. Additionally, Aoki et al. (2010) measured WTP for a ham sandwich in a non-hypothetical experiment by providing information about sodium nitrate that was both positive (prevents botulism and adds flavor) and negative (poses cancer risk) simultaneously. They found that positive information had a stronger impact on the value of sodium nitrate. Similarly, our result shows that other consumers' positive evaluations of Ibis rice had a greater impact than did the negative evaluation from the small number of chefs so that the main effects of Sado rice and Ibis rice kept their tendencies.

In the real world, the Japan Grain Inspection Association has a large impact and highly rated evaluators on Amazon and Yahoo! have a stronger impact than ordinary evaluators do. However, since rice is a staple food in Japan and one that the Japanese are highly accustomed to eating, almost all the participants appeared to give the most weight to their own evaluation of taste instead of those of chefs or other consumers. According to the results of "Refer to whose evaluation" in Table 4, 41.5% of the participants trusted their own evaluations. Therefore, the coefficients of Sado rice and Ibis rice did not change in the taste ranking information treatment. Professional advice will be more useful for unfamiliar foods such as expensive wines.

5.3. Taste beliefs

Bernard and Liu (2017) indicated that taste beliefs have a large impact on selection behavior. If consumers believe an apple tastes good before tasting it, they tend to rate it as good even after tasting. In other words, expected evaluation influences actual evaluations. Likewise, in this study, the WTP for Ibis rice in the no-information treatment did not change after tasting. However, the WTP for Sado rice and Niigata rice were reversed after tasting, with Sado rice ranking above Niigata rice, even though consumers did not receive any new information. This result may be because Sado rice is not as well-known as Niigata rice. It is possible that, as a result, when participants noticed that Sado rice compared favorably with Niigata rice during tasting, they markedly revised their expected evaluations and switched to a positive actual evaluation. These results contradict those in previous research where preexisting expectations improved through tasting. Tasting, therefore, appears to be effective when a brand is not well known and consumers have markedly low expectations. Thus, having consumers taste foods that conserve biodiversity will likely be useful for promoting them in a new market.

6. Conclusion

This study shows that information on the cultivation method increases the WTP for rice types that protect the crested ibis as a symbol of endangered birds. In terms of taste rankings, chefs' evaluations may have a greater influence than those of other consumers.

This study indicates that when promoting food products using methods that conserve biodiversity, it is more important to communicate process information that is directly related to biodiversity—in other words, input information—rather than information about taste, which is the final outcome of the production process.

Future research aims include expanding beyond staple foods to investigate whether or not the outcome of taste or input of the production processes have greater impacts on the value of unfamiliar foods from unfamiliar regions, such as imported goods, and comparing consumer value attitudes with producer cultivation costs to calculate the appropriate investment level for biodiversity conservation.

Acknowledgements

We wish to acknowledge the helpful comments of participants at the Pangborn 2017 conference in the United States. We appreciate Professor William H. Greene and the LIMDEP/NLOGIT list members for useful comments on program codes in LIMDEP. We also thank the anonymous reviewers and the editor for their suggestions. Moreover, we thank Katsuyuki Aoki, Yoshiko Aoki for conducting the experiments as well as staffs for cooking rice. This study was financially supported by the Government of the City of Sado in Japan and Japan Society for the Promotion of Science (JSPS) Grant-in-Aid for Scientific Research (B) (#16H04985).

Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.foodqual.2018.11.021.

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